THE RELATIONSHIP BETWEEN EARLY WORD READING AND READING COMPREHENSION GROWTH FOR LANGUAGE-MINORITY LEARNERS AND NATIVE-ENGLISH-SPEAKING STUDENTS: A SEVEN-YEAR LONGITUDINAL STUDY

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ABSTRACT

JACKIE EUNJUNG RELYEA: The Relationship between Early Word Reading and Reading Comprehension Growth for Language-Minority Learners and Native-English-Speaking Students: A Seven-Year Longitudinal Study (Under the direction of Dr. Jill Fitzgerald)

The significant role of early word-reading ability in reading comprehension development for monolingual native-English-speaking (NE) children has long been theoretically and empirically recognized. Yet, whether this is the case for language-minority (LM) learners who learn to read in a second or additional language has yet to be thoroughly established in the research literature. The purpose of the present study was to examine whether the relationship between first-grade word reading and reading comprehension growth through eighth grade varied as a function of children’s language status (i.e., LM learners and NE students). Using seven-year longitudinal data from a nationally representative sample of children from the Early Childhood Longitudinal Study–Kindergarten Class of 1998-1999, growth trajectories of English-reading comprehension proficiency for LM learners (n = 992) and NE students (n = 7,188) of differing initial English word-reading proficiency were examined. A series of Hierarchical Generalized Linear Modeling growth curve analyses was conducted.

The main conclusion was that children with initially high Word-Reading Proficiency demonstrated more growth than children with initially low Word-Reading Proficiency, but the effect of initial Word-Reading Proficiency was especially impactful for LM learners as compared to NE learners. Specifically, LM learners with initially high Word-Reading Proficiency had relatively lower Reading-Comprehension Proficiency than their NE peers with high Word-
Reading Proficiency in first grade, but Reading-Comprehension Proficiency growth trajectories of the two groups converged by the end of eighth grade. In contrast, LM learners with initially low Word-Reading Proficiency had a relatively lower Reading-Comprehension Proficiency in first grade and had significantly less growth as compared to NE students with low Word-Reading Proficiency, thereby leading to a large gap between the two groups by the end of eighth grade. Results emphasize enhanced instructional opportunities for LM learners that focus on promoting strong word-reading skills in first grade.
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CHAPTER 1
INTRODUCTION AND RATIONALE

The purpose of the present study was to examine the association between word-reading proficiency in the spring of first grade and reading-comprehension proficiency growth across the spring of first, third, fifth, and eighth grades for language-minority (LM) learners and native-English-speaking (NE) students. The specific research question guiding the study was: Is the relationship between first-grade word-reading proficiency and reading-comprehension proficiency growth through eighth grade different for LM learners as compared to their NE peers? The current study was a secondary analysis of longitudinal data from a nationally representative sample of children of U.S. elementary schools from the Early Childhood Longitudinal Study Kindergarten Class of 1998-1999 (ECLS-K).

The current chapter begins with the rationale for the present study. Then, significance of the study and hypothesis are presented. Finally, definitions for key terms are provided.

Rationale

The number of school-age LM learners has increased immensely over the past decades. LM learners refers to children who come from home and community in which a language other than English is spoken (August & Shanahan, 2006). There were approximately two million LM learners in public schools in 1990, but the number grew to nearly 11 million in 2009, representing 1 of every 21 school-age students in the United States (U.S. Department of Education, 2011). LM learners, typically classified as English language learners (ELLs), come from more than 480 different language backgrounds (Kindler, 2002). Nearly 80% of LM
learners come from Spanish-speaking backgrounds, and Asian-language-speaking (e.g., Vietnamese, Hmong, Cantonese, Korean, and Khmer) children make up most of the rest of the LM population (Goldenberg, 2011). With a burgeoning influx of LM learners who are learning English as a new language in the United States, issues concerning their English-language academic performance have received unprecedented attention from educators, researchers and policy makers across the nation (e.g., August & Hakuta, 1997; August & Shanahan, 2006; Goldenberg, 2011; National Clearinghouse of English Language Acquisition [NCELA], 2007). According to results of the 2013 What’s Hot, What’s Not survey polled by the International Reading Association (Cassidy & Grote-Garcia, 2012), ELLs/English as a second language (ESL) was rated as one of the “hot” topics and should be a very hot issue in literacy education.

Of particular concern is that LM learners encounter considerable difficulties with reading and understanding complex text written in English (Carlo, August, McLaughlin, Snow, Dressler, Lippman, Lively, & White, 2004; Lesaux & Siegel, 2003). According to the recent National Assessment of Educational Progress (NAEP) reading assessment, fourth-grade LM learner’s reading performance was significantly lower than their native English-speaking peers (National Center for Education Statistics [NCES], 2011), and large and persistent gaps consistently exist between LM learners and native English-speaking children in reading achievement performance over the course of the school years. Moreover, LM learners who achieve below the basic English-reading comprehension level are at substantial risk for difficulties in almost all subject content areas and behavioral and social success in school, and are more likely to drop out than are native English-speaking students (Fry, 2007; Genesee, Lindholm-Leary, Saunders, & Christian, 2006; Kaufman, Alt, & Chapman, 2001; Reardon, 2003; Ruiz-de-Velasco & Fix, 2000; Snyder, Dillow, & Hoffman, 2007). Thus, fostering LM learners’ English-reading growth is a
vital goal of formal reading education among educators and researchers at the local and nation levels (August & Shanahan, 2006).

Despite the pressing need to serve this ever-growing population, there is a limited scope of sound empirical work needed to inform educational practice and policy. A major issue is that little is known about the developmental pattern of LM learners’ reading comprehension. Although the number is increasingly sharply, only a handful of researchers have modeled LM learners’ English-reading growth, and very little research has provided insight into the growth trajectories of their English-reading comprehension over time or into early predictors of that comprehension growth. The approach to examining a componential reading sub-skill and its relationship to long-term reading-ability growth is particularly important to understanding the complexity and difficulty inherent in LM learners’ second-language reading development (Lesaux, 2006; McCardle, Mele-McCarthy, Cutting, Leos, & D’Emilio, 2005).

In addition, while a great deal of large-scale research and intervention funding projects that support LM learners’ English-reading development have focused on those at primary grade levels, relatively less attention has been paid to those beyond the primary grades (e.g., August & Shanahan, 2006; Bailey, 2007; RAND Reading Study Group, 2002; Snow & Uccelli, 2009). Furthermore, few studies have examined early factors that might be associated with LM learners’ developmental change in English-reading comprehension. It is thus unclear whether and to what extent early reading-related skills contribute to LM learners’ success or struggles in reading comprehension growth over short or lengthy time periods.

Early word-reading ability is widely recognized as one of the most salient predictors of reading comprehension success for monolingual English-speaking children (e.g., Adam, 1990; Cain, 2006; Francis, Fletcher, Catts, & Tomblin, 2005; Kintsch, 2004; National Reading Panel,
The relationship between word reading and ability to comprehend text has been theoretically and empirically established in various ways for monolinguals (e.g., Baumann, 2005; Beck & McKeown, 2007; Beck, Perfetti, & McKeown, 1982; Davis, 1994; Juel, Griffith, & Gough, 1986; Nagy, Anderson, & Herman, 1987; Snow, Burns, & Griffin, 1998; Stanovich, Cunningham, & Freeman, 1984; Tannenbaum, Torgesen, & Wagner, 2006). Not only does a strong correlation exist between the two constructs, but causal evidence indicates that word reading plays a critical role in increasing text comprehension ability (e.g., Anderson & Freebody, 1981; Blanchard, 1980; Cunningham & Stanovich, 1997; Herman, 1985; Lesgold, Resnick, & Hammond, 1985; McKeown, Beck, Omanson, & Pople, 1985; Scarborough, 2001; Stanovich, 1985). For instance, readers with well-developed automatic word recognition competence do not focus unduly on lower-level processing skills (e.g., word identification), and, consequently, more attention can be paid to integration of new information with background knowledge and critical evaluation of the information being read (e.g., Beebe, 1980; Biemiller, 1970; Cain, Oakhill, & Bryant, 2000; Calfee & Piontkowsky, 1981; Juel, 1991; Lomax, 1983; Stanovich, 1991). Moreover, early word reading influences text comprehension in a cumulative manner (Chall, Jacobs, & Baldwin, 1990; Stahl & Nagy, 2006). The more words children recognize and understand, the more opportunity they have to spend time engaged with texts, to learn about the world and new words, and to understand richer texts. Thus, reading comprehension competence at upper grade levels is likely to hinge upon the accumulated knowledge from early experiences with words (Cunningham & Stanovich, 1997; RAND Reading Study Group, 2002).

Nevertheless, whether this is the case for LM-learner population has yet to be thoroughly established in the research literature. Cross-sectional studies to date on LM learners
have documented that while LM learners often perform on a par with monolingual English-speaking students in English word-level reading in the primary grades, the great majority of LM learners underperform their monolingual English-speaking peers on English-reading comprehension in the upper elementary and middle grades (Lesaux, Koda, Siegel, & Shanahan, 2006, for a review; NCES, 2007). However, far less is known as to whether early English-word reading is an essential prerequisite to LM learners’ long-term development of English-reading comprehension, and whether early English word-reading ability contributes to the persistence of reading comprehension success or difficulties across upper elementary and middle grades.

The use of a longitudinal research design rather than cross-sectional design is particularly essential in the study of LM learners’ reading development. Although the snapshot approach provides a basic understanding about reading achievement levels at one or two points in time, it does not address critical questions about LM learners’ English-reading growth that occurs in a slow and gradual manner, nor does it reveal their developmental pattern over long periods of time (Mancilla-Martinez, Kieffer, Biancarosa, Christodoulou, & Snow, 2011; Mancilla-Martinez & Lesaux, 2010). Longitudinal research findings accomplished with sound methodology will help to provide a more in-depth perspective on the reading developmental process of LM learners who typically make the transition from learning-to-read to reading-to-learn stages in a slow and gradual manner over time.

The analysis of LM learners’ developmental trajectories in reading comprehension using precursor reading skills could serve as a primary source of identifying and diagnosing students at risk for reading difficulties (Francis, Shaywitz, Stuebing, Shaywitz, & Fletcher, 1996). The existing reading research with monolingual English-speaking students has established the importance of early identification of risk factors associated with difficulties in learning to read.
skills (e.g., Lyon, 1998; Satz & Fletcher, 1988; Schenck, Fitzimmons, Bullard, Taylor, & Satz, 1980; Strag, 1972). Early screening and detection could be the key to providing preventive and sound instruction before students experience serious failure throughout the school years (e.g., Fuchs & Fuchs, 2006; Snow et al., 1998; Torgesen & Burgess, 1998).

**What is Known about LM Learners’ English-Reading Growth?**

Monolingual native English-speaking children’s reading growth trajectories tend to demonstrate quadratic developmental patterns that have steeper ascending slopes in the earlier phases, followed by decelerating growth rates, reaching a plateau at older ages (e.g., Catts, Bridges, Little, & Tomblin, 2008; Francis et al, 1996; Williamson, Fitzgerald, & Stenner, 2014). Similar developmental patterns have also been found in LM learner studies. For instance, from preschool through fifth grade, Spanish-speaking LM learners’ English vocabulary, verbal short-term language memory, and word reading accelerated rapidly originally, and then decelerated (e.g., Mancilla-Martinez & Lesaux, 2011; Nakamoto, Lindsey, & Manis, 2007).

Among the handful of studies that have modeled reading growth of LM learners, only a few researchers have investigated the association of reading-related predictor variables with initial status and growth rates of global reading achievement and specific reading sub-skills. While LM learners’ English-reading growth rates have been studied in relation to several predictive factors such as socioeconomic status (SES; D’Angiulli, Siegel, & Maggi, 2004; Kieffer, 2008), initial English oral proficiency (e.g. Fitzgerald, Amendum, Relyea, & Garcia, in press; Kieffer, 2011), or first-language backgrounds (e.g., Roberts, Mohammed, & Vaughn, 2010), very little research has been done that provides insight into the predictive relationship between early reading-related sub-skill variables and later reading outcome growth.

**Significance of the Study**
Public schools in the United States have experienced phenomenal and rapid growth in the number of LM learners who often lag far behind their monolingual English-speaking peers in English reading over the past few decades. Consequently, fostering LM learners’ English-reading comprehension has become a vital goal of formal reading education at the national, state, and local levels. Despite the nationwide attention focused on the improvement of LM learners’ English-reading comprehension ability, knowledge of developmental patterns of English-reading comprehension during the elementary and middle grades still remains lacking. In addition, although the extant literature on LM learners’ reading has documented the predictive relationship between English-word reading on reading comprehension at one time point or over a short period, far less is known as to whether and to what extent LM learners’ early English word-reading ability contributes to developmental patterns of English-reading comprehension over time.

To my knowledge, the present study is the first study to empirically address the association between LM students’ early word-reading ability and English-reading comprehension growth in comparison to those for NE students over lengthy time periods. Although an emerging number of studies has begun to focus on growth trajectories of LM learners’ overall English-reading achievement using large-scale longitudinal data (i.e., ECLS-K) in recent years (e.g., Halle, Hair, Wandner, McNamara, & Chien, 2011; Han & Bridglall, 2009; Kieffer, 2008, 2011), no researchers to date have investigated the growth trajectories of a specific reading sub-skill in relation to other early reading sub-skill. The potential results from the current study would make unique contributions to growing knowledge about LM learners’ reading comprehension development by adding more detailed information to previously available literature. In addition,
findings from the study may have important implications for curriculum decisions and instructional approaches to address individual LM learner’s unique literacy learning needs.

Re-Statement of the Research Question and Hypothesis for the Present Study

The research question guiding the study was: Is the relationship between first-grade word-reading proficiency and reading-comprehension proficiency growth through eighth grade different for LM learners as compared to their NE peers?

The major hypothesis for the study was that the relationship between children’s word-reading proficiency and reading-comprehension proficiency growth over time would vary as a function of children’s language status (i.e., LM learners versus NE students). Thus, an ordinal interaction between initial word-reading proficiency and language status was expected. More specifically, I hypothesized that LM learners who had initially higher word-reading ability would experience greater growth in reading-comprehension proficiency as compared to LM learners and NE peers who had initially lower word-reading ability. LM learners with initially higher word-reading ability would start out at a lower level than their NE peers with initially higher word-reading ability in the spring of first grade. Additionally, I expected that LM learners with initially higher word-reading ability would follow a growth trajectory similar to that of their NE peers with initially higher word-reading ability such that high-performing LM learners would eventually catch up with their high-performing NE peers in reading-comprehension proficiency. On the other hand, LM learners who had initially lower word-reading ability would experience slower growth in reading-comprehension proficiency and lag increasingly behind not only their NE peers who had initially lower word-reading ability but LM learners with initially well-established word-reading ability.

Definition of Terms
Language-minority learners refers to students who come from a home and community setting in which a language other than English is primarily spoken and may have developed some extent of home-language proficiency (e.g., August & Shanahan, 2006; Kieffer, 2008).

Native-English-Speaking Students refers to students who were born in the United States or any other English-speaking country and come from home and community where only English is spoken.

Word Reading refers to the ability to read (a) words by sight as whole units by accessing information stored in lexical memory (Ehri & Robbins, 1992; Perfetti, 1985), and/or (b) words through word analysis strategies such as by using context cues to make predictions about upcoming words (Rumelhart, 1977; Ehri, 1994).

Reading Comprehension is a multifaceted cognitive process in which a reader constructs meaning through interaction with text. The RAND Reading Study Group report (2001) stated that reading comprehension is “the process of simultaneously extracting and constructing meaning through interaction and involvement with written language” (p. 11). In a similar vein, the NAEP (2009) Reading Framework Committee defines reading comprehension as “an active and complex process that involves understanding written text, developing and interpreting meaning, and using meaning as appropriate to type of text, purpose and situation” (National Center for Educational Statistics, 2005, p. 2). The reading comprehension measure developed for the ECLS-K study and used in the present study was based on the RAND Reading Study definition of reading comprehension.

Oral English-Language Proficiency refers to the ability to use English language accurately and appropriately in its oral forms in various settings (Cloud, Genesee, & Hamayan, 2000). The specific aspects of oral English-language proficiency examined for the ECLS-K
English-proficiency assessment were listening comprehension, productive vocabulary, and ability to understand and retell a story.
CHAPTER 2

REVIEW OF THE LITERATURE

The purpose of the present study was to examine the relationship between word-reading proficiency in the spring of first grade and reading-comprehension proficiency growth across the spring of first, third, fifth and eighth grades for language-minority (LM) learners and native-English-speaking (NE) students. The research question guiding the study was: Is the relationship between first-grade word-reading proficiency and reading-comprehension proficiency growth through eighth grade different for LM learners as compared to their NE peers?

In the current chapter, I first provide theoretical perspectives pertaining to the relationship between word reading and reading comprehension growth and moderating factors on the relationship. Next, I provide empirical research findings regarding (a) correlational relationships between word reading and reading comprehension among monolingual children and LM learners and (b) reading-comprehension/reading-achievement development for Monolinguals and LM Learners. Last, I provide a summary statement.

Theoretical Perspectives

In the following sections, I provide a theoretical discussion of (a) how early word reading might be related to reading comprehension growth and (b) how language status and other factors may moderate the relationship between early word reading and reading comprehension growth.

How Might Early Word Reading be Related to Reading Comprehension Growth?

Early word-reading ability for monolinguals is related to later comprehension development. Developmental views of reading for monolingual children suggest that readers
move from lower-level word-reading skills to constructing meaning of complex text in a sequential and cumulative manner (e.g., Chall, 1996). Initial acquisition of lower-level word reading skills (i.e., code-breaking) with automaticity and accuracy during the primary grades facilitates reading practice and provides opportunities to gain the various types of knowledge, which in turn leads to developmental improvements in the higher-order processing involved in construction of the meaning-based representation of the texts in the later school years (e.g., Juel, Griffith, & Gough, 1986; Perfetti & Hogaboam, 1975; RAND Reading Study Group, 2002; Stanovich, 2000).

Given the cumulative nature of reading skills, if children have difficulties in word reading in the primary grades, they are likely to experience greater challenge and struggle with text comprehension and fall further behind their same-age peers as they reach the upper elementary or middle school grades (Alexander, Entwisle, & Horsey, 1997; Juel, 1988; Oakhill, Yuill, & Parkin, 1986). The ability to read words fluently and accurately is closely related to the cognitive resources that can be devoted to the processes involved in comprehending and making meaning from text (e.g., Frederiksen & Warren, 1987; Jenkins, Fuchs, van den Broek, Espin, & Deno, 2003; Just & Carpenter, 1987; Perfetti, 1985). Therefore, word reading is an important prerequisite and consequence for successful reading comprehension and should be considered as a potential causal factor (e.g., Chen & Vellutino, 1997; Conners, 2009; Francis, Fletcher, Catts, & Tomblin, 2005; Cutting & Scarborough, 2006; Georgiou, Das, & Hayward, 2009; Gough, Hoover, & Peterson, 1996; Jenkins & Jewell, 1993; Kirby & Savage, 2008; Joshi & Aaron, 2000; Vellutino, Tunmer, Jaccard, & Chen, 2007).

One theoretical position that can explain the cognitive mechanism between word reading and reading comprehension for monolingual children is that the two constructs develop in mutual
support because they share common cognitive processes and draw on the same knowledge sources in working memory (Guttentag & Haith, 1978; LaBerge & Samuels, 1974). Within this view, children who lack the ability to read words quickly and accurately either in isolation or in connected text may have significant demands on cognitive processes, particularly in the area of working memory, while devoting significant attention to decoding the words. Thus, relatively little cognitive processing resources are directed to constructing meaning and monitoring meanings already apprehended (Perfetti, 1985). If children can read words from working memory by sight in a fast and less intrusive way, more sources drawn from working memory can contribute to reading comprehension processes (Frederiksen & Warren, 1987; Jenkins, Fuchs, van den Broek, Espin, & Deno, 2003; Just & Carpenter, 1987; Perfetti, 1985; Walczyk, 2000). Therefore, learning to read by sight and building a vocabulary of sight words in memory is one of several essentials in reading instruction for beginning readers to promote the development of word reading and reading comprehension skills (Ehri & Snowling, 2004).

Two contradictory theoretical models of reading development in general mainly conceived for monolingual children—*the cumulative growth model* (e.g., Bast & Reitsma, 1998; Stanovich, 1986; Walberg & Tsai, 1983) and *the developmental lag model* (e.g., Aunola, Leskinen, Lerkkanen, & Nurmi, 2004; Francis et al., 1996). To my knowledge, there have been no studies in which two aforementioned models are hypothesized and tested to address the relationship between word reading and reading comprehension growth, although one prior study tested the two hypothetical models for overall initial reading level and its growth pattern among LM learners (cf. Kieffer, 2008). In particular, to date, no one has incorporated the language-status effect into the models.
The cumulative growth model, better known as the Matthew effect (e.g., Bast & Reitsma, 1998; Stanovich, 1986; Walberg & Tsai, 1983), addresses the importance of acquiring early reading skills in general, not specifically the importance of early word reading. However, implications for the significance of early word reading arise from the model. According to the cumulative growth model, more-skilled readers at the early reading acquisition stage grow at more advanced speeds over the years than the less-skilled readers by taking advantage of greater involvement in reading-related activities (Stanovich, 1986). As a result, the gap between children who are initially lesser skilled readers as compared to more skilled readers gradually widens (Pfost, Hattie, Dörfler, & Artelt, 2014). Although the model describes the relationship between initial reading level and their intraindividual reading gains in general, it also applies to the relationship between early word-reading ability and reading comprehension growth, specifically. Based on the conceptual perspective of the model, it is expected that an initially higher word-reading ability would be advantage in reading comprehension development, while initially lower word-reading ability would be disadvantages. Thus, a widening gap in reading comprehension outcomes would occur over school years between children who initially have higher and those who initially have lower word-reading abilities.

Alternatively, according to the developmental lag model, as children receive systematic reading instruction in school, less-skilled readers initially start out with lower reading achievement but tend to make greater gains through escalating speed to acquire reading knowledge and skills more rapidly than those who demonstrate better initial reading. Consequently, initially less-skilled readers are able to catch up to more-skilled peers over time or at least close the achievement gap between the two groups (e.g., Stanovich, Nathan, & Vala-Rossi, 1986; Stanovich, Nathan, & Zolman, 1988). The developmental lag model in the domain
of overall reading can be also explained in the particular relationship between early word-reading ability and reading comprehension growth. Children who start elementary school with lower word-reading ability might show lower growth rates in reading comprehension at an early point in time as compared to those who start with higher word-reading ability. However, despite the early increasing competence gap, children with initially lower word-reading ability might gradually accelerate growth rates in reading comprehension and catch up to those with initially higher word-reading ability, therefore narrowing the gap.

**How Might Language Status and Other Factors Moderate the Relationship between Early Word Reading and Reading Comprehension Growth?**

**Language status.** The deep and close relationship between early word-reading skills and reading comprehension development for monolingual children has long been theoretically well established (Perfetti & Hogaboam, 1975; Snow, Burns, & Griffin, 1998). However, despite the widely held view of the relationship between the two constructs, given the lack of theoretical and empirical research on LM learners’ reading comprehension development, very little is known about whether the role of early word reading for long-term reading comprehension development also pertains to LM learners who learn to read in a second or additional language.

Hypothetically speaking, the association between early word reading and reading comprehension growth may differ between LM learners and their NE peers. There are two possible explanations for the relative influence of children’s language status on the relationship between word reading and reading comprehension growth. First, LM learners expend a great deal of cognitive energy and resources to the task of learning to read (e.g., phonological, syntactic, and lexical skills) 

*in a language that they have yet to master.* The acquisition of word-reading skills for LM learners may require more processing time as compared to their monolingual peers who draw upon substantial oral language skills (Verhoeven, 2011).
However, it is viable to assume that those LM learners who acquire strong early word reading skills would show similar reading comprehension growth to that of their monolingual peers. Or, alternatively, even for those LM learners who acquire strong early word reading skills, their lesser exposure to English relative to monolingual NE peers may result in limited syntactic sensitivities and morphological knowledge that is a presumably a consequence of delay in reading comprehension growth (Kieffer, 2012).

Second, in addition to linguistic and cognitive factors, LM learners’ background knowledge may influence the strength of the relationship between word reading and reading comprehension growth. Language-Minority learners are more likely than their NE peers to lack sufficient background knowledge of the topic of a text (e.g., Droop & Verhoeven, 1998; Hacquebord, 1994). Having sufficient type and amount of prior knowledge of the topic to be read plays a strong role in understanding and constructing meaning from text. Some LM learners with limited or interrupted prior educational experiences may possess a lack of background knowledge required to understand much of what is read, resulting in great comprehension difficulty. Even for other LM learners with a high degree of academic schooling in their native language or country, their cultural perspectives and culturally-based assumptions may not match the background knowledge assumed or required in the U.S. classrooms.

**Other factors.** Two prominent domains—LM learners’ oral language proficiency and child’s socio-demographic characteristics (e.g., gender, race/ethnicity, and family SES)—may influence the strength of the predictive association between word reading and reading comprehension growth. Thus, they should be taken into consideration in examining the relationship between the two constructs.
First, the relationship between LM learners’ English word-reading ability and reading comprehension growth can be largely constrained by initial English oral-language competence. Consistently, as has been the case for monolingual children (Anderson & Freebody, 1981; Roth, Speece, & Cooper, 2002; Vellutino, Scanlon, Small, & Tansman, 1991; Storch & Whitehurst, 2002), elementary school-age LM learners’ early oral English-language proficiency is closely interwoven with English-reading performance. Thus, those LM learners who are not yet proficient in oral English language are likely to exhibit difficulties in learning to read in English in the primary grades and attain relatively low levels of English-reading outcomes than their native-English-speaking peers (Kieffer, 2011) or initially proficient LM counterparts (Fitzgerald, Amendum, Relyea, & Garcia, 2015).

Second, the association of LM learners’ English word-reading ability with reading comprehension growth can be confounded by child’s socio-demographic characteristics such as gender, race/ethnicity, and family SES. Although indicators of family SES, in particular, are significant factors that affect students’ literacy attainment in the general population (Aikens & Barbarin; 2008, Chatterji, 2006; Entwisle & Alexander, & Olson, 2005; Fryer & Levitt, 2004; Kaplan & Walpole, 2005; Perie, Grigg, & Donahue, 2005; Snow et al., 1998), such phenomenon is particularly prevalent among LM learners in the United States who are most likely to be from low-income and immigrant backgrounds (Goldenberg, Rueda, & August, 2006; Kieffer, 2012; Roberts, Mohammed, & Vaughn, 2010). Language-minority learners from low SES families often have parents with low levels of formal education, lack of home/family literacy experiences and inadequate access to educational resources, which, as a result, negatively influence second-language literacy development (Cobo-Lewis, Pearson, Eilers, & Umbel, 2002; Goldenberg, 1987; Hus, 2001; McLoyd, 1998).
What is known about Relationship between Word Reading and Reading Comprehension?

The following sections provide empirical research findings regarding static cross-sectional correlational relationship and longitudinal relationship between word reading and reading comprehension among monolingual children and LM learners.

Monolingual Children

Static cross-sectional correlational relationship. The findings on the static relationship between measures of word reading and reading comprehension of monolingual English-language speakers are mixed. First, a large number of studies that have focused on the relationship between word reading and reading comprehension have reported that there are moderate to high positive correlations between the two constructs (National Reading Panel, 2000). In addition, word reading has been found to predict unique variance in reading comprehension tasks (e.g., Snow et al., 1998). However, despite the well-established body of research confirming that word reading and reading comprehension are strongly related, substantial variability has been found in the strength of the association between word reading and comprehension. For example, in Gough, Hoover, and Peterson’s (1996) review of 10 studies, correlations between word reading and reading comprehension ranged from $r = .18$ to $r = .83$ across the first grade through college students. Also, there has been considerable variability in the magnitude of variance in reading comprehension explained by word reading. Some researchers reported the proportion of variance ($R^2$ values) in the range of .0001 or .0005 (e.g., Berninger, Abbott, Vermeulen, & Fulton, 2006), whereas others reported in the range of .90 (e.g., Katzir, Kim, Wolf, Kennedy, Lovett, & Morris, 2006).

A close look at the studies that have explored the correlational relationship between word reading and reading comprehension reveals that the strength of the association has varied by
several reader-related factors. First, the correlations between word reading and reading comprehension differ by the ages of the participants. Cross-sectional research for monolingual English-speaking readers has indicated that the relative contribution of word reading to reading comprehension is stronger among younger readers than older ones (Gough et al., 1996; Keenan, Betjemann, & Olson, 2008).

Second, monolingual readers’ oral-language proficiency might also influence the strength of the association between word reading and reading comprehension. Guided by the Simple View of Reading (SVR; Gough & Tunmer, 1986; Hoover & Gough, 1990) framework that contends that reading comprehension is best predicted by word reading and listening (linguistic) comprehension and their cross-product, researchers have provided evidence that oral language proficiency predicts a greater proportion of variance in reading comprehension among monolingual English-speaking students (e.g., Anderson & Freebody, 1981; Cutting & Scarborough, 2006; Johnston & Kirby, 2006; Joshi & Aaron, 2000; Savage, 2006; Savage & Wolfforth, 2007; Tunmer & Hoover, 1992; Vellutino, Tunmer, Jaccard, & Chen, 2007).

In addition to reader-related characteristics, variance in the magnitude of the correlations may be attributed to different measures or tasks used to assess the two constructs (e.g., Best, Floyd, & McNamara, 2008; Cutting & Scarborough, 2006; Johnston & Kirby, 2006; Keenan et al., 2008). For example, Best and colleagues (2008) found that the amount of variance in reading comprehension explained by word reading skills varied according to comprehension measures, with greater relations evident when a narrative text was used ($R^2$ values ranging from .39 to .42) as compared to when an expository text was used ($R^2$ values from .04 to .23).

**Longitudinal relationship.** Change in the correlational relationship between word reading and reading comprehension for monolinguals during reading development has been
widely studied, but findings are divergent and seemingly contradictory. Specifically, some studies show that initial word reading exerts increasingly weaker influence on reading comprehension with increasing age (e.g., Abbott, Berninger, & Fayol, 2010; Burgoyne, Whiteley, & Hutchinson, 2011; Deacon & Kirby, 2004; Juel, 1988; Kim, Wagner, & Lopez, 2012). That is, once children develop a sufficient level of word-reading skills during the primary grades, the relative contribution of word reading to reading comprehension gradually decreases due to less variability in children’s word-reading skills during the elementary and middle school years.

On the other hand, previous research guided by the SVR framework has demonstrated that measures of oral language skills (i.e., vocabulary and listening comprehension) exert an increasingly stronger influence on reading comprehension (e.g., Ouellette & Beers, 2010; Storch & Whitehurst, 2002). Still, other longitudinal studies have demonstrated that the magnitudes of the correlations between early word reading and later reading comprehension are similarly retained from the first to the last time point among native-English-speaking students (e.g., Cain & Oakhill, 2011; Cain, Oakhill, & Bryant, 2004; Compton, Fuchs, Fuchs, Elleman, & Gilbert, 2008; Torgesen, Wagner, Rashotte, Burgess, & Hecht, 1997).

**Language-Minority Learners**

**Static cross-sectional correlational relationship.** Language-minority learners’ second-language word reading has also been found to be strongly correlated with second-language comprehension when measured at static time points. Several empirical studies have sought to apply the SVR framework to a sample of LM learners (e.g., Droop & Verhoeven, 2003; Erdos, Genesee, Savage, Haigh, 2011; Hoover & Gough, 1990; Jared, Cormier, Levy, & Wade-Woolley, 2011; Lesaux, Crosson, Kieffer, & Pierce, 2010; Manis, Lindsey, & Bailey, 2004;
Proctor, August, Carlo, & Snow, 2005). In support of the SVR framework, the studies have provided evidence that young LM learners’ second-language word reading explains some of the variability in second-language comprehension.

Despite the strong correlation evident between word reading and comprehension among LM learners, like monolingual readers, the average amount and range of variance in reading comprehension accounted for by word reading tends to vary depending on several factors—age, native and new-language oral proficiency, and measures and tasks used for assessment. For example, Lesaux and colleagues (2010), who investigated the word reading with reading-comprehension relationship among fourth-grade Spanish-speaking LM learners, found that word reading was more strongly predictive of comprehension when comprehension was measured using a cloze procedure (i.e., Woodcock Language Proficiency Battery-Revised [Woodcock, 1991]) than when measured with reading passages and corresponding questions (i.e., Gates–MacGinitie Reading Test).

**Longitudinal relationship.** Although there is a small number of studies involving LM learners over time (e.g., Droop & Verhoeven, 2003; Gottardo & Mueller, 2009; Hoover & Gough, 1990; Proctor et al., 2005; Reese, et al., 2000; Verhoeven, 1990, 2011), the studies were conducted with LM learners only in the primary grades by using predictor-to-later-outcome correlational approaches rather than examining growth patterns of reading comprehension in relation to word reading over time. The findings from the correlational studies have revealed that LM learners’ age is a significant moderator of the word-reading-comprehension relationship. Specifically, LM learners’ word reading accounts for the bulk of variance in reading comprehension during the primary grades, but the correlational relationship gradually decreases
with increasing chronological age, while the influence of second-language oral proficiency on reading comprehension becomes increasingly stronger.

There is one recent longitudinal study, in which a growth-curve modeling approach was used in examining the predictive role of LM learners’ initial English-word reading in English-reading comprehension growth, but only focusing on Spanish-speaking LM learners in middle schools (e.g., Mancilla-Martinez, Kieffer, Biancarosa, Christodoulou, & Snow, 2010). Mancilla-Martinez and colleagues (2010) reported that Spanish-speaking adolescent LM learners’ initial English-word reading significantly predicted rate of growth in English-reading comprehension. Students designated as low-, middle-, and high-performing word readers in fifth grade followed parallel trajectories of English-reading comprehension between fifth and seventh grade. The comprehension trajectories for LM learners with low performance in word reading in fifth grade were far below from those of middle- and high-performing LM learners. In short, LM learners with initially low performance in word reading continued to struggle with English-reading comprehension during the middle school years. Although the study provided valuable evidence about the development of native-Spanish speaker LM learners’ word-reading–comprehension relationship, the investigation was limited to middle-school native Spanish-speaking students, with no comparison NE peers. Without a comparison group of NE speakers, it is unclear to what extent the association of initial word reading with reading comprehension growth differs between LM learners and NE students. As well, there is a need to address very early word-reading during the emergent reading phase in relation to longer-term reading comprehension.

**What is Known about Reading-Comprehension/Reading-Achievement Development for Monolinguals and LM Learners?**
The following sections provide a review of extant research focused on the development of reading comprehension as well as global reading achievement for both monolingual children and LM learners.

**Monolingual Children**

Several prior longitudinal findings have suggested that reading comprehension growth patterns among school-aged monolingual English-speaking students can be well characterized by quadratic shape functions. That is, trajectories in reading comprehension are initially linear with a high rate of growth, but rate of growth starts declining over time after high initial acceleration, resulting in an eventual plateau around middle grades (Catts, Bridges, Little, & Tomblin, 2008; Francis, Shaywitz, Stuebing, Shaywitz, & Fletcher, 1996; Speece, Ritchey, Cooper, Roth, & Schatsneider, 2004; Williamson, Fitzgerald, & Stenner, 2014). For example, Francis and colleagues (1996), who examined monolingual reading achievement growth from first grade through ninth grade, found that the reading trajectory followed a quadratic function in that children initially showed the most rapid growth in reading and began to decrease thereafter. Consistent with Francis and colleagues (1996), Catts and colleagues (2008) also reported that quadratic models provided the best fit to reading achievement growth among monolingual English-speaking children with language impairments tracked from kindergarten through tenth grade.

**Language-Minority Learners**

Given the limited number of empirical studies examining LM learners’ reading comprehension development over time, far less is known about the developmental processes of reading comprehension for LM learners relative to NE peers. While LM learners and NE students often obtain comparable levels of word-level reading skills in English in the primary
grades (Chiappe & Siegel, 1999; Lesaux & Siegel, 2003), LM learners gradually struggle with reading comprehension and fall behind their peers in later grades (Lesaux, et al., 2006). Indeed, previous cross-sectional studies reported that LM learners perform substantially lower than NE students on reading comprehension outcomes (e.g., Gottardo & Mueller, 2009; Hutchinson, Whiteley, Smith, & Conors, 2003).

Nakamoto and colleagues (2007) investigated Spanish-speaking LM learners’ English-reading comprehension growth following a same cohort from the first grade through sixth grade. Consistent with the trend observed by research evidence on monolingual children’s reading comprehension growth, they found an initially rapid growth followed by gradually decreasing growth thereafter among LM learners across the six years. However, their findings further indicated that LM learners’ English-reading comprehension scores were comparable to the national averages in the first and second grades but fell increasingly behind the normative sample of NE students and remained behind by sixth grade. Thus, despite the similar shapes of growth trajectories of English-reading comprehension between LM learners and NE peers in the primary grades, the trajectories gradually showed divergent paths by increasing a gap between the two populations as text demands increased.

**Summary**

In short, a general consensus in theoretical and empirical research conducted with monolingual readers is that reading comprehension performance and development are highly dependent on monolingual children’s early word-reading ability. Monolingual children with well-developed word-reading ability tend to show relatively advanced reading comprehension as compared to peers with slow, inefficient, and inaccurate word-reading ability (Ehri, 1979; Perfetti, 1985). However, given the lack of empirical research on LM learners’ English-reading
development, far less is known about whether LM learners’ well-established English-word reading ability also has a positive impact on English-reading comprehension development.

The relationship between early word reading and reading comprehension growth is expected to vary as a function of language status—LM learners and monolingual NE students. One explanation is that the acquisition of word-reading skills for LM learners learning to read in a second or additional language requires more processing time and cognitive demands as compared to their monolingual peers who draw upon substantial oral language skills to reading (Verhoeven, 2011). However, it is viable to assume that those LM learners who initially establish strong word-reading skills would show similar reading comprehension growth to their monolingual peers who also have strong word-reading skills.

The current study extends prior research by addressing reading-comprehension growth in relation to early word-reading ability for a sample of LM learners in comparison to NE peers over the course of elementary and middle school. Findings may provide a conceptual foundation for understanding of whether early word-reading predicts difficulties in English-reading comprehension development for LM learners and inform classroom teachers and future theory and research.
CHAPTER 3

METHODOLOGY

Design

Using eight-year longitudinal data from a nationally representative sample of children from the Early Childhood Longitudinal Study–Kindergarten Class of 1998-1999 (ECLS-K: 1998-1999) dataset, the relationship between the first-grade word-reading proficiency and reading-comprehension proficiency growth across the spring of first, third, fifth and eighth grades was examined. The sample included 992 first-grade LM learners and 7,188 first-grade native-English-speaking (NE) students in 2000 who were followed into third (2002), fifth (2004), and eighth grades (2007).

Three ECLS-K data sources were used: (a) English-reading assessment (basic early reading skills [letter recognition, beginning and ending sounds], word reading, and reading comprehension); (b) parts of a parent interview; and (c) oral English-language proficiency assessment (selected subtests of the Pre-Language Assessment Scales [PreLAS; Duncan & DeAvila, 1998]). The present study involved six variables. First, drawing upon English-reading assessment data from the ECLS-K dataset, the following two variables were created by the researcher: (a) Word-Reading Proficiency in the spring of first grade (a dichotomous variable indicating two groups—low and high Word-Reading Proficiency); and (b) Reading-Comprehension Proficiency (a dichotomous variable—whether or not a child passed Reading-Comprehension Proficiency). In addition, the following two sets of variables were directly taken from the ECLS-K dataset for the current study: (a) children’s Gender, (a dichotomous variable)
Race/Ethnicity (a categorical variable), and Socioeconomic Status (SES) (a continuous variable) that were all collected during the parent interview; and (b) Time to Oral English-Language Proficiency (a categorical variable grouping children based on which of four time points [fall/spring kindergarten, and fall/spring first grade] a child passed the ECLS-K pre-established cut-score on the oral English-language assessment, PreLAS).

A series of Hierarchical Generalized Linear Modeling (HGLM; Raudenbush & Bryk, 2002) analyses for longitudinal data was conducted. The independent variable was Word-Reading Proficiency at first grade, and the dependent variable was Reading-Comprehension Proficiency, with Reading-Comprehension Proficiency repeated at first, third, fifth, and eighth grade. The control variables were child’s Gender, Race/ethnicity, SES, and Time to Oral English-Language Proficiency.

**Data Sources: The ECLS-K**

Data for the present study were drawn from the ECLS-K study, sponsored by the U.S. Department of Education, National Center for Education Statistics (NCES) along with supports offered by the Survey Research Center, School of Education at the University of Michigan and Educational Testing Services (ETS). In conducting the ECLS-K study, NCES gathered data from a large-scale, nationally representative sample of U.S. students entering kindergarten in the 1998-99 school year and continuing through eighth grade.

The ECLS-K study is a multifaceted and longitudinal study, designed to capture information on a wide range of individual child, home, and school characteristics collected from student assessment, parent interviews, and teacher and school administration surveys. The ECLS-K study is an effort to better understand children’s status at entry to kindergarten in the United States, their transition into elementary school, progression from kindergarten through
eighth-grade school years, and to provide important implications with respect to educational policy and classroom practice. The main objectives and potential applications of the ECLS-K study are outlined as:

1) a study of achievement in the elementary and middle school years;
2) an assessment of the developmental status of children in the United States at the start of their formal schooling and at key points during the elementary and middle school;
3) a cross-sectional study of the nature and quality of kindergarten programs in the United States; and

There are positive benefits to using the ECLS-K database for the current study. The ECLS-K is a national dataset in which information on children who came from a non-English speaking background was included. Thus, the ECLS-K data is suitable for studying LM learners’ English-reading performance. In addition, the present study design fully took advantage of the multi-wave longitudinal nature of the ECLS-K data. It provides an invaluable opportunity to observe students’ growth trajectories in reading-comprehension proficiency for a relatively long period of time, which is not available from cross-sectional studies.

**ECLS-K Study Sample and Sampling Design**

The ECLS-K sample includes 21,409 children who attended both public and private kindergartens offering full- and part-day programs across approximately 3,500 classrooms in 1,280 schools during the 1998-99 academic year. Of 21,409 children originally recruited for the ECLS-K study, 9,189 children were followed through eighth grade (Tourangeau, Nord, Lê,
Pollack, & Atkins-Burnett, 2006). The sampling process was conducted by using a multistage probabilistic sampling design that includes three main stages: (a) Primary Sampling Units (PSUs, counties or groups of counties within the United States); (b) schools within sampled PSUs; and (c) students from these schools. In the first stage, the 1990 county-level population data was used to construct PSUs in which contained 1,404 counties or groups of contiguous counties with minimum 15,000 persons. The existing PSU frame was then updated with 1994 population estimates of five-year-olds by race/ethnicity by using the U.S. Census Bureau. The eligibility criterion for the selection of a PSU was to have at least 320 five-year-olds children. Each PSU that did not meet this requirement was collapsed with an adjacent PSU. After collapsing, 1,335 PSUs remained in the sampling frame.

In the second stage of sampling, a sample of representative schools offering kindergarten programs was systematically selected with probability proportional to the measure of size within the 100 PSUs. A total of 1,280 schools (934 public and 346 private schools) were determined from 1,335 PSUs using the school universe files: 1995-96 Common Core of Data (CCD), Private School Universe Survey (PSS), Bureau of Indian Affairs, and the Department of Defense. The minimum required sample size of children for a school to be included was 24 children for public schools and 12 children for private schools. Asians and Pacific Islanders (APIs) were over-sampled to ensure adequate sample sizes for statistical subgroup comparisons. Finally, the student sample was obtained from 1,280 schools.

After the first data collection wave in the fall of first grade, sample attrition was observed due to high mobility among the children who were initially selected. In the spring of first grade, thus the sample was refreshed to restore the reduced sample size and to have a nationally representative population of first graders by including children who had not attended
kindergarten in 1998 and thus would not have been selected during 1998-99 academic year. As a result, 165 new children were added to the sample in the spring of first grade. However, at third grade, the sample was not representative of third grade students because children who had just arrived to the United States were not included in the sample. Thus, the third grade data was only representative of the population cohort who participated in the ECLS-K study, but not representative of all third grade children in the United States in 2001-2002. Population cohort references the entire group of children who began kindergarten during the 1998-1999 school year in the United and were following over the several years while participating in the ECLS-K study (Tourangeau et al., 2009).

**Instruments and Procedures**

In the present section, ECLS-K instruments and procedures are described. In a following section, variables (and reliabilities) used in the present study are portrayed, including variables that were created from ECLS-K variables and variables that were taken directly from ECLS-K.

Three ECLS-K instruments were selected to create the variables for the present study: (a) English-reading assessment, (b) parts of a parent interview, and (c) oral English-language proficiency. The NCES field staff collected both English-reading assessment and oral English-language proficiency data from the participating children and information about family and children’s characteristics from the children’s parents/guardians. A majority of the field staff was mostly former educators or teachers, and experienced in working with children and conducting assessments. They had in-person training sessions before collecting data. The field staff was divided into 100 geographic areas selected for the ECLS-K study as a data collection team consisting of one field supervisor and three assessors. The teams had responsibility for all data collection activities within their assigned work areas including conducting the direct child
assessments and the parent interviews. The three types of ECLS-K instruments are described in the following sections.

**ECLS-K English-Reading Assessment and its Development**

In the following sections, I provide a summary description of the ECLS-K English-reading assessment, the ECLS-K framework for the reading assessment, item development for the reading test, test administration procedures, Proficiency Level scores, and validation of the English-reading scale. In the Proficiency Level scores section, I describe the ECLS-K Proficiency Level scores that were used as a basis for creating two variables for the present study, Word-Reading Proficiency and Reading-Comprehension Proficiency. A detailed description of how the two variables were created is presented in the later section, Variables (and Reliabilities) Used in the Current Study.

**Summary description of the ECLS-K English-reading assessment.** The ECLS–K English-reading test was designed to assess children’s cognitive skills and knowledge in reading that were typically taught and developmentally essential in elementary and middle schools’ literacy curricula. In consultation with curriculum specialists, the test was designed as a developmental scale test. The arrayed sets of items formed a vertical scale, based on Item Response Theory (IRT), such that at a particular point in time a student’s performance could be placed on the ladder-like scale.

Table 3.3 presents descriptions of 11 Proficiency Levels identified in the kindergarten through eighth-grade reading assessments. The 11 Proficiency Levels represented children’s cognitive reading development and marked developmental stages in going from easiest to the most difficult level. Within each Proficiency Level, there were four items that were similar in content and difficulty. The items embedded in Proficiency Levels formed a hierarchical
structure implying that a child who mastered a particular Proficiency Level was expected to have mastered all the lower Proficiency Levels.

Two-stage adaptive testing was used so that students responded to items in their personal developmental range. In the first-stage, in order to assess the child’s approximate reading level, the child received a first-stage routing test consisting of 12 to 20 items with a range of difficulty levels selected from a large pool of test items. Then, based on the performance level on the first-stage routing test, the difficulty level of the second-stage test form (the actual reading assessment) was determined, and a battery of test items was provided in the second stage (Rock & Pollack, 2002). That is, a child who performed above grade level on the first-stage routing test received a second-stage form with more difficult items, whereas a child who scored below grade level on the routing test received a less difficult second-stage reading test form. By matching the item difficulties to each child’s developmental reading level, the two-stage, adaptive testing format led to increasing test efficiency and accuracy, reducing the risk of floor and ceiling effects (Tourangeau et al., 2006; Weiss, 1982).

The entire assessment then consisted of 44 items, four items at each of 11 Levels. However, the entire set of 44 items was not administered at each grade level. Instead, the ECLS-K reading test items were used only in grades for which their difficulty was appropriate. As shown in Figure 3.1, reading test items corresponding to Proficiency Level 1 through 3 appeared only in the kindergarten and first-grade assessments; items for Level 4 appeared in kindergarten, first-, and third-grade assessments; items for Level 5 appeared in all grade-level assessments; items for Levels 6 and 7 appeared in third- and fifth-grade assessments; items for Level 8 appeared in third-, fifth-, and eighth-grade assessments; items for Level 9 appeared in fifth- and eighth-grade assessments; and items for Level 10 in eighth-grade assessment only.
(Najarian et al., 2009). Viewed from the child perspective, children in kindergarten and first grade could have received up to 20 items (four items at each of Levels 1 through 5), depending on a child’s pass rate at a given level. Children in third grade could have received up to 20 items (four items at each Levels 4 through 8), depending a child’s pass rate at a given level. Children in fifth grade could have received up to 20 items (four each at Levels 5 through 9), and children in eighth grade could have received up to 16 items (four each at Levels 5, 8, 9, and 10).

**Framework for the ECLS-K assessment.** The ECLS-K English-reading test specifications were derived from the Reading Framework for the 1996 National Assessment of Educational Progress (NAEP; National Assessment Governing Board, 1994). The Framework is based on a developmental outlook about reading growth in which different cognitive abilities are emphasized at different phases of development. Therefore the English-reading assessment test developers created a ladder-like set of items, progressing from items representing focal cognitions of code-breaking during early reading development to other items representing reading cognitions developed later and later in time. The NAEP frameworks served as useful models because both the ECLS-K and NAEP assessment projects have similar goals that are to assess cognitive skills in reading that are typically taught and developmentally emphasized at different points in time in literacy curricula. The NAEP Framework, developed for the fourth grade and up, features four categories of reading comprehension skills: initial understanding, developing interpretation, personal reflection and response, and demonstrating a critical stance. To accommodate applicability to the early elementary years in the ECLS-K, two additional categories were added to the NAEP framework in developing the ECLS-K reading framework: basic skills (e.g., familiarity with print, recognition of letters and phonemes, and decoding) and vocabulary. The basic skills represent the major emphasis of first-grade reading assessment.
After first grade, there is a decrease in the emphasis on basic skills so that the allocation of measuring different ones of four reading comprehension skills increases in third, fifth, and eighth grades, that is, items shift from measuring selected early-reading skills to reading comprehension abilities.

**Item development for the ECLS-K reading test.** Following the model of the NAEP 1996 Reading Framework, a pool of ECLS-K reading test items was developed by item writers from Educational Testing Service (ETS) and literacy curriculum specialists and practitioners. There were a total of nearly 200 reading test items. A partial pool of items was borrowed or adapted, with permission, from published commercial tests including the *Peabody Individual Achievement Test-Revised* (Markwardt, 1989), the *Peabody Picture Vocabulary Test–Revised* (Dunn & Dunn, 1981), the *Primary Test of Cognitive Skills* (Huttenlocher & Levine, 1990), the *Test of Early Reading Ability* (Reid, Hresko, & Hammill, 1981), the *Woodcock-Johnson Tests of Achievement–Revised* (Woodcock & Bonner, 1989) for first, third, and fifth grades; and from other NCES studies including released NAEP, the National Education Longitudinal Study of 1988 (NELS:88), and the Education Longitudinal Study of 2002 (ELS: 2002) test items for eighth grade (Najarian, Pollack, & Sorongon, 2009).

**ECLS-K procedures for administering the English-reading assessment.** The English-reading assessment was conducted by trained NCES examiners who visited children in the school. Given the two-stage adaptive structure of the assessments, testing sessions were individually administered to provide more sensitivity to each child’s needs (Rock & Pollack, 2002). The test was un-timed, and testing time averaged from 50 to 70 minutes per child at each testing occasion. While the first-grade reading test items were presented in easel format, the third-, fifth-, and eighth-grade reading assessment formats incorporated a paper-based booklet
format containing the reading passages to accommodate longer reading passages used for the older sample (Tourangeau et al., 2006).

**ECLS-K Proficiency Level scores.** One type of score provided by the ECLS-K researchers is a Proficiency Level. For the present study, the ECLS-K Proficiency Level scores were used to create two secondary variables, Word-Reading Proficiency and Reading-Comprehension Proficiency. The two specific variables for the present study are detailed in a following section, Variables (and Reliabilities) Used in the Current Study. Clear understanding of the nature of the ECLS-K Proficiency Level variable is necessary as a preliminary foundation for understanding the specific variables used in the present study that will be described in a following section.

The ECLS-K Proficiency Level represented a student’s specific level of mastery on the vertical developmental scale (as shown in Table 3.3 and Figure 3.1) (Rock, 2012). The 11 Proficiency Levels shown in Table 3.3 are assumed to comply with the Guttman model (Guttman, 1950). That is, a particular Proficiency Level that a student attained at a certain point in time indicates that the student mastered all previous or lower levels and did not yet master higher levels. The Proficiency Levels function as “gates” that children pass through over time. The highest Proficiency Level mastered by a child at each assessment occasion was the highest of the 11 Proficiency Levels mastered by passing three or four of the four-items in a given level (cluster of four items). For instance, if a first-grade child answered correctly at least three out of the four questions within each cluster (four items per Level) at reading Proficiency Levels 1, 2, and 3, but did not pass the cluster of four items at Level 4, the highest Proficiency Level that the child mastered would be Level 3. A value of 0 indicated that a child was unable to reach Proficiency Level 1.
Validation of the ECLS-K scale. One means of the ECLS-K scale validity assessment was that the overall English-reading assessment items were reviewed by elementary and middle school curriculum specialists across different geographic regions of the United States for content, difficulty, sensitivity, and relevance to the reading assessment framework. The items that passed the review stage by school curriculum specialists were field tested.

The ECLS-K study researchers provided a second indication of scale validity. One score (not used in the present study) that can be obtained from the ECLS-K English-reading assessment was an overall reading ability score (a theta score). The ECLS-K researchers assessed interpretation of scores arising from the vertical scale by using the overall reading ability score in conjunction with other non-ECLS-K test scores. A means of assessing the validity of score inferences from the scale was to compare the field-test overall reading ability (theta) estimate with scores on the following reading assessment instruments in approximately 1,800 children: the Kaufman Test of Educational Achievement (KTEA; Kaufman & Kaufman, 1998) test for first grade and the Woodcock-McGrew-Werder Mini-Battery of Achievement (MBA; Woodcock, McGrew, & Werder, 1994) test for third and fifth grade. The correlation of the overall reading ability estimate (theta) based on ECLS-K reading field-test results with the KTEA scores was in the mid-to upper-eighties (Rock & Pollack, 2002), and that with the MBA scores for third and fifth grades was .83 and .73, respectively (Pollack et al., 2005; Tourangeau et al., 2006). Comparison of field test results with scores on an established reading assessment instrument was not conducted during the eighth-grade reading field test. The design and content of the eighth-grade reading assessments were drawn from previous assessments including released items from NAEP, NELS:88, ELS:2002, and the ECLS-K fifth-grade English-reading assessment. Thus, the test authors considered evidence of the high correlations from the prior
validation studies from NAEP, NELS, and the ECLS-K fifth grade as support for the ECLS-K eighth-grade item pool (Najarian et al., 2009).

**Parent Interview**

The NCES field staff collected data on socio-economic and demographic characteristics from the participating children’s parents/guardians through interview. The NCES field staff interviewed the parent at home over the telephone, lasting approximately 45 minutes. A Computer-Assisted Telephone Interviewing (CA TI) method was used to pose the questions on the computer screen and record the parent’s responses directly into the computer during the parent interview. If a respondent did not have a telephone or was reluctant to do a phone interview, the interview took place in person. Although the language of interviews was predominantly English, bilingual interviewers were trained to conduct the interview for those parents/guardians whose primary language was not English. Some information collected from the parent interview was used for the study and is described in the following sections.

**Home language background.** Parents who participated in the ECLS-K study responded to two questions regarding student’s home language: “Is any language other than English spoken in your home?” and “What is the primary language spoken in your home?” A composite variable of whether English was a student’s home or primary language was created from the two questions. The specification for the variable composite was as follows: If the first question’s response was ‘no other language than English regularly spoken in home,’ then the variable was coded as ‘English is a student’s home language.’ If the first question’s response was ‘a language other than English was regularly spoken in the home’ and any non-English language was reported in the second question, then the variable was coded as ‘English is not a student’s home language.’
Gender, race/ethnicity and SES. Student’s socio-demographic characteristic information—gender, race/ethnicity and SES—was collected from the parent interviews in the first grade. Parents/guardians were asked to provide information on a child’s gender, and identify child’s race/ethnicity as in one of the following categories: White (non-Hispanic), Black (non-Hispanic), Hispanic, and Asian/Pacific Islander/Other.

In addition, parents/guardians were asked to provide information on five items (see Table 3.4), including overall household income, the sample child’s father/male guardian’s education, mother/female guardian’s education, father/male guardian’s occupation prestige and mother/female guardian’s occupational prestige. Drawing on the five items, NCES researchers created a composite variable that captures the household’s SES at the time of data collection for first grade (spring 2000). If there were missing values for some of the five components of the SES for children with a female single parent or male single parent, imputation procedures were undertaken to fill in the missing information.

The SES variable is estimated both on a continuous (i.e., WISESL) and a categorical (i.e., WISESQ5) scale. NCES researchers calculated the continuous SES variable by transforming the scores of the five items into z-scores and then averaging the five z-scores, each of which had a mean of 0 and a standard deviation of 1. The continuous SES variable ranges from -2.96 to 2.88. Using the continuous measure of SES, NCES researchers created the categorical SES variable to indicate the quintile for the value of the composite SES with the first quintile representing the lowest SES group to the fifth quintile representing the highest SES group. For the present analyses, the SES variable on a continuous scale was used.

Oral English-Language Proficiency
An oral English-language proficiency assessment was administered to children who were identified as needing screening for oral English-language proficiency including LM learners who spoke a non-English language in the home in the fall and spring of kindergarten and in the fall and spring of first grade. Three of the six subtests of the English *Pre-Language Assessment Scales (PreLAS) 2000* Form C (Duncan & DeAvila, 1998) were selected for the ECLS-K study to measure children’s listening comprehension, vocabulary, and ability to understand and produce language. The *PreLAS 2000* is known as a widespread language screening tool in identifying English-language learners from pre-kindergarten through first grade (NCES, 2002). There were 60 items across the three subtests, so raw scores could range from 0 to 60.

The key purpose of the assessment was to determine whether children had sufficient oral English-language proficiency to participate in English-language battery of assessments at any given time point. Children who passed a cut-score of 37 out of a total score of 60, established by the authors of the *PreLAS 2000*, were assumed to be proficient in English and thus were administered the English reading assessment (Rock & Pollack, 2002). Children who scored 36 or below in *PreLAS 2000* during one data collection period were not given English reading assessment, but their oral English-language proficiency was rescreened at the subsequent data collection time point to determine whether they had progressed to demonstrate sufficient oral English-language proficiency and they were eligible to take reading assessment in English. Split-half reliability coefficients for the three subtest of the English *PreLAS 2000* were .97, .96, .98, and .96 in the fall and spring of kindergarten, and the fall and spring of first grade, respectively (Rock & Pollack, 2002).

**Variables (and Reliabilities) Used in the Current Study**
In the following section, I describe each of the variables used in the present study, and where relevant and possible, their reliabilities. Table 3.5 also provides a list of the present-study variables (column 1) and a description of each variable (levels used in the HGLM analysis for the present study, definitions, coding scheme, measurement scale, and original ECLS-K variable names).

**English Reading: Word-Reading Proficiency and Reading-Comprehension Proficiency Variables for the Study**

The two variables—Word-Reading Proficiency and Reading-Comprehension Proficiency—for the present study were constructed by using the ECLS-K variable, Highest Proficiency Level Mastered (described earlier). Recall that the ECLS-K Proficiency Level score was on an ordinal scale of 0 to 10, and that the foundational items at the lowest Proficiency Levels were about word reading, and the different comprehension levels followed in sequence (see Table 3.3).

**Word-Reading Proficiency.** Word-Reading Proficiency was a dichotomous predictor variable that indicated whether a child had low or high Word-Reading Proficiency in the spring of first grade. From the first-grade reading assessment, children were divided into two groups: low and high Word-Reading Proficiency. Children with low Word-Reading Proficiency were defined as those who reached the highest reading Proficiency Level 0, 1 (letter recognition), 2 (beginning sounds), or 3 (ending sounds), but did not reach reading Proficiency Level 4 (reading sight words) in the spring of first grade. Children with high Word-Reading Proficiency were defined as those who passed Levels 4 and 5, or above (see Table 3.3 for definitions of Levels above Level 5). In this way, two clearly distinct groups of children were formed such that a group of children with moderate Word-Reading Proficiency was excluded (children who reached Proficiency Level 4, but did not achieve Level 5 [reading words in context]). In the analyses, a
value of 0 represented children in the low Word-Reading Proficiency group, and a value of 1 represented children in the high Word-Reading Proficiency group.

The rationale for the group assignment decisions was as follows: Children in the low-proficiency group were developing pre-word-reading skills such as letter identification and phonological awareness, but had not yet been proficient in word-reading skills. Children in the high-proficiency group, on the other hand, had gained pre-word-reading skills and become proficient in reading words by sight (i.e., Level 4) and in the context of text (i.e., at least Level 5) by the spring of first grade. Table 3.6 shows the number and percentage of children in the two groups by low and high Word-Reading Proficiency.

**Reading-Comprehension Proficiency.** Following the same procedure used by O’Connell and her colleagues (2008, 2013), the outcome variable for the present study, Reading-Comprehension Proficiency, was created from whether or not a child achieved reading-comprehension Proficiency Level 8. The outcome variable was a repeated measure at each of the four time points (spring of first, third, fifth, and eighth grade). That is, the dichotomous variable for Reading-Comprehension Proficiency was for each child at each time point either a 0 or 1, indicating whether Proficiency Level 8 had been reached (coded as 1) or not (coded as 0). So for example, a child who did not reach Reading-Comprehension Proficiency (Proficiency Level 8) in the spring of third grade, but did reach it in the spring of fifth grade would have outcome scores of 0 (for the spring of first grade), 0 (for the spring of third grade), 1 (for the spring of fifth grade), and 1 (for the spring of eighth grade).

The rationale for choosing reading comprehension Proficiency Level 8 was that it was the only comprehension level for which items were administered at all three grade levels beyond first grade—the spring of third, fifth, and eighth grade (see Figure 3.1).
Proficiency Level 8 demonstrated the ability to understand an author’s craft and make connections between a problem in the narrative and similar life problems (Pollack et al., 2005). Children passing Proficiency Level 8 have achieved a reasonably advanced comprehension ability in that they could make inferences using explicit cues in text, identify the clues used to make inferences, use background knowledge to understand homonyms, understand why authors’ make choices and how they use their texts to impact readers, and connect text content to life problems. While Proficiency Level 8 was not the most advanced reading-comprehension level, it was construed as equivalent to the NAEP 8th grade reading framework. The NAEP expectations of 8th grade students’ reading comprehension performance involve the ability to make inferences about a text, interpret causal relations, and analyze and evaluate the author’s perspective. Thus Proficiency Level 8 was considered a sufficiently high expectation for mastery by the eighth grade.

**Reliability.** According to the ECLS-K study researchers, an approach to a reliability estimate of the highest reading Proficiency Level mastered variable was to evaluate the extent to which the measurement yielded consistent or similar results under different circumstances or on a different occasion (Pollack et al., 2005). For instance, when a child’s highest reading Proficiency Level mastered was Level 5 in the spring of first grade, reliability estimates could be determined by the extent to which the same highest Proficiency Level 5 would be achieved in other circumstances in which a different set of items may have been used.

To assess the reliability of the highest reading Proficiency Level mastered, the ECLS-K researchers calculated the inter-rater reliability between two differentiated coding methods in obtaining a child’s highest reading Proficiency Level mastered: (a) using the actual four-item cluster response data solely; and alternatively (b) using IRT ability estimates and item parameters
that were used to generate pass/fail scores and the highest reading Proficiency Level mastered for the same child (Najarian et al., 2009). The inter-rater reliability estimates by comparing the two coding methods were applied to 80% of the full sample; that is, using only students who had non-missing actual four-item cluster responses. The remaining 20% with missing values in four-item cluster responses were determined by IRT model-based imputations alone. The percentages of agreement on each value were computed by dividing the total number of agreements by the total number of agreements plus disagreements and multiplying by 100. The percentages of agreement within one score point in the spring of first, third, fifth, and eighth grades were 96%, 96%, 96%, and 84%, respectively (Najarian et al., 2009).

**Time**

The variable denoting the passage of time was specified as individual child’s actual age in months on the day the English reading assessment was administered (Singer & Willet, 2003). Child age provides a continuous measure that is sensitive to the chronological distance between assessment points and therefore contributes more variance to an outcome than does time measured as static months of administration. Child age also provides a detailed summary of the growth process. Children’s actual age in months on the day assessment was centered on the average child’s age at the testing date in the spring of first grade for the HGLM analysis.

**Language Status**

Following procedures used by Han and Bridglall (2009), and Kieffer (2011), the language status classification was determined based on home-language information that the participating students’ parents/guardians provided during the interviewing process during the child’s first grade year. If parents/guardians reported English as the primary language spoken at home, the student was identified as a NE student. If parents/guardians reported that a non-English
language was spoken as a primary language at home, the student was considered as a LM learner. In the analyses, Language Status was a dichotomous variable in which a value of 0 indicated NE students and a value of 1 indicated LM learners (reference group).

**Control Variables**

Child’s demographic data (i.e., Gender, Race/ethnicity, and SES) and Time to Oral English-Language Proficiency were included as control variables in the analyses because they have been previously identified as significant predictors of reading achievement in the literature (e.g., Chatterji, 2006; Kieffer, 2008; 2011; McCoach et al., 2006; Roberts et al., 2010).

**Gender, Race/ethnicity, and SES.** The Gender variable was represented by a dichotomous variable indicating whether a child was female (coded as 1; reference group) or male (coded as 0). Following the ECLS-K classification, the Race/ethnicity variable consisted of four categories representing (a) White, non-Hispanic, as a reference group; (b) Black, non-Hispanic; (c) Hispanic; and (d) Asian/Pacific Islander/Other. The household’s SES variable was the NCES-computed composite variable, estimated on a continuous scale through a z-transformation in first grade (Spring 2000). In the present study it ranges between -2.96 and 2.88.

**Time to Oral English-Language Proficiency.** The Time to Oral English-Language Proficiency variable was taken directly from the ECLS-K dataset as created by the ECLS-K researchers. Children were categorized into five groups on the basis of the when they passed the ECLS-K pre-established cut-score on the English PreLAS assessment (cf. Kieffer, 2011 for a similar procedure). The cut-score on the English PreLAS assessment by the ECLS-K researchers and the PreLAS test authors was 37. The five groups in the present study were: (a) kindergarten children who were not identified as needing the PreLAS test (specified as the
reference category); (b) children who became proficient in English (passed the cut-score of the PreLAS test) by the fall of kindergarten; (c) children who became proficient in English (passed the cut-score) by the spring of kindergarten but not sooner; (d) children who became proficient in English (passed the cut-score) by the fall of first grade but not sooner; and (e) children who became proficient in English (passed the cut-score) by the spring of first grade but not sooner.

In the present-study sample, all children had passed the cut-score by the spring of first grade at the latest.

**Sample for the Current Study**

**Criteria for Sample Selection for the Present Study**

The sample for the study consisted of a subset of children who participated in the ECLS-K study. To be eligible for the present analysis, the sample met the following inclusion criteria for children who: (a) had parents’ report of the primary language spoken in the home that was used to identify the subsample (i.e., LM learners versus NE children); (b) had at least one measurement occasion of Reading-Comprehension Proficiency from the four data collection points (the spring of first, third, fifth and eighth grades); (c) had non-missing values on Word-Reading Proficiency mastered in the spring of first grade; and (d) had a valid non-missing sampling weight on English-reading Proficiency Levels for first, third, fifth and eighth grades in the ECLS-K database.

A fifth criterion was used that excluded some children. As described earlier, to ensure that two distinct Word-Reading Proficiency groups were formed, children with “moderate-level” proficiency (as operationalized in a preceding section) were excluded. The final sample of children for the study, therefore, had a valid predictor variable (either low or high Word-Reading
Description of the Selected Sample for the Present Study

The analytic sample included 8,180 children with 992 LM learners and 7,188 NE students. Table 3.2 presents the unadjusted percentage distribution of demographic characteristics of the analytic sample and the comparable ECLS-K full sample. For every characteristic, the analytic sample percentages are highly similar or identical to the ECLS-K full sample.

Overall, children’s mean age in the spring of first grade was 87 months (range=72 to 96 months). The sample was approximately evenly divided between female and male. The two language-status subsamples differed by race/ethnicity, SES, and Time to Oral English-Language Proficiency.

The LM-learners group consisted of approximately 69% Hispanic, 11% White, 1% Black, and 19% Asian/Pacific Islander/Other. The NE-students group consisted of nearly 68% White, 16% Black, 10% Hispanic, and 6% Asian/Pacific Islander/Other. The distributions of race/ethnicity for each group were comparable to those reported in the study by Kieffer (2008), where the same procedure was used to define LM and NE groups. The LM learners were somewhat more socioeconomically disadvantaged than the NE students with more children in the lower and lowest (1st Quintile) SES quintile.

In addition, the LM learners are heterogeneous with respect Time to Oral English-Language Proficiency. Among 992 LM learners, at fall of kindergarten, nearly 72% were identified by teachers as needing oral English-language screening assessment, while slightly more than 28% were excluded from oral English-language screening assessment. Of 72% of
LM learners who were eligible for oral English-language screening assessment, approximately 30% passed the oral English-language assessment in the fall of kindergarten, 19% passed in the spring of kindergarten, 3% passed in the fall of first grade, and 20% passed in the spring of first grade. All children in the current study passed the oral English-language proficiency assessment by the spring of first grade; that is, they became sufficiently proficient in English to participate in English-reading assessments in the spring of first grade.

Data Analytic Approach

Data Preparation

Handling missing data. Missing values are a common occurrence in any large-scale longitudinal studies. The ECLS-K data also contains multiple missing values at each time point. Hierarchical Linear Model (HLM)-type models are flexible in handling missing data at level 1, but it does not allow missing values at level 2. The percentages of missing data for the outcome variable in the spring of third, fifth, and eighth grade were 7.52%, 25.68%, and 34.34%, respectively. To investigate whether missing data were distributed randomly, a missing value analysis using the Expectation–Maximization method was performed. Little’s Missing Completely At Random test indicated that the current data were not missing completely at random ($\chi^2 = 195.99$, $df = 2; p < 0.001$; Little & Rubin 1987). Therefore, a multiple imputation using an iterative Markov chain Monte Carlo technique was performed to include all observed data and maximize power of analysis (Allison 2002; Rubin, 2004).

The multiple imputation technique involves replacing missing data with a set of plausible values drawn from predictive distribution of the missing values multiple times (Rubin, 1987). The technique has the advantage of computing missing values based upon the observed
In the multiple imputation process, five imputed data sets were generated. Five imputations achieved 91% efficiency of estimate even with 50% of missing information (Rubin, 1987; Schafer, 1997). The five imputed datasets were then combined to yield a final single set of results into the Stata software program, in which parameter estimates were averaged across the five imputed data sets, and standard errors were adjusted by incorporating the variance in imputed values across the five imputed data sets.

**Sampling weights.** The ECLS-K sample was from a multistage stratified sampling frame with a complex design, including equal probability systematic sampling for students other than APIs and higher rate of probability sampling for APIs. These procedures would yield over or underestimation of the population. Therefore, analyses using the ECLS-K data require the use of weights to compensate for unequal probabilities of selection within and between schools (e.g., oversampling of private schools and Asian/Pacific Islander children) and to balance the demographic profile of the sample.

The ECLS-K public-use database provided sampling weights to be used for descriptive and inferential analyses. For descriptive analysis, a child-level sampling weight in the first grade (C4CPTW0) was employed. For HGLM analysis for change, a child-level sampling weight designed for analyses involving the full sample of children across the spring of first, third, fifth and eighth grades (C4_7CW0) was included. The application of the sampling weight procedures results in enhancing the generalizability of empirical results to a larger population by accounting for the unequal selection probabilities of certain subpopulations and adjusting for non-response bias over time. The results of the sampling weight procedure produced unbiased estimates for

**Preliminary Data Analysis**

Prior to proceeding to a series of HGLM analyses, preliminary tests were completed in order to facilitate interpretation of results. First, for the preliminary examination, descriptive statistics, and bivariate correlations for all variables across the time points were examined to understand the basic features of the data in the present study. Next, as suggested by Menard (2010), multicollinearity was examined to identify whether there was a strong correlation among predictors and control variables by using a tolerance and Variance Inflation Factor (VIF). Finally, to identify the most appropriate functional time for growth (e.g., linear versus curvilinear) that captured growth trend of the outcome variable in the data, a series of unconditional models was fitted by a comparison of competing nested unconditional models.

**The HGLM Analysis**

HGLM (Raudenbush & Bryk, 2002), also known as a Generalized Linear Mixed Model (GLMM; Skrondal & Rabe-Hesketh, 2004), served as the primary analysis for the current study. The HGLM approach employs the conceptual framework of the Logistic Regression model and the results are interpreted based on the Logistic Regression model (Snijders & Bosker, 1999). In the HGLM analysis for a longitudinal data, repeated measurements on individuals are expressed as a function of time.

HGLM approach is the best-suited modeling procedure for the current study because of the dichotomous nature of the outcome variable (i.e., Reading-Comprehension Proficiency). Given that the dichotomous variable has the restricted values of 0 and 1, its residuals cannot be normally distributed. The dichotomous variable thus violates the assumptions of normality,
linearity, and homoscedasticity presupposed by Ordinary Least Squares (OLS) regression (Long, 1997) as well as HLM that can be applied only to continuous outcomes with a normal sampling model and an identity link function (Raudenbush & Bryk, 2002). Therefore, it is appropriate to use the HGLM approach that contends with the issues by modeling for binary outcomes with a Bernoulli (or binominal) sampling model and logit link (Raudenbush & Bryk, 2002).

There are two additional reasons that the HGLM approach is a well-suited modeling procedure for the present study. First, HGLM is suitable for the analysis of nested or hierarchical data structure. In the current data, the time variable was nested in child-level data (i.e., first-grade Word-Reading Proficiency, Language Status, Gender, Race/ethnicity, SES, and Time to Oral English-Language Proficiency). Although HGLM employs the conceptual framework of Multiple Logistic Regression and takes the interpretations of results based on the structure of the Multiple Logistic Regression, Multiple Logistic Regression does not properly account for potential dependency that is inherent when dealing with hierarchical information (Snijders & Bosker, 1999). The HGLM approach provides potential solutions for dealing with the lack of independence among the observations clustered within individuals over time (Raudenbush & Bryk, 2002). In HGLM, a penalized-quasi likelihood (PQL; Breslow & Clayton, 1993), also known as Generalized Estimating Equations, is used as an estimation technique for fitting Multilevel Logistic Regression models by appropriately accommodating the binary dependent variable.

Additionally, HGLM offers flexibility and adequate estimation of individual change over time and how child-level characteristics are associated with the average level and change of reading comprehension over time for all participants, including those with incomplete data. In addition, HGLM approach for longitudinal data has flexibility in terms of data requirements
permitting unequally balanced numbers of participants and uneven spacing of occasions (Raudenbush & Bryk, 2002).

An important distinction between parameter interpretation in traditional regression models and the HGLM model is how coefficients (beta values) are created and interpreted. In traditional linear regression models (e.g., HLM), coefficients are used to interpret the effects of independent variables on a dependent variable. However, to use coefficients in HGLM or Logistic Regression model, the values of the dichotomous outcome variable (0 and 1) must be transformed into log-odds (i.e., logit; the logarithm of odds), so that estimates of coefficients represent changes in log-odds of the dependent variable as opposed to the changes in the dependent variable itself.

The coefficients (logits) are converted to odds-ratios by using the inverse exponential transformation. The odds-ratio is essential for proper interpretation of the results of HGLM and Logistic Regression because the odds ratio is a measure that describes the strength of association between a predictor variable and the occurrence of the outcome variable. The odds-ratio is defined as the ratio of the probability of success (i.e., a child achieving Reading-Comprehension Proficiency) in one group relative to the probability of success in the other group. In the example of the predictor variable—Word-Reading Proficiency, the odds-ratio greater than 1.0 indicates that the high Word-Reading Proficiency group (reference group) is more likely to achieve Reading-Comprehension Proficiency relative to the low Word-Reading Proficiency group. If the odds-ratio is less than 1.0, then the high Word-Reading Proficiency group is less likely to achieve Reading-Comprehension Proficiency than the low Word-Reading Proficiency group. If the odds-ratio is equal to 1.0, it indicates that an association does not exist, and that there is no difference in the odds for the high Word-Reading Proficiency group and the odds for
the low Word-Reading Proficiency group. Therefore, the odds-ratio was used to predict the likelihood of achieving Reading-Comprehension Proficiency and interpreted as how different the odds of achieving Reading-Comprehension Proficiency are for two different groups.

**Modeling Strategy**

The two-level HGLM with the repeated observations over time was estimated by using Stata software `xtlogit` command (version 12.0, StataCorp, 2011a). The within-person or time-point data (level 1) were nested in between-person or child-level data (level 2), which accounted for the association across the four time periods. The within-person model estimated how Reading-Comprehension Proficiency changed over time. The between-person model estimated the interaction effect between Language Status and Word-Reading Proficiency on Reading-Comprehension Proficiency growth across the first, third, fifth, and eighth grades, while accounting for main effects of the two predictors and control variables. The purpose of the inclusion of the control variables along with the predictors in the same model was to isolate the impact of the control variables on the dependent variable from the effects of the predictors. Thus, the explanatory power of the predictors (main and interaction effects) on the dependent variable was assessed, while all control variables in the model were held constant.

The control variables for the current study were referenced and specified in the Stata program by using `local controls` command, followed by the control variables, prior to `xtlogit` command.

Additionally, note that due to the nature of dichotomous outcome variable (i.e., Reading-Comprehension Proficiency), reading comprehension *growth* in fact refers to growth of the probability of achieving Reading-Comprehension Proficiency (ECLS-K reading Proficiency Level 8).
Specifications of two-level HGLM models. In contrast to the typical HLM in which a normal sampling model and an identity link function are used, the HGLM approach accommodates binary outcomes using a Bernoulli (or binominal) sampling model and logit link function at level 1 (Raudenbush & Bryk, 2002). In HGLM, the dichotomous dependent variable is transformed onto a logit scale to eliminate the 0/1 range constraints and makes the skewed distribution approximate a normal distribution. The logit-transformed probability can be theoretically assumed as any real value, and can be modeled as a linear function of a set of predictor variables. The following section describes the specification of the level-1 model in HGLM that consists of three parts—a sampling model, a link function, and a structural model—and the level-2 model.

Level-1 sampling model. The first part of HGLM was the level 1 sampling model. Given the level-1 binary outcomes, the level-1 sampling model utilized the Bernoulli (binominal) distribution expressed as:

\[ Y_{it} \mid \phi_{it} \sim Bernoulli(\phi_{it}), \]

where \( Y_{it} \) referred to whether child \( i \) at time \( t \) ever mastered Reading-Comprehension Proficiency, given the probability of success of outcome (\( \phi_{it} \)) for child \( i \) at time \( t \). With the Bernoulli sampling model, the expected value and variance of \( Y_{it} \) was equal to the probability of success in mastering Reading-Comprehension Proficiency. That was written as:

\[ E(Y_{it} \mid \phi_{it}) = \phi_{it}, \quad \text{Var}(Y_{it} \mid \phi_{it}) = \phi_{it}(1 - \phi_{it}). \]

Level-1 link function. The second part of HGLM was to specify a level-1 link function that transforms the expected values—0 and 1—into any real value, \( \eta_{i} \), that is the log-odds of success.
The logit transformation involved two steps. The first step was to calculate the odds of the success by taking the ratio of a value, $\phi$ to $1−\phi$ (Long, 1997; Snijders & Bosker, 1999). While $\phi$ is the probability of achieving Reading-Comprehension Proficiency, $1−\phi$ is the probability of not achieving Reading-Comprehension Proficiency. The odds of the success, a ratio of probability of success to the ratio of probability of failure, could be represented as follows:

$$\text{Odds} = \frac{\phi_i}{1-\phi_i}.$$  

The next step was to take the natural logarithm of the odds to obtain the logit. The logit could be given as the following:

$$\eta_i = \text{logit} (\phi_i) = \ln \left( \frac{\phi_i}{1-\phi_i} \right),$$

where the predicted values for $\eta_i$ was the log-odds (logit) of success for a child $i$, and $\ln$ is the natural logarithm. Given that the coefficients from the regression models using the predicted logits represented the log-odds of success in achieving Reading-Comprehension Proficiency, the predicted logits needed to be converted back to predicted probabilities using the inverse link as follows:

$$\phi_i = \text{logit}^{-1}(\eta_i) = \frac{\text{odds}}{1 + \text{odds}} = \frac{\exp(\eta_i)}{1 + \exp(\eta_i)}.$$  

**Level-1 structural model.** The third part of HGLM was the level-1 structural model. The level-1 structural model was the within-person model, in which the log-odds of success in achieving Reading-Comprehension Proficiency were modeled as a function of time. Each child’s Reading-Comprehension Proficiency was defined by an individual growth trajectory that depends on a unique set of parameters (Bryk & Raudenbush, 1987, 1992). The level-1 structural model was expressed as follows:
\[ \eta_{ti} = \beta_{0i} + \beta_{1i} TIME_{ti} + \beta_{2i} TIME_{ti}^2, \]

where \( \eta_{ti} \) represented the log-odds of Reading-Comprehension Proficiency for child \( i \) at time point \( t \), and \( \beta_{0i} \) represented initial status of child \( i \) in the spring of first grade (i.e., \( TIME = 0 \)). \( TIME_{ti} \) indicated child’s age in months at time point \( t \), centered on the sample mean at the testing date in the spring of first grade, and \( TIME_{ti}^2 \) was the square of \( TIME_{ti} \). The level-1 submodel assumed that a quadratic line would represent each child’s true change over time. The two slope parameters (\( \beta_{1i} \) and \( \beta_{2i} \)) were included in the level-1 model: \( \beta_{1i} \), associated with \( TIME \), estimating the instantaneous growth rate of child \( i \)’s log-odds of Reading-Comprehension Proficiency; and \( \beta_{2i} \) (i.e., the coefficient on the quadratic slope term), associated with \( TIME^2 \), estimating quadratic changes in the log-odds of Reading-Comprehension Proficiency over time, reflecting the acceleration/deceleration of the growth trajectory. No residual was not included in the structural model as it was specified by the sampling model.

**Level-2 model.** Finally, HGLM was completed by specifying the level-2 structural model. The level-2 model models the association between inter-individual differences in change trajectories and time-invariant, person-specific characteristics (i.e., fixed effects) of the individual (Singer & Willet, 2003). The level-2 model simultaneously reflects the general patterns (i.e., the between-group differences in intercepts and slopes) as well as inter-individual heterogeneity in patterns within groups. Singer and Willett (2003) suggest four distinct features for the level-2 model: (a) outcomes must be individual growth parameters from the level-1 structural model (i.e., \( \beta_{0i}, \beta_{1i}, \) and \( \beta_{2i} \)); (b) each individual growth parameter from the level-1 structural model must appear in a separate equation of the level-2 model; (c) each equation must specify a relationship between an individual growth parameter and the predictors; and (d) level-2
model must allow individuals who share common predictors to vary in individual change trajectories. The level-2 model can be expressed as:

\[ \beta_{0i} = \gamma_{00} + \gamma_{01} \text{PREDICTOR}_i + \zeta_{0i} \]
\[ \beta_{1i} = \gamma_{10} + \gamma_{11} \text{PREDICTOR}_i \]
\[ \beta_{2i} = \gamma_{20} + \gamma_{21} \text{PREDICTOR}_i, \]

In the level-2 structural model, each child’s intercept, \( \beta_{0i} \), and the growth parameters, \( \beta_{1i} \) and \( \beta_{2i} \), were expressed as functions of the fixed effects—level-2 intercepts (i.e., \( \gamma_{00}, \gamma_{10}, \) and \( \gamma_{20} \)) and level-2 slope parameters (i.e., \( \gamma_{01}, \gamma_{11}, \) and \( \gamma_{21} \))—associated with the predictor and control variables, \( \text{PREDICTOR} \). The fixed effects captured systematic differences between individuals in change trajectory, representing the effect of variation in level-2 predictor variables (i.e., \( \text{PREDICTOR} \)). The equation contained a random error term (i.e., \( \zeta_{0i} \)) that represented deviations of the individual growth parameters from the population averages (Singer & Willet, 2003).

**Fitting the two-level model for change to data.** Table 3.7 displays a taxonomy of the four multilevel logistic models for change that fit to the current data. The taxonomy of multilevel models shows a systematic sequence of statistical models in which each model extends a previous model, allowing examination and comparison across models (Singer & Willet, 2003). Table 3.7 shows specifications of level-1 and level-2 submodels at the five sequential models.

As recommended by Francis, Schatschneider, and Carlson (2000), the results were demonstrated in two phases: unconditional and conditional phases. In the unconditional phase, three unconditional models (i.e., Model A, B, and C) without including child-level predictors and control variables were fitted to identify the best model to capture the shape of growth by a comparison of competing nested models (e.g., linear versus curvilinear).
The first model to be fit to data was an *unconditional means model* (i.e., Model A in the Table 3.7) that had no predictor variables at both level-1 and -2 structural models. The second step to be fit to data was an *unconditional linear growth model* (i.e., Model B) with a random intercept and a random effect for the linear change (i.e., \( \text{TIME} \)). Model B included \( \text{TIME} \) as the only level-1 predictor variable, while none of predictors were specified at level-2 equations. The unconditional models allowed (a) determination of the extent of between-individual variation on the outcome (\( \eta_{ti} \), the log-odds of Reading-Comprehension Proficiency), (b) estimation of the intra-class correlations (ICC) among the growth parameters and the reliability of effects at each level, and (c) examination of a proper specification of each child’s growth equation and baseline statistics for evaluating consequent level-2 model (Raudenbush & Bryk, 2002). An additional unconditional growth model was fit to the data—an *unconditional quadratic growth model* (i.e., Model C)—that included the acceleration/deceleration rate parameter associated with level-1 predictor \( \text{TIME}^2 \).

In the conditional phase, based on the best-fitting unconditional model determined in the first phase, a *conditional growth model* (i.e., Model D) was fitted to examine the growth rate for the probability that children achieve Reading-Comprehension Proficiency as a function of the interaction effect between the two level-2 predictor variables—Language Status and Word-Reading Proficiency. Model D took into account the interaction effect, the main effects of the two predictor variables, and the control variables (i.e., Gender, Race/ethnicity groups, SES, and Time to Oral English-Language Proficiency groups) at level-2 submodel.

**Model comparisons.** The selection of a final model was determined by model comparisons through examination of deviance statistics (-2 Log-Likelihood) that provide a comparative index of goodness-of-fit versus parsimony, Akaike information criterion (AIC), and
Bayesian information criterion (BIC). Examining deviance statistics was particularly preferable because this approach offers superior statistical properties and allows composite tests on several parameters simultaneously (Singer & Willett, 2003).
CHAPTER 4
RESULTS

The results are presented in three main sections. In the first section, preliminary analyses results are presented. In the second section, results of the Hierarchical Generalized Linear Models (HGLM) analyses are presented to address the research question. The research question guiding the current study was: Is the relationship between first-grade word-reading proficiency and reading-comprehension proficiency growth through eighth grade different for language-minority (LM) learners as compared to their native-English-speaking (NE) peers? The major hypothesis for the study was that the relationship between children’s word-reading proficiency and reading-comprehension proficiency growth over time will vary as a function of children’s language status (i.e., LM learners versus NE students). An ordinal interaction of initial word-reading proficiency and language status was thus expected. Finally, I conclude the chapter by providing a summary of findings.

Preliminary Analysis

Prior to fitting the growth curves to address the research question, I conducted preliminary analyses. First, descriptive statistics for all variables across the time points were examined. Next, correlations and multicollinearity were evaluated to identify whether there is a strong correlation among the variables using a tolerance and Variance Inflation Factor (VIF). Finally, to determine the shape of patterns (e.g., linear versus quadratic growth) that captured the
growth trajectories of the outcome variable in the data, I fitted a series of unconditional models through a comparison of competing nested unconditional models.

**Descriptive Statistics**

Table 4.1 displays proportions (and standard deviations) of children achieving Reading-Comprehension Proficiency by full sample, Language-Status subsamples, and Word-Reading Proficiency Groups (low and high) across the first, third, fifth, and eighth grades. Recall that Reading-Comprehension Proficiency is an indicator variable showing whether or not a child achieved Reading Proficiency Level 8 at a given time point. As Table 4.1 shows, the proportion of children achieving Reading-Comprehension Proficiency for the full sample gradually increased over time (see Marginal Mean). On average, the proportions of the full sample of children who achieved Reading-Comprehension Proficiency in the first, third, fifth, and eighth grades were 0.01, 0.28, 0.44, and 0.68, respectively (see column 4). The first two columns in Table 4.1 show that from the third grade on, children with initially high Word-Reading Proficiency tended to achieve Reading-Comprehension Proficiency to a greater degree than children with initially low Word-Reading Proficiency.

Looking at the Language-Status subsamples’ marginal mean proportions, in the first grade, the proportions of LM learners and NE students who achieved Reading-Comprehension Proficiency were near 0. However, greater absolute differences between the two sub-groups appeared by the third grade, but by the eighth grade the two groups were more similar. As Figure 4.1 shows, in the third and fifth grade, the proportions of LM learners who achieved Reading-Comprehension Proficiency in the third and fifth grades (0.15 and 0.26, respectively) were approximately half those of NE students (0.29 and 0.46, respectively). In the eighth grade,
however, the proportions of the LM learners and NE students who achieved Reading-Comprehension Proficiency were very close (0.61 and 0.68, respectively).

As would be expected, the standard deviations for the first-grade Reading-Comprehension Proficiency were relatively low (0.07 for LM learners and 0.11 for NE students) because few children would be expected to attain Reading-Comprehension Proficiency by the end of first grade. Notably, the standard deviations of the two groups dramatically increased from the first to third grade and remained fairly steady across the third, fifth, and eighth grade, indicating that the scores in the third, fifth, and fifth grades were more widely dispersed than those in the first grade.

Table 4.1 also displays the proportions (and standard deviations) for the four following subgroups of children—a) LM learners with low Word-Reading Proficiency (LM-Low), b) LM learners with high Word-Reading Proficiency (LM-High), c) NE students with low Word-Reading Proficiency (NE-Low), and d) NE students with high Word-Reading Proficiency (NE-High). As would be expected, only a few or none of children across the four groups achieved Reading-Comprehension Proficiency in the spring of first grade. However, across the third, fifth, and eighth grades, the proportions of children in the LM-Low and NE-Low groups who achieved Reading-Comprehension Proficiency were considerably lower than those of children in the LM-High and NE-High groups who achieved Reading-Comprehension Proficiency. By the end of eighth grade, over 8 in 10 children in the LM-High and NE-High groups achieved Reading-Comprehension Proficiency, whereas only approximately 4 in 10 children in the LM-Low and NE-Low groups achieved Reading-Comprehension Proficiency.

In addition, Table 4.2 shows the number and percentage of children in the two groups of Word-Reading Proficiency further subcategorized by Time to Oral English-Language
Proficiency. Among children in the high Word-Reading Proficiency group, only 10% were not proficient in oral English at kindergarten entry and identified as needing the PreLAS test, whereas nearly 20% of children in the low Word-Reading Proficiency were not proficient in oral English at kindergarten entry. Due to the difference between the two groups, Time to Oral English-Language Proficiency was confirmed to be a potential confounding factor and was needed as a control variable in analyses.

**Correlations and Collinearity**

Table 4.3 shows zero-order phi-coefficient correlations between Reading-Comprehension Proficiency (a binary variable indicating whether or not children achieved Proficiency Level 8) at the four time points and Word-Reading Proficiency (a binary variable indicating whether a child had a low or high Word-Reading Proficiency) in the first grade. First-grade Word-Reading Proficiency (the reference category is the high-Word-Reading-Proficiency group) was very slightly positively and significantly related to Reading-Comprehension Proficiency at each grade, though several correlation coefficients were nearly negligible and the remaining correlations were modest ($r_\phi = 0.07$ to 0.39). Most noticeable in Table 4.3 (column 2) was that the correlation between first-grade Word-Reading Proficiency and Reading-Comprehension Proficiency increased substantially after the first grade and stabilized at moderate levels across the third, fifth, and eighth grades. The highest magnitude of correlation coefficient was observed in the eighth grade ($r_\phi = 0.39$).

Significant positive relationships among the four time-points of Reading-Comprehension Proficiency were also found ($r_\phi = 0.05$ to 0.39), though again, they were either negligible or modest. In some cases, the statistical significance was likely due in part to the large sample size. The relatively low correlations of Reading-Comprehension Proficiency in the first grade with the
third, fifth, and eighth grades (column 2) indicated that attainment of Reading-Comprehension Proficiency in the spring of first grade had a weak relation with attainment of Reading-Comprehension Proficiency in the other grades. However, as shown in Table 4.3 (column 3), attainment of Reading-Comprehension Proficiency in the spring of third grade had a relation with attainment in the spring of fifth and eighth grades at least to a modest extent, as did attainment in the spring of fifth grade with attainment in the spring of eighth grade. The pattern indicates the possibility that an optimal level of word-reading ability has to develop before high-level reading-comprehension proficiency can be attained, which is supported by prior research. However, the pattern was likely an artifact of the measurement system—once reading reading-comprehension proficiency was attained, then it had to remain attained.

To assess collinearity, Table 4.4 presents correlation coefficients among the predictors and all control variables for the HGLM analyses. An examination of Phi correlation coefficients showed that there was a significantly negative but weak Phi correlation between Word-Reading Proficiency and Language Status ($r_\phi = -0.13$). That is, a larger portion of NE students than LM learners tended to attain high Word-Reading Proficiency in the first grade. Word-Reading Proficiency was, however, significantly and positively related to Female ($r_\phi = 0.13$), White ($r_\phi = 0.21$), and SES ($r_{point-biserial(p_b)} = 0.36$), indicating that Female, White, and higher SES were more likely to attain high Word-Reading Proficiency in the first grade than Male, other Race/ethnicity groups than White, and lower SES, respectively.

Language Status was significantly but moderately strongly and positively correlated with Hispanic ($r_\phi = 0.39$) and Asian/Pacific Island and Others ($r_\phi = 0.29$), reflecting that LM learners in the present study tended to be Hispanic and Asian/Pacific Island and Others. Language status
was weakly but significantly negatively related to SES ($r_{pb} = -0.19$), indicating that LM learners tended to be described with lower SES.

It is worth noting that the subgroups of Time to Oral English-Language Proficiency were significantly correlated with Language Status and Word-Reading Proficiency variables. The correlations with Language Status in Table 4.4 indicated that only a subgroup of children who were fully proficient in oral English proficiency at kindergarten entry was strongly significantly negatively related to LM learners ($r_{φ} = -0.70$), whereas remaining subgroups of children who became proficient in oral English proficiency during the kindergarten and first-grade years were modestly significantly positively correlated with LM learners ($r_{φ} = 0.14$ to $0.40$). The preceding correlation patterns were expected because LM learners tended to attain oral English-language proficiency later than earlier, while NE students were orally proficient at kindergarten entry.

The correlations of Time to Oral English-Language Proficiency with Word-Reading Proficiency in Table 4.4 also suggested that among the five subgroups of Time to Oral English-Language Proficiency, a subgroup of children who were not identified as needing the oral proficiency test at kindergarten entry was significantly positively, but weakly, related to high Word-Reading Proficiency ($r_{φ} = 0.13$), while other subgroups of children who gained oral English proficiency during the kindergarten and first-grade years were weakly negatively related to high Word-Reading Proficiency ($r_{φ} = -0.14$ to $-0.05$). That is, children will full oral English-language proficiency earlier were more likely to attain high Word-Reading Proficiency in the first grade than others who gained oral English-language proficiency later.

The subgroup of children with fully proficient at kindergarten entry was significantly positively correlated with White ($r_{φ} = 0.41$), Black ($r_{φ} = 0.12$), and SES ($r_{pb} = 0.19$), indicating that White, Black, and higher SES were more likely to arrive in kindergarten with full oral
English proficiency as compared to Hispanic, Asian/Pacific Island and Others, and lower SES, respectively.

Given the significantly correlated multiple control variables and predictor, potential multicollinearity problems were tested using a tolerance and Variance Inflation Factor (VIF). As a rule of thumb, tolerance values less than 0.1 and VIF values above 10 indicate the presence of the multicollinearity effect (Myers, 1990). The tolerance values of all variables were greater than 0.1 and the VIF values ranged between 1.03 and 1.88, indicating that there were no problematic multicollinearity conditions and that the subsequent HGLM analyses and interpretations could be considered to be reasonably robust.

**Selecting a Functional Form for Growth**

Three unconditional growth models (Model A, B, and C in Table 4.5) were estimated to determine a functional form of growth (i.e., linear versus quadratic growth) in the probabilities of achieving Reading-Comprehension Proficiency between the spring of first grade and eighth grade. Relative model fit was assessed by comparing the \(-2\log\text{ likelihood} (-2\text{LL})\) statistics of competing, nested models (Snijders & Bosker, 1999). Note that in describing results of HGLM analyses the phrase “the probability of achieving Reading-Comprehension Proficiency” is used throughout. As described in The HGLM Analysis section in Chapter 3, in the HGLM analysis, the dichotomous dependent variable is transformed into log-odds (i.e., logit; the natural log of the odds of the dependent variable occurring or not), so that estimates of coefficients represent changes in log-odds of the dependent variable as opposed to the changes in the dependent variable itself. To facilitate interpretation, therefore, the results of the analysis are reported in the form of (a) odds ratios, converted from the coefficients using the exponential function; and (b) predicted probabilities, converted from the log-odds coefficients through a logit-link function.
Unconditional Means Model (Model A)

The first model to fit was an unconditional means model (Model A) without any predictor variables. The purpose for fitting Model A was to examine whether systemic variation existed within children ignoring time. Table 4.5 shows the results of fitting Model A to the current data. The average baseline odds ratio for achieving Reading-Comprehension Proficiency was statistically significantly different from zero ($p < .001$), which indicated that there was adequate variation to warrant further analysis. The Intraclass Correlation Coefficient (ICC; which uses $\pi^2/3$ as the within-group variance in multilevel logit models) was estimated as 0.074, indicating that 7.4% of the total variation in achieving Reading-Comprehension Proficiency was attributable to difference between children.

Unconditional Linear Growth Model (Model B)

The next step was to estimate an unconditional growth model (Model B) by taking into account only a linear growth factor (i.e., child’s age in months) as a predictor at the level-1 submodel. The results of Model B (see Table 4.5) indicated that the fixed effects (i.e., intercept [initial status] and instantaneous growth rate [initial velocity]) were significantly different from zero ($p < .001$).

With time included as a fixed effect, the ICC accounting for linear growth was calculated. The ICC was estimated as 0.451 suggested that 45.1% of the total variation in achieving Reading-Comprehension Proficiency was due to between-individual differences across time.

Unconditional Quadratic Growth Model (Model C)

The third unconditional model to fit was an unconditional quadratic growth model (Model C) that included both a linear and quadratic growth term as level-1 predictors. Although Model B was found to be a better model fit than Model A, the graphical representation (see
Figure 4.2) captured a potential quadratic trend. Thus a growth model with a quadratic factor was further examined to determine the growth rates of the probabilities of achieving Reading-Comprehension Proficiency over time. The results for the unconditional quadratic growth model (Model C in Table 4.5) revealed that the fixed effects (i.e., intercept, instantaneous growth rate, and acceleration/deceleration rate) were all statistically significant ($p < .001$).

The results for Model C indicated that the estimated odds ratio of achieving Reading-Comprehension Proficiency for overall sample in the spring of first grade was 0.009 ($p < .001$), corresponding to the estimated probability of $0.009/(1 + 0.009) = 0.009$. That is, as a whole, approximately 1.0% of children in the sample were likely to achieve Reading-Comprehension Proficiency in the spring of first grade. The positive coefficient associated with the instantaneous growth rate ($\gamma_1 = 0.14$, OR [Odds Ratio] = 1.15, 95% = 1.15 to 1.15, $p < .001$) and the negative coefficient associated with the acceleration/deceleration rate ($\gamma_2 = -0.001$, $p < .001$) indicated that the probability that children achieved Reading-Comprehension Proficiency initially increased, but the growth rate of the probability decelerated by the spring of eighth grade.

The ICC was estimated as 0.483 suggesting that 48.3% of the total variation in Reading-Comprehension Proficiency was due to between-individual differences across time. As compared to 7.4% and 45.1% of the variance was explained by differences between children in Model A and B, respectively, Model C provided a better estimate of the proportion of variance in Reading-Comprehension Proficiency that was attributable to variation between children. The random effects information from the variance component analysis indicated that there were statistically significant variability in the log-odds of achieving Reading-Comprehension Proficiency ($\tau_0 = 1.12$, $SE = 0.003$, $p < .001$).
Model Comparisons

In comparing Model A (deviance = 11,722,700.2, 1 parameters) to Model B (deviance = 8,561,193.6, 2 parameters), the Wald test, Akaike information criterion (AIC), and Bayesian information criterion (BIC) were performed to assess whether a reduction in deviance given an additional parameter contributed to significant improvement in the fit of the model. The results of the Wald test ($\chi^2[1] = 1.4e+06, p < .0001$), AIC, and BIC (see Table 4.5) indicated that an inclusion of a linear growth term in Model B significantly led to a better model fit.

However, in comparing Model B to Model C (deviance = 8,212,451.6, 3 parameters), the results for the Wald test ($\chi^2[1] = 2.8e+05, p < .0001$), AIC, and BIC suggested that an inclusion of the quadratic growth term in Model C resulted in a statistically significant improvement in the fit of the model. Therefore, a quadratic function of time was determined as the best representation of growth for the data.

HGLM Final Analyses Results

In the following sections, I first report results for the research question on the interaction effect of child’s Language Status and Word-Reading Proficiency on Reading-Comprehension Proficiency growth. Recall that Reading-Comprehension Proficiency growth refers to growth of the probability of achieving Reading-Comprehension Proficiency (ECLS-K reading Proficiency Level 8). The follow-up examination of the main effects of the two predictor variables (i.e., Language Status and Word-Reading Proficiency) was accomplished in order to assess whether the main effects held in the face of a significant interaction. The effects of the control variables included in the HGLM model are also presented. To examine the interaction and main effects, a conditional growth model (i.e., Model D) was estimated. Model D, the final full model, included the interaction effect between child’s Language Status and Word-Reading Proficiency, main
effects of each of the two preceding variables, and a set of control variables (i.e., Gender, Race/ethnicity, SES, and Time to Oral English-Language Proficiency) on the intercept (initial status), instantaneous growth rate (linear slope), and acceleration/deceleration rate (quadratic slope) parameters in the level-2 submodel.

Is the Relationship between First-Grade Word-Reading Proficiency and Reading-Comprehension-Proficiency Growth through Eighth Grade Different for LM Learners as Compared to Their NE Peers?

Interaction effects of Language Status and Word-Reading Proficiency. The relationship between Word-Reading Proficiency and Reading-Comprehension-Proficiency growth significantly varied according to children’s Language Status. The statistical results for Model D are provided in Table 4.5. The results of the fixed-effects estimation of Model D revealed that the interaction term had a statistically significant effect on the intercept ($OR = 0.54$, $p < .001$), a small but statistically significant effect on instantaneous growth rate ($OR = 1.01$, $p < .001$), and a small but statistically significant effect on acceleration/deceleration rate ($OR = 0.99$, $p < .001$) for the probability that children achieved Reading-Comprehension Proficiency, holding all else constant. It should be noted that the odds ratios of instantaneous growth rate and acceleration/deceleration rate, close to 1.00, indicated small interaction effects possibly due to the large sample size and the unit of measurement of the binary independent variable. Practical significant may be further gleaned from visualization of the growth trajectories and from the subgroup proportions. The growth trajectories of the probability of achieving Reading-Comprehension Proficiency for the four subgroups of children were estimated and plotted based on the final model (Figure 4.3). The trajectories in combination with the results of the descriptive statistics for proportion of students attaining proficiency (i.e., Table 4.1) are
explained and discussed in the following sections, where the practical significance of the interaction effect is also emphasized.

On the whole, better Word-Reading Proficiency at the start promotes greater growth in Reading-Comprehension Proficiency. In the spring of first grade, there were only slight, but statistically significant, differences across the four groups in the probability of achieving Reading-Comprehension Proficiency, but variation in the instantaneous growth rates and acceleration/deceleration rates across groups was apparent. On the whole, when children’s demographic backgrounds and Time to Oral English-Language Proficiency test were controlled for, children who began first grade with higher Word-Reading Proficiency, regardless of Language Status, made better Reading-Comprehension Proficiency progress than did children who began with lower Word-Reading Proficiency. As shown in Figure 4.3, the top two groups (high Word-Reading Proficiency groups) outperformed the bottom two groups (low Word-Reading Proficiency groups) from first-grade through eighth grade. The results of the descriptive statistics in Table 4.1 also support the practical significance. Children with high Word-Reading Proficiency made noticeably greater increase from the spring of first grade to eighth grade (as shown in column three, the predicted probabilities of 0.02 to 0.81, respectively) relative to children with low Word-Reading Proficiency (as shown in column two, the predicted probabilities of 0.00 to 0.37, respectively). In short, better word-reading ability at the start was important, regardless of language status.

However, early Word-Reading Proficiency was especially beneficial for LM learners. On the whole, for LM children who began with relatively high Word-Reading Proficiency, Reading-Comprehension Proficiency nearly approached that of NE students with initially high Word-Reading Proficiency throughout the years, and the Language Status gap was closed by the
spring of eighth grade when the predicted probabilities of achieving Reading-Comprehension Proficiency were 0.81 for both LM learners and NE students (see Table 4.1).

To elaborate, when the two groups of children with high Word-Reading Proficiency—children in the LM-High and NE-High groups (the top two, depicted by the dashed and solid lines, respectively, in Figure 4.3)—were compared, the positive effect of high Word-Reading Proficiency was particularly strong for NE students, predominantly between the spring of first grade and fifth grade. Children in the NE-High not only had a significantly higher predicted probability of achieving Reading-Comprehension Proficiency in the spring of first grade, but also showed an initially faster instantaneous growth rate than did children in the LM-High group. Table 4.1 also shows that across the spring of the first, third, and fifth grades, children in the NE-High made slightly more increases in the probability of achieving Reading-Comprehension Proficiency (0.02, 0.39, and 0.57, respectively) as compared to children in the LM-High (0.01, 0.27, and 0.40, respectively). However, beginning around the spring of fifth grade, children in the NE-High group had a greater deceleration rate than those in the LM-High group. By the spring of eighth grade, thus, children in the LM-High group caught up with the predicted probability for children in the NE-High group by narrowing the gap. Although the effect of Language Status was negligible by the eighth grade among children with initially high Word-Reading Proficiency, from a practical standpoint, it is important to note that children in the LM-High group lagged behind those in the NE-High group for many years.

On the other hand, LM learners who began with lower Word-Reading Proficiency were at a disadvantage compared to their NE peers. Their growth progression departed from their NE peers, fanning out rather than closing in. To elaborate, for the two groups of children who had the lowest Word-Reading Proficiency—children in the LM-Low and NE-Low groups (the
bottom two, depicted by dotted and dash-dot lines, respectively, in Figure 4.3), acceleration rates were substantially different. The trajectories of both groups showed a similarly slow and consistent growth rate between the spring of first grade and third grade, and were virtually indistinguishable each other by the spring of third grade. However, as children in NE-Low group showed a slightly faster rate of acceleration relative to that of children in the LM-Low group beginning around the spring of third grade, the trajectory lines for both groups started to separate from each other, which led to a divergence in the trajectories by the spring of eighth grade. Table 4.1 also provides further information corroborating the visualization in Figure 4.3. Note that children with the LM-Low on the whole made slower progress than their peers in the NE-Low from first through eighth grade, with the proportion of students achieving proficiency somewhat consistently lower throughout the grades. In the spring of eighth grade, the predicted probabilities of achieving Reading-Comprehension Proficiency for children in the LM-Low and NE-Low groups were approximately 0.36 and 0.41, respectively (see columns five and eight in Table 4.1). Therefore, although the interaction effect for instantaneous growth rate and acceleration/deceleration rate was very small, the effect was notable and practically important.

**Main effects of Language Status and Word-Reading Proficiency.** There was a significant main effect for Language Status, but it did not hold true for the intercept, instantaneous growth rate, and acceleration/deceleration rate of Reading-Comprehension-Proficiency attainment in the face of the significant interaction effect. As shown in Figure 4.3, in the spring of first grade, both LM learners and NE students who were in the low Word-Reading-Proficiency group began with the same intercept. That is, it is not true that, on the whole, one language group outperformed the other.
Turning to instantaneous growth rate, again, for children in the low Word-Reading-Proficiency group, the instantaneous growth rate appeared to be nearly identical. That is, it is not true that, on the whole, one language group outperformed the other.

As for acceleration/deceleration rate, the pattern of curvature for the two Language-Status groups was also conditioned by Word-Reading-Proficiency group affiliation. For children in the high Word-Reading-Proficiency group, NE students started to decelerate earlier than LM learners, while for children in the low Word-Reading-Proficiency group, NE students started to accelerate more sharply than LM learners. Therefore, it is not true that, on the whole, one language group outperformed the other for acceleration/deceleration.

A significant main effect was also found for Word-Reading Proficiency, but it held true only for the intercept and instantaneous growth rate but not for acceleration/deceleration rate. As shown in Figure 4.3, in the spring of first grade, regardless of Language Status, children with high Word-Reading Proficiency outperformed those with low Word-Reading Proficiency, and they also had a greater instantaneous growth rate than their counterparts. As for acceleration/deceleration rate, however, the two Word-Reading-Proficiency groups exhibited different curvatures in that children in the high Word-Reading-Proficiency group showed a deceleration in growth, while those with low Word-Reading Proficiency displayed an acceleration.

**Main effects for the control variables.** Although the control variables included in the final model (i.e., children’s Gender, Race/ethnicity, SES, and Time to Oral English-Language Proficiency) were not of interest in the current study, significant results for associations between control variables and outcomes are explained in the following sections.
**Gender.** There were significant differences between female and male children, favoring females in the intercept \((OR = 0.80, \ p < .001)\), instantaneous growth rate \((OR = 1.02, \ p < .001)\), and acceleration/deceleration rate \((OR = 0.99, \ p < .001)\) for the probabilities of achieving Reading-Comprehension Proficiency, when controlling for other variables in the final HGLM model. Specifically, the odds ratio of achieving Reading-Comprehension Proficiency for female children in the spring of first grade was 0.80 (95% CI = 0.79, 0.81), which was less than 1.0, such that female children were 1.25 times less likely \((1/0.80 = 1.25)\) than male children to achieve Reading-Comprehension Proficiency in the spring of first grade. The odds ratios for instantaneous growth rate and acceleration/deceleration rate for female children were 1.02 (95% CI = 1.02, 1.02) and 0.99 (95% CI = 0.99, 0.99), respectively, which indicated that female children exhibited greater instantaneous growth rate but a slightly slower rate of deceleration as compared to male children. The predicted probabilities of achieving Reading-Comprehension Proficiency in the spring of eighth grade for female and male children were approximately 0.73 and 0.62, respectively.

In summary, the growth trajectories significantly varied between female and male children. Although female children, on average, started with slightly lower probability to achieve Reading-Comprehension Proficiency than male children, female children gained Reading-Comprehension Proficiency at a faster rate relative to male children during the elementary and middle school years such that female children outperformed male children by the spring of eighth grade.

**Race/ethnicity.** Each of the racial/ethnic groups—Black, Hispanic, and Asian/Pacific Islander/Other children—was compared with White children (a reference group). When Black and White children were compared, statistical differences between the two groups were found in
the intercept \( OR = 0.29, p < .001 \), and instantaneous growth rate \( OR = 1.004, p < .001 \), but not in acceleration/deceleration rate \( OR = 1.00, p = 0.42 \), in the probabilities of achieving Reading-Comprehension Proficiency. The odds ratio of achieving Reading-Comprehension Proficiency for Black children in the spring of first grade was 0.29 (95% CI = 0.29, 0.30), indicating that Black children were 3.45 times less likely \( (1/0.29 = 3.45) \) than White children to achieve Reading-Comprehension Proficiency. The odds ratio for instantaneous growth rate, 1.004 (95% CI = 1.002, 1.005), suggests that Black children exhibited linear increase at a greater rate than White children. No difference was found between the two groups in decelerating growth rate. Despite the sharper increase for Black children, the gap between the two groups continued to widen by the spring of eighth grade with the predicted probabilities of 0.45 and 0.75 for Black and White children, respectively.

A comparison between Hispanic and White children indicated that Hispanic children were statistically different from White children in the intercept \( OR = 0.35, p < .001 \), instantaneous growth rate \( OR = 1.02, p < .001 \), and acceleration/deceleration rate \( OR = 0.99, p < .001 \). Specifically, the odds ratio of achieving Reading-Comprehension Proficiency for Hispanic children in the spring of first grade was 0.35 (95% CI = 0.34, 0.37), indicating that Hispanic children were 2.86 times less likely \( (1/0.35 = 2.86) \) than White children to achieve Reading-Comprehension Proficiency in the spring of first grade. The odds ratios for instantaneous growth rate and acceleration/deceleration rate for Hispanic children were 1.02 (95% CI = 1.02, 1.02) and 0.99 (95% CI = 0.99, 0.99), respectively, which indicated that Hispanic children displayed linear increase at a slightly higher rate followed by a slower rate of deceleration as compared to White children. Despite the higher instantaneous growth rate for Hispanic children, the gap between the two groups remained consistent by the spring of eighth
grade with the predicted probabilities of 0.59 and 0.75 for Hispanic and White children, respectively.

Asian/Pacific Islander/Other children were also statistically different from White children in the intercept ($OR = 0.74, p < .001$), instantaneous growth rate ($OR = 0.99, p < .001$), and acceleration/deceleration rate ($OR = 1.00004, p < .001$). The odds ratio of achieving Reading-Comprehension Proficiency for Asian/Pacific Islander/Other children in the spring of first grade was 0.74 (95% CI = 0.29, 0.30), indicating that Asian/Pacific Islander/Other children were 1.35 times less likely ($1/0.74 = 1.35$) than White children to achieve Reading-Comprehension Proficiency in the spring of first grade. The odds ratios for instantaneous growth rate and acceleration/deceleration rate for Asian/Pacific Islander/Other children were 0.99 (95% CI = 0.99, 0.99) and 1.00004 (95% CI = 1.00003, 1.00005), respectively, which indicated that Asian/Pacific Islander/Other children displayed linear increase at a slightly lower rate followed by a faster rate of deceleration as compared to White children. The predicted probability in the spring of eighth grade for Asian/Pacific Islander/Other children was 0.73 such that they tended to catch up to White children by the end of eighth grade.

In summary, in the spring of first grade, on average, all three racial/ethnic groups—Black, Hispanic, and Asian/Pacific Islander/Other children—had significantly lower levels of Reading-Comprehension Proficiency than White children. Asian/Pacific Islander/Other children were the only racial/ethnic group that showed increasingly steady growth and narrowed the gap with White children by the spring of eighth grade, whereas disparities still existed between Black and Hispanic children and White children.

**SES.** Children’s SES had a statistically significant effect on the intercept ($OR = 1.52, p < 0.001$), instantaneous growth rate ($OR = 1.01, p < 0.001$), and acceleration/deceleration rate ($OR
More specifically, the significant odds ratio of the intercept \((OR = 1.52, p < 0.001)\) implied that a one-standard deviation increase in SES was associated with a 1.52-fold increase in the odds of achieving Reading-Comprehension Proficiency in the spring of first grade. In other words, a one-standard deviation change in SES yielded more than a 40% (a log-odds of 0.42) increase in the predicted probability of achieving Reading-Comprehension Proficiency in the spring of first grade. The odds ratios for instantaneous rate of change and acceleration/deceleration rate were 1.01 (95% CI = 1.01, 1.01) and 0.99 (95% CI = 0.99, 0.99), respectively, which implied that children from higher SES families had a slightly greater instantaneous growth rate than those from lower SES families in the probability of achieving Reading-Comprehension Proficiency, but the former group showed a relatively slower rate of deceleration.

In summary, children’s SES was significantly and positively related to Reading-Comprehension Proficiency attainment across time. Children from higher SES were not only more likely to achieve Reading-Comprehension Proficiency in the spring of first grade, but all other things being equal, also continued to achieve at higher growth rates across time.

**Time to Oral English-Language Proficiency.** Finally, the four groups of children categorized according to Time to Oral English-Language Proficiency were compared with a reference group of children who were not identified as needing the oral proficiency test at kindergarten entry.

When the first group of children (i.e., children who gained proficiency by the fall of kindergarten) was compared with the reference group, there were statistical differences between the two groups in the intercept \((OR = 0.82, p < .001)\), instantaneous growth rate \((OR = 1.01, p < .001)\), and acceleration/deceleration rate \((OR = 0.99, p < .001)\) for the probabilities of
achieving Reading-Comprehension Proficiency. The odds ratio of achieving Reading-Comprehension Proficiency for the first group in the spring of first grade was 0.82 (95% CI = 0.78, 0.86), indicating that the first group of children was 1.22 times less likely (1/0.82 = 1.22) than the reference group to achieve Reading-Comprehension Proficiency. The odds ratios for instantaneous rate of change and acceleration/deceleration rate for the first group were 1.01 (95% CI = 0.01, 0.02) and 0.99 (95% CI = 0.99, 0.99), respectively, which indicated that the first group of children showed a faster rate of increase at an earlier time point and a slower rate of deceleration than did the reference group.

A comparison of the second group of children (i.e., children who gained proficiency by the spring of kindergarten) with the reference group shows that a statistical difference between the two groups was found only in the intercept (OR = 0.81, p < .001), but not in the instantaneous growth rate (OR = 1.00, p = .19) and acceleration/deceleration rate (OR = 1.00, p = .06) for the probabilities of achieving Reading-Comprehension Proficiency. Specifically, the odds ratio of achieving Reading-Comprehension Proficiency for the second group in the spring of first grade was 0.81 (95% CI = 0.75, 0.86), indicating that the second group of children was 1.23 times less likely (1/0.81 = 1.23) than the reference group to achieve Reading-Comprehension Proficiency in the spring of first grade. However, there was no significant difference between the two groups in growth rates across time.

In a comparison between the third group (i.e., children who gained proficiency by the fall of first grade) and the reference group, a statistically significant difference were found between the two groups in the intercept (OR = 2.27e-19, p < .001), instantaneous growth rate (OR = 4.11, p < .001), and acceleration/deceleration rate (OR = 0.99, p < .001). The odds ratio of achieving Reading-Comprehension Proficiency for the second group in the spring of first grade was 2.27e-
The odds ratios for instantaneous growth rate and acceleration/deceleration rate for the first group were 4.11 (95% CI = 3.69, 4.59) and 0.99 (95% CI = 0.99, 0.99), respectively, indicating that the third group of children showed a faster rate of increase at an earlier time point and a slower rate of deceleration than did the reference group.

Comparing the fourth group of children (i.e., children who gained proficiency by the spring of first grade) with the reference group revealed that the two groups were significantly different in the intercept ($OR = 1.22$, $p < .001$), instantaneous growth rate ($OR = 0.99$, $p < .001$), and acceleration/deceleration rate ($OR = 0.99$, $p < .001$). The odds ratio of achieving Reading-Comprehension Proficiency for the fourth group in the spring of first grade was 1.22 (95% CI = 0.78, 0.86), indicating that, interestingly, the fourth group of children was 1.22 times more likely than the reference group to achieve Reading-Comprehension Proficiency in the spring of first grade. However, the odds ratios for instantaneous growth rate and acceleration/deceleration rate for the fourth group, 0.99 (95% CI = 0.99, 0.99) and 0.99 (95% CI = 0.99, 0.99), respectively, indicating that the fourth group of children had a slower instantaneous growth rate as well as a slower rate of deceleration across time as compared to the reference group.

Taken all together, differences in the probability of achieving Reading-Comprehension Proficiency in the spring of first grade and growth rates varied across all Time to Oral English-Language Proficiency subgroups. Compared to children who were fully proficient in oral English at kindergarten entry, those who became proficient throughout the kindergarten year and in the fall of first grade were less likely to achieve Reading-Comprehension Proficiency in the spring of first grade but tended to show faster growth rates by the end of eighth grades. However, surprisingly, children who acquired oral English proficiency by the end of first grade had a higher probability of achieving Reading-Comprehension Proficiency in the spring of first grade.
grade as compared to those with full oral English proficiency at kindergarten entry, whereas they had significantly slower growth rates than their peers who entered kindergarten with initially full oral English proficiency.

**Summary of the Main Finding**

The main conclusion was that the relationship between early Word-Reading Proficiency and Reading-Comprehension Proficiency growth was different for LM learners as compared to their NE peers, when children’s gender, race/ethnicity, SES, and oral English proficiency were controlled for. On the whole, children with initially high Word-Reading Proficiency demonstrated more growth than children with initially low Word-Reading Proficiency, but the effect of initial Word-Reading Proficiency was especially impactful for LM learners as compared to NE students.

Language-minority learners and NE students with low Word-Reading Proficiency began at a similar, but statistically significantly different, level of Reading-Comprehension Proficiency attainment in the spring of first grade. However, LM learners with low Word-Reading Proficiency had a significantly slower initial growth of Reading-Comprehension Proficiency followed by a lower rate of acceleration than NE students with low Word-Reading Proficiency such that their growth trajectory was diverged from that of NE peers, leading to a large gap between the two groups by the end of eighth grade.

In contrast, for LM learners and NE students who had high Word-Reading Proficiency in the spring of first grade, the picture was quite different. Children with high Word-Reading Proficiency started out with a slightly higher level of Reading-Comprehension Proficiency attainment and showed a faster initial increase followed by a deceleration pattern as compared to those who had low Word-Reading Proficiency. Particularly noticeable was that among children
who had initially high Word-Reading Proficiency, LM learners started at a slightly lower level of Reading-Comprehension Proficiency attainment than NE students, but Reading-Comprehension Proficiency growth trajectories of the two groups converged over time so that LM learners caught up with their counterparts by the end of eighth grade.
CHAPTER 5
CONCLUSION AND DISCUSSION

In the present chapter, the main conclusion drawn from the study is presented and discussed. The chapter is divided into five sections. First, the main study conclusion is described. The current study’s limitations are discussed next. The next section offers a discussion of possible meanings of the conclusion and findings. Finally, implications related to the conclusion and findings are suggested for classroom instruction, theory, and research.

Conclusion

The main conclusion was that the relationship between early Word-Reading Proficiency and Reading-Comprehension Proficiency growth was different for language-minority (LM) learners as compared to their native-English-speaking (NE) peers, when children’s gender, race/ethnicity, socioeconomic status (SES), and time to pass oral English-language proficiency were taken into account. On the whole, children with initially high Word-Reading Proficiency demonstrated more growth than children with initially low Word-Reading Proficiency, but the effect of initial Word-Reading Proficiency was especially impactful for LM learners as compared to NE learners.

Specifically, LM learners with initially high Word-Reading Proficiency had relatively lower Reading-Comprehension Proficiency than their NE peers with high Word-Reading Proficiency in first grade, but Reading-Comprehension Proficiency growth trajectories of the two groups converged by the end of eighth grade. In contrast, as compared to NE students with low Word-Reading Proficiency, LM learners with initially low Word-Reading Proficiency had a
relatively lower Reading-Comprehension Proficiency in first grade, slower initial growth, and less acceleration over time, thereby leading to a large gap between the two groups by the end of eighth grade.

**Limitations**

The present study has several limitations to be acknowledged. The major limitations are inherent in the nature of using secondary data. First, while the ECLS-K data offers a broad view of the population and nationally representative trends, no information was available to determine students’ native-language reading ability. Second, the sample for the present study consisted of LM learners who had passed an oral English proficiency assessment in first grade. Consequently, the results are relevant to similar students rather than to the LM learner population in general. Third, as is typical in studies of school-aged LM learners in the U.S., the vast majority of LM learners was from Spanish-speaking backgrounds. However, the Early Childhood Longitudinal Study (ECLS-K) sample was obtained to represent LM learners and ethnic groups in proportion to the population.

**Discussion**

In the following sections of the current chapter, the major study findings are first discussed. Next, a discussion of the control variables is presented.

**The Relationship between Early Word Reading and Reading Comprehension Growth: The Moderating Effect of Language Status**

The current study is among the first to examine the association of early English-word reading with English-reading comprehension growth for a large sample of LM learners and NE students from first through eighth grade. The findings of the current study about the predictive power of early word-reading ability on reading comprehension development not only converged with substantial prior research conducted with monolingual children (e.g., Carr, Brown, Vavrus,
& Evans, 1990; Cunningham & Stanovich, 1997; Juel, 1988; Snow, Porche, Tabor, & Harris, 2007; Vellutino, Tunmer, Jaccard, & Chen, 2007), but also provided equally strong support for the importance of early word-reading ability for LM learners as a foundation for second-language reading-comprehension development through the elementary and middle school grades.

The interaction effect between children’s language status and early word-reading ability adds to a growing literature on LM learners’ reading performance as compared to monolingual students’ performance. First, the present study suggested that selected prior findings may be moderated by early word-reading ability. Previous comparative studies reported LM learners’ substantially lower performance than NE peers’ performance on reading comprehension outcomes (Gottardo & Mueller, 2009; Hutchinson, Whiteley, Smith, & Conors, 2003; Lesaux, Koda, Siegel, & Shanahan, 2006, for a review). However, the current study results suggested that for LM learners who have developed strong English-word reading skills by first grade, LM learners had opportunities to facilitate reading comprehension development and catch up their NE peers who also have strong initial word-reading skills by the end of middle school. That was the case despite their lesser exposure to English at home or community as compared to NE students. In contrast, LM learners who did not reach a sufficient level of word-reading skills in first grade had persistent and growing disparities in English-reading comprehension as compared to NE students through the course of the elementary and middle school grades.

Recall that all of the LM learners in the current sample developed a sufficient level of oral English proficiency by first grade to participate in English-reading assessment. Even children with initially low Word-Reading Proficiency had passed the oral English proficiency cut score. Thus, LM learners who had low Word-Reading Proficiency and who did not pass the oral
English proficiency test in first grade might have experienced more delay in reaching reading comprehension proficiency.

Second, the current findings are only partially consistent with previous research evidence that LM learners and NE peers demonstrated more similarities rather than differences when long-term reading comprehension growth patterns between the two populations was compared (e.g., Chiappe, Glaeser, & Ferko, 2007; Fitzgerald, Amendum, & Guthrie, 2008; Lesaux & Siegel, 2003; Proctor, Carlo, August, & Snow, 2005; Weber & Longhi-Chirlin, 2001). In the present study, the similarities in growth trajectories of reading comprehension between LM learners and NE counterparts were evident only when the two populations initially had comparable and similar profiles in early word-reading ability. Specifically, consistent with the findings from the two previous studies in which LM learners’ English-reading comprehension growth was modeled in a relatively shorter period of time (e.g., Mancilla-Martinez et al., 2011; Nakamoto et al.’s, 2007), the decelerating quadratic growth patterns (i.e., initial linear increase followed by a gradual deceleration) were observed in the current study among LM learners as well as NE students. However, that was only in case when both LM learners and NE students had initially high Word-Reading Proficiency in first grade.

In evaluating whether the cumulative growth model or the developmental lag model best characterized the growth trajectories of reading-comprehension proficiency, the findings indicate that different developmental patterns of reading comprehension growth may result as a function of children’s word-reading ability in first grade and their language status, partially supporting both models. First, the growth patterns comparing children with initially high Word-Reading Proficiency and those with initially low Word-Reading Proficiency, regardless of language status, provided support for the developmental lag model in Reading-Comprehension Proficiency
growth over time. That is, despite the appearance of early increasing gaps between the two word-reading-proficiency groups, the initial differences between the two groups gradually decreased as children with low Word-Reading Proficiency gradually escalated to acquire Reading-Comprehension Proficiency and began to approach those with high Word-Reading Proficiency through by the end of eighth grade.

Second, the pattern of the developmental lag model was also found in comparing the growth trajectories of LM learners and NE students who had initially high Word-Reading Proficiency. LM learners with high Word-Reading Proficiency had relatively lower Reading-Comprehension Proficiency attainment in the spring of first grade, but they caught up and closed the gap with NE students who had initially high Word-Reading Proficiency by the end of eighth grade, although it took some time for them to do it. A plausible explanation for the lag through fifth grade may be that LM learners’ oral and academic English proficiency was insufficiently advanced to bring them to the level of their peers—until eighth grade, but LM learners’ initially high level of word-reading ability in English became increasingly salient for success in reading-comprehension development in later years. The lag has practical significance in that educators might be especially cautious in their expectations for rapid comprehension growth advancement for LMs with high Word-Reading Proficiency.

Finally, in contrast, when describing the developmental patterns of reading comprehension among LM learners and NE students who had initially low Word-Reading Proficiency, the cumulative growth model was most applicable. Again, both groups followed the similar accelerating trend, but LM learners with low Word-Reading Proficiency had significantly lower Reading-Comprehension Proficiency in first grade and fell increasing further behind NE learners with low Word-Reading Proficiency.
Comparing the LM Learners’ Relationship between Early Word Reading and Comprehension Growth to Prior Findings

Only one prior study addressed the relationship of early word reading to comprehension growth—though only for middle grades. Several comparisons can be made for selected findings from the present study to the Mancilla-Martinez and colleagues’ study of middle-school Spanish-speaking LM learners’ English-reading comprehension growth in relation to initial word reading.

First, in the current study and Mancilla-Martinez and colleagues’ (2011) study, early word reading was related to comprehension at each time point where comprehension was measured. Second, however, findings from the two studies diverged about the relationship between word reading and reading comprehension growth. Specifically, in the present study, LM learners’ first-grade word-reading proficiency was significantly associated with reading comprehension growth, such that LM learners with initially high word reading had different instantaneous rates of change and acceleration/deceleration in reading comprehension as compared to LM learners with initially low word reading. In contrast, Mancilla-Martinez and colleagues (2011) found no significant effect of word reading in fifth grade on reading comprehension growth rates across fifth and seventh grade. Thus in the prior study, the quadratic growth trajectories of reading comprehension for both LM learners with initially high and low word reading remained parallel throughout the middle school grades. The divergent results are likely due to three factors: (a) differences in range of ages studied, (b) sample demographics (native-Spanish only versus diverse LM subgroups), and (c) the relative importance of emergent word-reading ability versus word-reading ability in fifth grade.

The Relationship between Early Word Reading and Comprehension Growth, Regardless of Language Status
In the present study, for both language groups taken together, that is, irrespective of language status, the pattern of word-reading ability correlation with comprehension at each time point is similar to prior research results, but the relationship between early word reading and later comprehension growth is different. The correlation patterns in the present study revealed that initial word reading had a stronger correlation with reading comprehension in the later grades than in first grade and that the magnitudes of the correlation were sustained across time points was in line with prior longitudinal studies for monolingual children (e.g., Cain & Oakhill, 2011; Cain, Oakhill, & Bryant, 2004; Oakhill, Cain, & Bryant, 2003; Torgesen, Wagner, Rashotte, Burgess, & Hecht, 1997). However, the pattern stands in opposition to a few other research findings showing that the predictive power of early word-level reading on later reading comprehension declined among monolingual children (e.g., Abbott, Berninger, & Fayol, 2010; Hoover & Gough, 1990; Droop & Verhoeven, 2003; Verhoeven & van Leeuwe, 2008) and Spanish-speaking LM learners who only followed from fourth through fifth grade (e.g., Lesaux, Crosson, Kieffer, & Pierce, 2010). A possible explanation for the disparity between the research findings on the change in the relationship may be due to the variability in the age range of the sample and the nature of assessment for word reading and reading comprehension.

**The Effects of Control Variables**

There were also other findings associated with control variables that were not the primary focus of the current study but still warrant discussion. First, with respect to gender differences, the growth trajectories of Reading-Comprehension Proficiency attainment significantly varied between boys and girls. In the first grade, boys, on average, significantly but slightly lower probability to achieve Reading-Comprehension Proficiency than girls. The finding is consistent with previous studies indicating that school-age girls outscore boys in various aspects of reading
competence (e.g., Brophy, 1985; Denton & West, 2002; Diamond & Onwuegbuzie, 2004) although the evidence is not entirely consistent. Prior research has suggested a reason for the gender pattern differences—boys were found more affected than girls by level of interest of the texts (Anderson, Shirey, Wilson, & Fielding, 1987; Oakhill & Petrides, 2007) and motivation (Becker, McElvany, & Kortenbruck, 2010; Wigfield, Eccles, Schiefele, Roeser, & Davis-Kean, 2006). The extent to which that was true in the present study is not knowable.

Second, consistent with prior research on a race/ethnicity achievement gap in reading (e.g., Chatterji, 2006; Kainz & Vernon-Feagans, 2007; Lee, 2002), race/ethnicity in the current study was significantly related to Reading-Comprehension Proficiency growth. Although racial and ethnic differences in the reading achievement gap have been the subject of much discussion and controversy (Jencks & Phillips, 1998; Meece & Kurtz-Costes, 2001), the current study provides evidence that the early differences in Reading-Comprehension Proficiency across race/ethnicity categories were likely to persist over time.

Third, the effect of children’s family SES on Reading-Comprehension Proficiency growth over the eight years was substantial. Convergent with much of the research on the relationship between family SES and reading achievement in the general school-aged population (e.g., Aikens & Barbarin; 2008, Chatterji, 2006; Entwisle & Alexander, & Olson, 2005; Fryer & Levitt, 2004; Kaplan & Walpole, 2005; Perie, Grigg, & Donahue, 2005; Snow, Burns, & Griffin, 1998), the findings indicated that children of higher SES made greater gains in reading comprehension relative to those of lower SES over the course of elementary and middle school grades, such that the gap between high- and low-SES children continued to increase. One explanation is that children’s family income is closely associated with reading development because those from low SES families often have parents with lower education levels, lack of
home/family literacy experiences, and inadequate access to educational resources, leading to negatively reading performance (Cobo-Lewis, Pearson, Eilers, & Umbel, 2002; Goldenberg, 1987; Hus, 2001; McLoyd, 1998).

Finally, consistent with Kieffer’s (2008) results, the growth trajectories of Reading-Comprehension Proficiency varied across all Time to Oral English-Language Proficiency subgroups. Extending previous longitudinal study conducted with LM learners throughout the primary grades (e.g., Fitzgerald et al., 2015), the present study found that LM learners who acquired oral English proficiency throughout the kindergarten year and first grade as compared to those who were fully proficient in oral English at kindergarten entry continued a trend of slower growth in reading comprehension across the elementary and middle school years.

**Implications**

In the current section, implications are discussed for instruction, theory, and research.

**Implications for Instruction**

The findings of the present study have several important instructional implications. First, children’s levels of word-reading skills in the first grade can provide valuable information for screening purposes to predict difficulties in later reading-comprehension development. Language-minority learners who struggle with developing reading comprehension in the upper elementary and middle school years might be identified much earlier on a basis on their first-grade word reading. Accurate assessment to determine pertinent risk factors for later grades can occur in the first grade (Foorman, Francis, Fletcher, Schatschneider, & Mehta, 1998; Hurford, Potter, & Hart, 2002; O’Connor & Jenkins, 1999; Torgesen, Burgess, Wagner, & Rashotte, 1996). Although children with reading-comprehension deficits are usually identified based on their performance on comprehension measures, the findings from this study suggest that they
might be identified on the basis of their early poor word-reading skills rather than waiting to assess their comprehension (Mancilla-Martinex & Lesaux, 2010). That is, LM learners’ low levels of word reading by the end of first grade indicate that educators might be seriously concerned about corresponding reading comprehension outcomes in later grades.

A second practical implication is the emphasis on enhanced instructional opportunities for LM learners that focus on promoting strong word-reading skills in the first grade. In the absence of explicit and systematic instruction, arguably in word-level reading processes, children, in particular, LM learners, may experience substantial difficulties in developing sophisticated levels of reading comprehension in later grades.

Although the current study suggests that both LM learners and NE students who have similar initial word-level reading ability also show comparable reading-comprehension growth patterns, it does not mean that the two groups of children would respond to instruction or intervention to a similar extent (Lesaux & Kieffer, 2010). While children will benefit from early exposure and effective instruction, instruction may need to be modified and individualized rather than a one-size-fits-all approach (Connor, Morrison, & Katch, 2004; Fitzgerald, et al., 2015; Gutiérrez, Zepeda, & Castro, 2010). The current study suggests that for LM learners who had relatively lower word-reading skills in the first grade, their possible persistent exposure to instruction may not have been sufficient to accelerate their reading-comprehension growth. They were the most likely candidates for more intensive, systematic, and sustained reading instruction.

It is important to note that explicit and systematic reading instruction should be differentiated from “skill and drill” and/or skills-based scripted reading instruction in the early grades. In scripted reading instruction, practitioners tend to implement a scripted commercial
curriculum without making adjustments for the instructional needs of the children in the classroom (Allington, 2002; Dresser, 2012). Moreover, there is an over-emphasis on decodable text with little or no interaction with authentic materials. For the efficacy of explicit and systematic word-reading instruction, educators should address individual developmental differences and needs by using a variety of instructional materials and authentic tasks (McIntyre, Rightmyer, & Petrosko, 2008). Most importantly, children’s word reading instruction should be integrated with a broader comprehension-oriented approach to create a balanced reading instruction (National Reading Panel, 2000).

Ehri’s (1998, 2009) theory of sight word learning process for monolingual children provides influential and practical implications on teaching practices that could be applied to LM learners with low word-reading skills. The theory posits that children learn sight words through a connection-forming process between letters in spellings and sounds in pronunciations of the words in memory. The connection process involves knowledge of grapheme–phoneme relations, phonemic awareness, and spelling patterns. Once the connections are enhanced, children can build a sight vocabulary. However, the use of faulty strategies including the use of selective visual cues or a few sound-letter correspondences is often observed among readers. In those cases, practitioners may need to provide experiences for developing an awareness of systematic nature of sounds-letter relationships by analyzing words (Ehri, 1992; Perfetti, 1991). Once attention is adequate and consolidated through ample practices, children can develop knowledge of the form and function of words in text and apply their word knowledge to understanding the text (Gaskins, 1998).

In addition to instruction supporting children’s attention to word-level reading, attending to reading-comprehension instruction especially for low-word-reading-performing LM learners
is critical. Although research evidence about effective reading instruction for monolingual NE students can hold true for LM learners learning to read in English (Goldenberg, 2011), there are two additional factors to consider in instructional supports for LM learners: comprehension strategies and background knowledge. First, teachers need to provide opportunities for LM learners to engage in explicit comprehension strategy instruction. Children learning to read in second language tend to use fewer metacognitive strategies and more slowly monitor comprehension (Fitzgerald, 1995). Thus, it is important that metacognitive strategies should be discussed, modeled, and effectively implemented for those children through a wide range of activities, which in turn enables them to monitor and assess their on-going performance in understanding what is being read.

Second, for LM learners, it is especially important to provide relevant background knowledge about a topic to be read and discussed in reading instruction. LM learners coming from diverse educational and cultural backgrounds are more likely than their NE peers to have a lack of background knowledge necessary for understanding texts. LM learners’ prior educational experiences may also have been substandard or interrupted, resulting in difficulties with reading comprehension. Thus, teachers need to help LM learners activate their existing knowledge of a topic that is prerequisite for understanding the text and identify and fill the gaps to facilitate reading comprehension (Dochy, Segers, & Buehl, 1999).

**Implications for Theory**

Features of the present result tend to affirm aspects of prior theory. An important theoretical implication is that prior theory could be expanded to include young LM learners. Children who have the ability to read words quickly, accurately, and effortlessly possess greater mental resources that affect an individual’s cognitive processes involved in constructing a
representation of the meaning from text (e.g., Cain, Oakhill, & Bryant, 2004; Just & Carpenter, 1987; Perfetti, 1985, 1992; LaBerge & Samuels, 1974; Stanovich, 1994). In accordance with this theory, LM learners who had initially low word-reading proficiency may have experienced significant cognitive demands while allocating almost entire processing capacity toward decoding text with relatively little attention to reading comprehension or other higher-order processes. By contrast, those LM learners who had initially high word-reading proficiency may have increasingly reduced the cognitive load associated with lower-level processing skills (e.g., word identification) and utilized remaining cognitive resources for integration of new information with background knowledge and critical evaluation of the information being read. Thus the role of early word-level reading skills is potentially more prominent for LM learners than for NE students to success with second-language reading comprehension development through the elementary and middle school grades.

In a similar vein, the current findings support a theory in which children’s reading development is influenced more significantly by early word-reading ability rather than their language status. As compared to monolingual children, LM learners may lack sufficient knowledge of the oral English language due to relatively limited exposure to English at home (Koda, 2007), thus experience greater difficulties with the task of learning to read in a language that they have yet to be proficient. However, given that those LM learners who initially acquire strong word-reading skills demonstrated similar reading comprehension growth to that of their monolingual peers, the role of early word-reading ability is even stronger for LM learners than oral English-language proficiency in reading comprehension development.

**Implications for Research**
The current study makes unique contributions to growing knowledge of how LM learners’ early word-reading ability can contribute to reading comprehension growth as compared to their monolingual NE peers. The study findings raise questions that warrant further investigation to advance knowledge in area of LM learners’ reading comprehension development. First, although the findings add to the literature on the relationship between word reading and reading comprehension providing more detailed information than previously available research, further research that explores the impact of LM learners’ other early reading sub-skills such as vocabulary and morphological and syntactic skills in comparison to those for NE students would provide a fuller picture of potential complexities involved in reading comprehension development.

Second, another important direction would be to include LM learners’ native-language oral and reading measures to take into account how first- and second-language factors play different roles across time points, allowing for a more nuanced understanding of their English-reading comprehension development. Several authors of empirical longitudinal studies on cross-linguistic influence argued that dual-language children’s initial first-language word-level skills contributed to later second-language reading comprehension (e.g., Jared, Cormier, Levy, & Wade-Woolley, 2011; Nakamoto, Lindsey, & Manis, 2007; Gottardo & Mueller, 2009).

Third, for LM learners, through intervention studies, researchers could investigate the effect of added instructional emphasis on early word-reading ability that may influence reading comprehension outcomes. Variability and effectiveness in the amount, types, and quality of instruction and strategies (e.g., Connor, Morrison, & Petrella, 2004) for monolinguals have been well documented and may apply equally to LM learners.
Fourth, future studies could account for school-level control variables in order to portray a holistic representation of LM learners. School-level characteristics such as school resources, poverty level, school minority representations can have a significant impact on students’ academic achievement and learning patterns (Entwistle & Alexander, 1989, 1993).

Finally, more future reading research attention is needed with LM learners at the secondary level, and longitudinal studies extending into high school and even college are needed. With most literacy research emphasis placed on LM learners in the elementary level, there is a relative paucity of research information pertaining to the middle- and high-school LM learners.
Table 3.1. *Number (Percentage) of Children Who Met and Did Not Meet Each Inclusion Criterion by Language-Status Groups*

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Language-minority learners</th>
<th>Native-English-speaking students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Children meeting inclusion criteria $n$ (%)</td>
<td>Children eliminated $n$</td>
</tr>
<tr>
<td>1. Non-missing home-language data</td>
<td>2,927</td>
<td>-</td>
</tr>
<tr>
<td>2. Non-missing data on Word-Reading Proficiency</td>
<td>1,831 (62.56)</td>
<td>1,096</td>
</tr>
<tr>
<td>3. Valid data on Reading-Comprehension Proficiency at one or more occasions</td>
<td>1,620 (55.35)</td>
<td>211</td>
</tr>
<tr>
<td>4. Low or High Word-Reading Proficiency</td>
<td>992 (33.89)</td>
<td>628</td>
</tr>
</tbody>
</table>

*Note.* A percentage of children meeting the inclusion criterion in the initial sample size of 2,927 for LM learners and 17,472 for native-English-speaking students.
Table 3.2. *Percentage Distribution of ECLS-K Full Sample, Full Final Analytic Sample, and Language-Status Sub-Samples (Language-Minority Learners and Native-English-Speaking Students) by Child Characteristics in the Spring of First Grade*

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>ECLS-K full sample (N=21,409; %)</th>
<th>Full analytic sample (N=8,180; %)</th>
<th>Language status</th>
<th>Language-minority learner (n=992; %)</th>
<th>Native-English-speaking student (n=7,188; %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in months</td>
<td>87.03</td>
<td>87.00</td>
<td>86.10</td>
<td>87.11</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>51.74</td>
<td>46.46</td>
<td>50.60</td>
<td>49.30</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>48.26</td>
<td>50.54</td>
<td>49.40</td>
<td>50.70</td>
<td></td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White, non-Hispanic</td>
<td>57.29</td>
<td>61.54</td>
<td>10.70</td>
<td>67.59</td>
<td></td>
</tr>
<tr>
<td>Black, non-Hispanic</td>
<td>16.21</td>
<td>14.17</td>
<td>1.18</td>
<td>15.72</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>18.87</td>
<td>16.63</td>
<td>68.71</td>
<td>10.43</td>
<td></td>
</tr>
<tr>
<td>Asian/Pacific Islander/Other</td>
<td>5.22</td>
<td>7.66</td>
<td>19.41</td>
<td>6.26</td>
<td></td>
</tr>
<tr>
<td>SES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st Quintile</td>
<td>19.44</td>
<td>14.92</td>
<td>39.80</td>
<td>12.11</td>
<td></td>
</tr>
<tr>
<td>2nd Quintile</td>
<td>20.24</td>
<td>17.92</td>
<td>23.74</td>
<td>17.26</td>
<td></td>
</tr>
<tr>
<td>3rd Quintile</td>
<td>20.23</td>
<td>19.96</td>
<td>14.76</td>
<td>20.55</td>
<td></td>
</tr>
<tr>
<td>4th Quintile</td>
<td>20.15</td>
<td>21.11</td>
<td>10.19</td>
<td>22.35</td>
<td></td>
</tr>
<tr>
<td>5th Quintile</td>
<td>19.93</td>
<td>26.09</td>
<td>11.51</td>
<td>27.74</td>
<td></td>
</tr>
<tr>
<td>Time to oral English-language proficiency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>PreLAS</em> assessment not needed</td>
<td>86.87</td>
<td>89.36</td>
<td>28.39</td>
<td>96.64</td>
<td></td>
</tr>
<tr>
<td>Passed <em>PreLAS</em> in fall of K</td>
<td>4.83</td>
<td>5.32</td>
<td>29.85</td>
<td>2.40</td>
<td></td>
</tr>
<tr>
<td>Passed <em>PreLAS</em> in spring of K</td>
<td>3.00</td>
<td>2.52</td>
<td>19.23</td>
<td>0.53</td>
<td></td>
</tr>
<tr>
<td>Passed <em>PreLAS</em> in fall of G1</td>
<td>0.52</td>
<td>0.33</td>
<td>2.61</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td>Passed <em>PreLAS</em> in spring of G1</td>
<td>4.77</td>
<td>2.46</td>
<td>19.93</td>
<td>0.38</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Estimates were weighted by child-level sampling weights to compensate for unequal probability of selection in the sample design. *PreLAS* = *Pre-Language Assessment Scales* (Oral English-language proficiency assessment), K = Kindergarten, G1 = First grade; SES = Socioeconomic status
<table>
<thead>
<tr>
<th>Proficiency level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Students did not achieve Level 1</td>
</tr>
<tr>
<td>1</td>
<td>Students scoring at Level 1 can identify upper- and lower-case letters by name</td>
</tr>
<tr>
<td>2</td>
<td>Students scoring at Level 2 can associate letters with sounds at the beginning of words</td>
</tr>
<tr>
<td>3</td>
<td>Students scoring at Level 3 can associate letters with sounds at the end of words</td>
</tr>
<tr>
<td>4</td>
<td>Students scoring at Level 4 can recognize common words by sight.</td>
</tr>
<tr>
<td>5</td>
<td>Students scoring at Level 5 can read words in context</td>
</tr>
<tr>
<td>6</td>
<td>Students scoring at Level 6 can make inferences using cues that are directly stated with key words in text (for example, recognizing the comparison being made in a simile)</td>
</tr>
<tr>
<td>7</td>
<td>Students scoring at Level 7 can identify clues used to make inferences, and use background knowledge combined with cues in a sentence to understand use of homonyms.</td>
</tr>
<tr>
<td>8</td>
<td>Students scoring at Level 8 can demonstrate understanding of author’s craft (how does the author let you know…), and make connections between a problem in the narrative and similar life problems.</td>
</tr>
<tr>
<td>9</td>
<td>Students scoring at Level 9 can critically evaluate, compare and contrast, and understand the effect of features of expository and biographical texts.</td>
</tr>
<tr>
<td>10</td>
<td>Students scoring at Level 10 can evaluate complex syntax and understand high-level nuanced vocabulary in biographical text.</td>
</tr>
</tbody>
</table>

*Note.* Table adapted from *Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K) Psychometric Report for the Eighth Grade* by M. Najarian, J. Pollack, A. G. Sorongon, and E. G. Hausken, 2009 by U.S. Department of Education. (Also, the ECLS-K psychometricians included a theta score for overall reading ability—not used in the present study.)
Table 3.4. *Parent Interview Questions on Indicators of Socioeconomic Status (SES) and Response Options: Spring-First grade (Spring 2000)*

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Question</th>
<th>Response option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income</td>
<td>(PAQ.100) In studies like this, households are sometimes grouped according to income. What was the total income of all persons in your household over the past year, including salaries or other earnings, interest, retirement, and so on for all household members?</td>
<td>Range</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Don’t Know</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Refused</td>
</tr>
<tr>
<td>Education</td>
<td>(PEQ.020) Now I have a few questions about education and job training. What {is/was} the highest grade or year of school that {you/{NAME}/{CHILD}'s biological/adoptive} mother/father} have/has/had completed?</td>
<td>Never went to school</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1st grade</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2nd grade</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3rd grade</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4th grade</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5th grade</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6th grade</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7th grade</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8th grade</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9th grade</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10th grade</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11th grade</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12th grade but no diploma</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High school Diploma/equivalent or Voc/tech program after high school but no Voc/tech diploma</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Voc/tech program after high school</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Some college but no degree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Associate's degree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bachelor's degree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Graduate or professional school but no degree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Master's degree (MA, MS)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Doctorate degree (Ph.D., Ed.D.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Professional degree after bachelor's degree (Medicine/MD; Dentistry/DDS; LAW/JD/LLB; etc.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Refused</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Don't know</td>
</tr>
<tr>
<td>Occupational prestige</td>
<td>Table 3.4, continued</td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>----------------------</td>
<td></td>
</tr>
<tr>
<td>(EMQ. 120) For whom {do/does/did} {you/{NAME}} work {when {you/{he/she}} last worked}?</td>
<td>Enter Employer Name Refused Don’t Know</td>
<td></td>
</tr>
<tr>
<td>(EMQ. 130) What kind of business or industry {is/was} this?</td>
<td>Enter Industry Description Refused Don’t Know</td>
<td></td>
</tr>
<tr>
<td>(EMQ. 140) What kind of work {are/is/were/was} {you/{NAME}} doing?</td>
<td>Enter Job Title Refused Don’t Know</td>
<td></td>
</tr>
<tr>
<td>(EMQ. 150) What {are/is/were/was} {your/{NAME}}’s most important activities or duties on this job? What {do/does/did} {you/{NAME}} actually do at this job?</td>
<td>Enter Job Duties Refused Don’t Know</td>
<td></td>
</tr>
</tbody>
</table>

*Note. Voc = vocational*
<table>
<thead>
<tr>
<th>Present Study Variable</th>
<th>Level*</th>
<th>Operational Definition</th>
<th>Coding Scheme</th>
<th>Measurement</th>
<th>ECLS-K Variables Names</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child ID</td>
<td>Individual</td>
<td>Student identifier</td>
<td>Integer</td>
<td>Ordinal</td>
<td>CHILDID</td>
</tr>
<tr>
<td>Age (Time)</td>
<td>Within-individual</td>
<td>A variable representing individual student’s actual age in months on the day assessment was administered and centered on the average child’s age at the testing date in the spring of first grade.</td>
<td>Integer</td>
<td>R4AGE</td>
<td></td>
</tr>
<tr>
<td>Reading-Comprehension Proficiency</td>
<td>Individual</td>
<td>A dichotomous dependent variable referring to whether students reached Reading-Comprehension Proficiency (Proficiency Level 8)</td>
<td>0 = Not achieved Proficiency Level 8 1 = Achieved Proficiency Level 8</td>
<td>Nominal</td>
<td>C4R4RPF</td>
</tr>
<tr>
<td>Word-Reading Proficiency</td>
<td>Individual</td>
<td>A dichotomous predictor variable representing whether students had a low or high Word-Reading Proficiency</td>
<td>0 = Low Word-Reading Proficiency 1 = High Word-Reading Proficiency</td>
<td>Nominal</td>
<td>C4R4RPF</td>
</tr>
<tr>
<td>Language Status</td>
<td>Individual</td>
<td>A dichotomous predictor variable representing whether a student was a language-minority learner or native-English-speaking student</td>
<td>0 = Native-English-speaking student 1 = Language-minority learner</td>
<td>Nominal</td>
<td>P1ANYLNG</td>
</tr>
<tr>
<td>Language Status by Word-Reading Proficiency</td>
<td>Individual</td>
<td>Interaction term between Language Status and Word-Reading Proficiency variables</td>
<td>Integer</td>
<td>Scale</td>
<td></td>
</tr>
<tr>
<td>Variable</td>
<td>Type</td>
<td>Description</td>
<td>Levels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-----------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>Individual</td>
<td>A demographic control variable representing student’s gender</td>
<td>0 = Male, 1 = Female</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>Individual</td>
<td>A demographic control variable representing whether or not a student is</td>
<td>0 = Non-Black, 1 = Black</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>Individual</td>
<td>A demographic control variable representing whether or not a student is</td>
<td>0 = Non-Hispanic, 1 = Hispanic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>Individual</td>
<td>A demographic control variable representing whether or not a student is</td>
<td>0 = Non-Asian, Pacific Island, and Other, 1 = Asian, Pacific Island, and Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SES</td>
<td>Individual</td>
<td>A demographic control variable representing student’s household SES</td>
<td>-2.96 to 2.88</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time to Oral English-Language</td>
<td>Individual</td>
<td>A control variable representing time that students passed a cut-score of oral</td>
<td>0 = PreLAS assessment not needed, 1 = Passed PreLAS in fall of K, 2 = Passed PreLAS in spring of K, 3 = Passed PreLAS in fall of G1, 4 = Passed PreLAS in spring of G1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proficiency</td>
<td></td>
<td>English proficiency on PreLAS assessment</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. SES = Socioeconomic status; PreLAS = Pre-Language Assessment Scales (Oral English-language proficiency assessment), K = Kindergarten, G1 = First grade.

*Within-individual = Level 1, Individual = Level 2.*
Table 3.6. *Number (Percentage) of Students in Two Groups According to Word-Reading Proficiency by Full Sample and Subsamples*

<table>
<thead>
<tr>
<th>Word-Reading Proficiency</th>
<th>Full Sample</th>
<th></th>
<th>Subsamples</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (%)</td>
<td>Language-minority Learners n (%)</td>
<td>Native-English-speaking Students n (%)</td>
<td></td>
</tr>
<tr>
<td>Low Word-Reading Proficiency(^a)</td>
<td>2,311 (28.25)</td>
<td>435 (43.85)</td>
<td>1,876 (26.10)</td>
<td></td>
</tr>
<tr>
<td>High Word-Reading Proficiency(^b)</td>
<td>5,869 (71.72)</td>
<td>557 (56.15)</td>
<td>5,312 (73.90)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>8,180 (100.00)</td>
<td>992 (100.00)</td>
<td>7,188 (100.00)</td>
<td></td>
</tr>
</tbody>
</table>

*Note.*
\(^a\)Children passed reading Proficiency Level 1, 2, or 3, but did not yet pass Level 4 (i.e., ability to recognize common words by sight) or above. \(^b\)Children passed reading Proficiency Level 5 (i.e., ability to read words in context), or above.
Table 3.7. Taxonomy of the Four Multilevel Logistic Models for Change

<table>
<thead>
<tr>
<th>Model</th>
<th>Level-1 model</th>
<th>Level-2 model</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>( \eta_{ii} = \beta_0 + \zeta_0 i )</td>
<td>( \beta_0i = \gamma_{00} + \zeta_0i )</td>
</tr>
<tr>
<td>B</td>
<td>( \eta_{ii} = \beta_0 + \beta_{1i} TIME_{ii} )</td>
<td>( \beta_0i = \gamma_{00} + \zeta_0i ) ( \beta_{1i} = \gamma_{10} )</td>
</tr>
<tr>
<td>C</td>
<td>( \eta_{ii} = \beta_0 + \beta_{1i} TIME_{ii} + \beta_{2i} TIME^2_{ii} )</td>
<td>( \beta_0i = \gamma_{00} + \zeta_0i ) ( \beta_{1i} = \gamma_{10} ) ( \beta_{2i} = \gamma_{20} )</td>
</tr>
<tr>
<td>D</td>
<td>( \eta_{ii} = \beta_0 + \beta_{1i} TIME_{ii} + \beta_{2i} TIME^2_{ii} )</td>
<td>( \beta_0i = \gamma_{00} + \gamma_{10} FEMALE_{ii} + \gamma_{01} BLACK_{ii} + \gamma_{02} HISPANIC_{ii} + \gamma_{03} ASIAN_{ii} + \gamma_{04} SES_{ii} + \gamma_{05} ORAL_{ii} + \gamma_{06} ORALFK_{ii} + \gamma_{07} ORALSK_{ii} + \gamma_{08} ORALFG1_{ii} + \gamma_{09} ORALSG1_{ii} + \gamma_{10} LANGSTATUS_{ii} + \gamma_{11} WORDPROF_{ii} + \gamma_{12} LANG<em>WORD_{ii} + \zeta_0i ) ( \beta_{1i} = \gamma_{10} + \gamma_{11} FEMALE_{ii} + \gamma_{12} BLACK_{ii} + \gamma_{13} HISPANIC_{ii} + \gamma_{14} ASIAN_{ii} + \gamma_{15} SES_{ii} + \gamma_{16} ORAL_{ii} + \gamma_{17} ORALFK_{ii} + \gamma_{18} ORALSK_{ii} + \gamma_{19} ORALFG1_{ii} + \gamma_{20} ORALSG1_{ii} + \gamma_{21} LANGSTATUS_{ii} + \gamma_{22} WORDPROF_{ii} + \gamma_{23} LANG</em>WORD_{ii} ) ( \beta_{2i} = \gamma_{20} + \gamma_{21} FEMALE_{ii} + \gamma_{22} BLACK_{ii} + \gamma_{23} HISPANIC_{ii} + \gamma_{24} ASIAN_{ii} + \gamma_{25} SES_{ii} + \gamma_{26} ORAL_{ii} + \gamma_{27} ORALFK_{ii} + \gamma_{28} ORALSK_{ii} + \gamma_{29} ORALFG1_{ii} + \gamma_{30} ORALSG2_{ii} + \gamma_{31} LANGSTATUS_{ii} + \gamma_{32} WORDPROF_{ii} + \gamma_{33} LANG*WORD_{ii} )</td>
</tr>
</tbody>
</table>

Note. Control variables are FEMALE, BLACK, HISPANIC, ASIAN, SES, ORAL, ORALFK, ORALSK, ORALFG1, and ORALSG1. SES = Socioeconomic Status, ORAL = PreLAS (Pre-Language Assessment Scales [Oral English-language proficiency assessment]) was not needed, ORALFK = Passed PreLAS in the fall of Kindergarten, ORALSK = Passed PreLAS in the spring of Kindergarten, ORALFG1 = Passed PreLAS in the fall of Grade 1, ORALSG1 = Passed PreLAS in the spring of Grade 1, LANGSTATUS = Language Status, WORDPROF = Word-Reading Proficiency, and LANG*WORD = The interaction term between LANGSTATUS and WORDPROF.
Table 4.1. Proportions (Standard Deviations) of Achieving Reading-Comprehension Proficiency in the First, Third, Fifth, and Eighth Grades by Full Sample, Language-Status Subsamples, and Word-Reading Proficiency Groups

<table>
<thead>
<tr>
<th>Grade</th>
<th>Full sample (N = 8,180)</th>
<th>Subsamples by Language Status</th>
<th>Subsamples by Language Status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low Word-Reading Proficiency (n = 2,311)</td>
<td>High Word-Reading Proficiency (n = 5,869)</td>
<td>Marginal Mean</td>
</tr>
<tr>
<td>G1</td>
<td>0.00 (0.00)</td>
<td>0.02 (0.13)</td>
<td>0.01 (0.11)</td>
</tr>
<tr>
<td>G3</td>
<td>0.05 (0.21)</td>
<td>0.38 (0.49)</td>
<td>0.28 (0.45)</td>
</tr>
<tr>
<td>G5</td>
<td>0.18 (0.38)</td>
<td>0.56 (0.50)</td>
<td>0.44 (0.50)</td>
</tr>
<tr>
<td>G8</td>
<td>0.37 (0.48)</td>
<td>0.81 (0.39)</td>
<td>0.68 (0.47)</td>
</tr>
</tbody>
</table>

Note. Estimates were weighted by child-level sampling weights to compensate for unequal probability of selection in the sample design. Proportion is equivalent to the mean of a variable with the value of 0 and 1 and can therefore be interpreted as a probability.
Table 4.2. Number (Percentage) of Students in Two Groups According to Time to Oral English-Language Proficiency by Full Sample and Subsamples

<table>
<thead>
<tr>
<th>Time to Oral English-Language Proficiency</th>
<th>Full Sample</th>
<th>Subsamples</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (%)</td>
<td>Low Word-Reading Proficiency n (%)</td>
</tr>
<tr>
<td>PreLAS not needed</td>
<td>7,186 (87.85)</td>
<td>1,879 (81.31)</td>
</tr>
<tr>
<td>Passed PreLAS in fall of K</td>
<td>519 (6.34)</td>
<td>153 (6.62)</td>
</tr>
<tr>
<td>Passed PreLAS in spring of K</td>
<td>259 (3.17)</td>
<td>130 (5.63)</td>
</tr>
<tr>
<td>Passed PreLAS in fall of G1</td>
<td>29 (0.35)</td>
<td>19 (0.82)</td>
</tr>
<tr>
<td>Passed PreLAS in spring of G1</td>
<td>187 (2.29)</td>
<td>130 (5.62)</td>
</tr>
<tr>
<td>Total</td>
<td>8,180 (100.00)</td>
<td>2,311 (100.00)</td>
</tr>
</tbody>
</table>

Note. 

*PreLAS*= Pre-Language Assessment Scales (Oral English-language proficiency assessment), K = Kindergarten, G=Grade.
Table 4.3. *Correlation Coefficients among Predictor and Outcome Variable at Each Time Point*

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Word-Reading Proficiency (G1)</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Reading-Comprehension Proficiency (G1)</td>
<td>0.07</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Reading-Comprehension Proficiency (G3)</td>
<td>0.32</td>
<td>0.10</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>***</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>4. Reading-Comprehension Proficiency (G5)</td>
<td>0.32</td>
<td>0.10</td>
<td>0.36</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>5. Reading-Comprehension Proficiency (G8)</td>
<td>0.39</td>
<td>0.05</td>
<td>0.28</td>
<td>0.30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
</tbody>
</table>

*Note.* G=Grade. The correlation coefficients are phi-coefficients.  
†p = .10, *p < .05, **p < .01, ***p < .001 (two-tailed tests)
Table 4.4. Correlation Coefficients, Tolerance, and Variance Inflation Factor (VIF) Values for Predictor and Control Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>Tolerance</th>
<th>VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Female</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.98</td>
<td>1.02</td>
</tr>
<tr>
<td>2. White</td>
<td>0.01</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ref.</td>
<td>Ref.</td>
</tr>
<tr>
<td>3. Black</td>
<td>-0.001</td>
<td>-0.46</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.87</td>
<td>1.15</td>
</tr>
<tr>
<td>4. Hispanic</td>
<td>-0.01</td>
<td>-0.52</td>
<td>-0.15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.67</td>
<td>1.50</td>
</tr>
<tr>
<td>5. Asian</td>
<td>0.003</td>
<td>-0.47</td>
<td>-0.14</td>
<td>-0.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.81</td>
<td>1.24</td>
</tr>
<tr>
<td>6. SES</td>
<td>0.01</td>
<td>0.31</td>
<td>-0.23</td>
<td>-0.22</td>
<td>-0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.78</td>
<td>1.29</td>
</tr>
<tr>
<td>7. PreLAS not needed</td>
<td>0.003</td>
<td>0.41</td>
<td>0.12</td>
<td>-0.44</td>
<td>-0.24</td>
<td>0.19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ref.</td>
<td>Ref.</td>
</tr>
<tr>
<td>8. Passed PreLAS in fall of K</td>
<td>0.01</td>
<td>-0.26</td>
<td>-0.08</td>
<td>0.26</td>
<td>0.19</td>
<td>-0.04</td>
<td>-0.70</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.68</td>
<td>1.47</td>
</tr>
<tr>
<td>9. Passed PreLAS in spring of K</td>
<td>-0.002</td>
<td>-0.21</td>
<td>-0.06</td>
<td>0.24</td>
<td>0.11</td>
<td>-0.14</td>
<td>-0.48</td>
<td>-0.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.69</td>
<td>1.45</td>
</tr>
<tr>
<td>10. Passed PreLAS in fall of G1</td>
<td>-0.02</td>
<td>-0.07</td>
<td>-0.02</td>
<td>0.10</td>
<td>0.02</td>
<td>-0.06</td>
<td>-0.16</td>
<td>-0.02</td>
<td>-0.01</td>
<td></td>
<td></td>
<td></td>
<td>0.93</td>
<td>1.06</td>
</tr>
<tr>
<td>11. Passed PreLAS in spring of G1</td>
<td>-0.01</td>
<td>-0.18</td>
<td>-0.06</td>
<td>0.22</td>
<td>0.09</td>
<td>-0.16</td>
<td>-0.41</td>
<td>-0.04</td>
<td>-0.03</td>
<td>-0.01</td>
<td></td>
<td></td>
<td>0.73</td>
<td>1.37</td>
</tr>
<tr>
<td>12. Language Status</td>
<td>-0.01</td>
<td>-0.40</td>
<td>-0.12</td>
<td>0.39</td>
<td>0.29</td>
<td>-0.19</td>
<td>-0.70</td>
<td>0.40</td>
<td>0.39</td>
<td>0.14</td>
<td>0.37</td>
<td></td>
<td>0.46</td>
<td>2.17</td>
</tr>
<tr>
<td>13. Word-Reading Proficiency</td>
<td>0.13</td>
<td>0.21</td>
<td>-0.15</td>
<td>-0.14</td>
<td>-0.01</td>
<td>0.36</td>
<td>0.13</td>
<td>-0.01</td>
<td>-0.09</td>
<td>-0.05</td>
<td>-0.14</td>
<td>-0.13</td>
<td>0.84</td>
<td>1.19</td>
</tr>
</tbody>
</table>

**Note.** SES = Socioeconomic Status, PreLAS = Pre-Language Assessment Scales (Oral English-language proficiency assessment), K = Kindergarten, G=Grade.

The correlation coefficients are phi-coefficients. Point-biserial correlation coefficients between a dichotomous variable and a continuous variable (i.e., SES) are shown in italics.

bThe reference category is Language-Minority learners.

cThe reference category is High Word-Reading Proficiency.

†p = .10, *p < .05, **p < .01, ***p < .001 (two-tailed tests)
Table 4.5. *Results of Fitting a Taxonomy of Hierarchical Generalized Linear Models (HGLM)*

<table>
<thead>
<tr>
<th>Fixed effects</th>
<th>Model A: Unconditional means model</th>
<th>Model B: Unconditional linear growth model</th>
<th>Model C: Unconditional quadratic growth model</th>
<th>Model D: Final model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \beta ) (SE)</td>
<td>OR</td>
<td>( \beta ) (SE)</td>
<td>OR</td>
</tr>
<tr>
<td><strong>Initial status</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>( \gamma_{00} )</td>
<td>-0.590*** (0.001)</td>
<td>0.554</td>
<td>-3.334*** (0.003)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>( \gamma_{01} )</td>
<td>( \gamma_{01} )</td>
<td>0.799</td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White, non-Hispanic</td>
<td>( \gamma_{02} )</td>
<td>Ref.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black, non-Hispanic</td>
<td>( \gamma_{03} )</td>
<td>-1.222*** (0.016)</td>
<td>0.295</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>( \gamma_{04} )</td>
<td>-1.038*** (0.016)</td>
<td>0.354</td>
<td></td>
</tr>
<tr>
<td>Asian/Pacific Islander/ and Other</td>
<td>( \gamma_{05} )</td>
<td>-0.306*** (0.015)</td>
<td>0.011</td>
<td></td>
</tr>
<tr>
<td>SES</td>
<td>( \gamma_{06} )</td>
<td>0.422*** (0.005)</td>
<td>1.525</td>
<td></td>
</tr>
<tr>
<td><strong>Time to Oral English-Language Proficiency</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PreLAS assessment not needed</td>
<td>( \gamma_{07} )</td>
<td>Ref.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passed PreLAS in fall of K</td>
<td>( \gamma_{08} )</td>
<td>-0.200*** (0.023)</td>
<td>0.819</td>
<td></td>
</tr>
<tr>
<td>Passed PreLAS in spring of K</td>
<td>( \gamma_{09} )</td>
<td>-0.208*** (0.038)</td>
<td>0.812</td>
<td></td>
</tr>
<tr>
<td>Passed PreLAS in fall of G1</td>
<td>( \gamma_{10} )</td>
<td>-42.931*** (1.725)</td>
<td>2.27e-19</td>
<td></td>
</tr>
<tr>
<td>Passed PreLAS in spring of G1</td>
<td>( \gamma_{11} )</td>
<td>0.200*** (0.053)</td>
<td>1.221</td>
<td></td>
</tr>
<tr>
<td><strong>Language Status</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Language-minority learners</td>
<td>( \gamma_{12} )</td>
<td>0.734*** (0.022)</td>
<td>2.084</td>
<td></td>
</tr>
<tr>
<td><strong>Word-Reading Proficiency</strong></td>
<td>( \gamma_{13} )</td>
<td>2.581*** (0.016)</td>
<td>13.216</td>
<td></td>
</tr>
<tr>
<td>Language status × Word-Reading Proficiency</td>
<td>γ_{10}</td>
<td>0.058*** (0.000)</td>
<td>1.060 0.141*** (0.000)</td>
<td>1.152 0.150*** (0.001)</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>--------</td>
<td>------------------</td>
<td>----------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Intercept</td>
<td>γ_{10}</td>
<td>0.058*** (0.000)</td>
<td>1.060 0.141*** (0.000)</td>
<td>1.152 0.150*** (0.001)</td>
</tr>
<tr>
<td>Gender</td>
<td>γ_{11}</td>
<td>0.141*** (0.000)</td>
<td>1.060 0.141*** (0.000)</td>
<td>1.152 0.150*** (0.001)</td>
</tr>
<tr>
<td>Race</td>
<td>γ_{12}</td>
<td>Ref.</td>
<td>Ref.</td>
<td>Ref.</td>
</tr>
<tr>
<td>White, non-Hispanic</td>
<td>γ_{13}</td>
<td>0.004*** (0.001)</td>
<td>1.004 0.023*** (0.000)</td>
<td>1.024 0.023*** (0.000)</td>
</tr>
<tr>
<td>Black, non-Hispanic</td>
<td>γ_{14}</td>
<td>0.020*** (0.001)</td>
<td>1.020 0.003*** (0.001)</td>
<td>0.997 0.003*** (0.001)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>γ_{15}</td>
<td>0.011*** (0.000)</td>
<td>1.011 0.011*** (0.000)</td>
<td>1.011 0.011*** (0.000)</td>
</tr>
<tr>
<td>Asian/Pacific Islander/Other</td>
<td>γ_{16}</td>
<td>Ref.</td>
<td>Ref.</td>
<td>Ref.</td>
</tr>
<tr>
<td>SES</td>
<td>γ_{17}</td>
<td>Ref.</td>
<td>Ref.</td>
<td>Ref.</td>
</tr>
<tr>
<td>Time to Oral English-Language Proficiency</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PreLAS assessment not needed</td>
<td>γ_{18}</td>
<td>0.014*** (0.001)</td>
<td>1.014 0.014*** (0.001)</td>
<td>1.014 0.014*** (0.001)</td>
</tr>
<tr>
<td>Passed PreLAS in fall of K</td>
<td>γ_{19}</td>
<td>0.002*** (0.002)</td>
<td>0.998 0.002*** (0.002)</td>
<td>0.998 0.002*** (0.002)</td>
</tr>
<tr>
<td>Passed PreLAS in spring of K</td>
<td>γ_{20}</td>
<td>1.414*** (0.056)</td>
<td>4.14 1.414*** (0.056)</td>
<td>4.14 1.414*** (0.056)</td>
</tr>
<tr>
<td>Passed PreLAS in fall of G1</td>
<td>γ_{21}</td>
<td>-0.007*** (0.002)</td>
<td>0.993 -0.007*** (0.002)</td>
<td>0.993 -0.007*** (0.002)</td>
</tr>
<tr>
<td>Passed PreLAS in spring of G1</td>
<td>γ_{22}</td>
<td>Ref.</td>
<td>Ref.</td>
<td>Ref.</td>
</tr>
<tr>
<td>Language-minority learners</td>
<td>γ_{24}</td>
<td>Ref.</td>
<td>Ref.</td>
<td>Ref.</td>
</tr>
<tr>
<td>Word-Reading Proficiency</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>High Word-Reading Proficiency</td>
<td>γ_{25}</td>
<td>0.028*** (0.001)</td>
<td>1.073 0.028*** (0.001)</td>
<td>1.073 0.028*** (0.001)</td>
</tr>
<tr>
<td>Language status × Word-Reading Proficiency</td>
<td>γ_{26}</td>
<td>0.008*** (0.002)</td>
<td>1.008 0.008*** (0.002)</td>
<td>1.008 0.008*** (0.002)</td>
</tr>
<tr>
<td>Acceleration/deceleration rate</td>
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<tr>
<td>Intercept</td>
<td>γ_{27}</td>
<td>Ref.</td>
<td>Ref.</td>
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<tr>
<td>Acceleration/deceleration rate</td>
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<tr>
<td>Intercept</td>
<td>γ_{28}</td>
<td>Ref.</td>
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Table 4.5, continued

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<th>Gender</th>
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<th>SE</th>
<th>$\beta$</th>
<th>SE</th>
<th>$\beta$</th>
<th>SE</th>
<th>$\beta$</th>
<th>SE</th>
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<tbody>
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<td>Female</td>
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<td>-0.0002***</td>
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<tr>
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<td>White, non-Hispanic</td>
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<td>4.59e-06</td>
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<td>Asian/Pacific Islander/Other</td>
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<td>SES</td>
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<tr>
<td>Time to Oral English-Language Proficiency</td>
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<td>PreLAS assessment not needed</td>
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<td>Ref.</td>
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<td>Passed PreLAS in fall of K</td>
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<td>Passed PreLAS in spring of G1</td>
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<td>1.000</td>
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<td>Language status</td>
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<td>Language-minority learners</td>
<td>$\gamma$</td>
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<td>0.001***</td>
<td>1.001</td>
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<td></td>
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<td>Word-Reading Proficiency</td>
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<td>High Word-Reading Proficiency</td>
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<td>0.0002***</td>
<td>1.0001</td>
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<td>5.52e-06</td>
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<td>Language status × Word-Reading Proficiency</td>
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<table>
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<tr>
<th>Variance component</th>
<th>$\beta$</th>
<th>SE</th>
<th>$\beta$</th>
<th>SE</th>
<th>$\beta$</th>
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<th>SE</th>
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<tbody>
<tr>
<td>Within-child</td>
<td>-1.330***</td>
<td>0.006</td>
<td>0.994***</td>
<td>0.003</td>
<td>1.124***</td>
<td>0.003</td>
<td>0.285***</td>
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<table>
<thead>
<tr>
<th>Goodness of fit</th>
<th>Deviance (-2LL)</th>
<th>11,722,700.2</th>
<th>8,561,193.6</th>
<th>8,212,451.6</th>
<th>7,030,645.8</th>
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<tbody>
<tr>
<td>AIC</td>
<td>1.17e+07</td>
<td>8,561,200</td>
<td>8,212,460</td>
<td>7,030,726</td>
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</table>
Table 4.5, continued

| BIC     | 1.17e+07 | 8,561,223 | 8,212,491 | 7,031,041 |

Note. The continuous control variable (i.e., SES) was centered at the grand means. OR = odds ratio, Ref. = Reference category, SES = Socioeconomic status, PreLAS = Pre-Language Assessment Scales (Oral English-language proficiency assessment), K = Kindergarten, G1 = Grade 1, -2LL = -2 × (Log Likelihood), AIC = Akaike information criterion, BIC = Bayesian information criterion. †p < .10, *p < .05, **p < .01, ***p < .001 (two-tailed tests).
Figure 3.1. *Levels and Items Administered for Associated Grades*

<table>
<thead>
<tr>
<th>Grade</th>
<th>K</th>
<th>Grade 1</th>
<th>Grade 3</th>
<th>Grade 5</th>
<th>Grade 8</th>
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<tr>
<td>10</td>
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</table>
Figure 4.1. *Observed Proportions of Achieving Reading-Comprehension Proficiency for Language-Minority Learners and Native-English-speaking Students in First, Third, Fifth, and Eighth Grades*
Figure 4.2. Predicted Growth in the Probabilities of Achieving Reading-Comprehension Proficiency Over Time ($N = 8,180$).

*Note.* G1 = first grade, G3 = third grade, G5 = fifth grade, and G8 = eighth grade
Figure 4.3. Effects of Language Status and Word-Reading Proficiency on Expected Growth in the Probabilities of Achieving Reading-Comprehension Proficiency ($N = 8,180$).

Note. G1 = first grade, G3 = third grade, G5 = fifth grade, and G8 = eighth grade.
Figure 4.4. *Predicted Growth in the Probabilities of Achieving Reading-Comprehension Proficiency for Language-Minority Learners and Native-English-speaking Students (N = 8,180).*

*Note.* G1 = first grade, G3 = third grade, G5 = fifth grade, and G8 = eighth grade.
Figure 4.5. *Predicted Growth in the Probabilities of Achieving Reading-Comprehension Proficiency for Children with High Word-Reading Proficiency and Children with Low Word-Reading Proficiency.*

*Note.* G1 = first grade, G3 = third grade, G5 = fifth grade, and G8 = eighth grade.
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However, far less is known as to whether early English-word reading is an essential prerequisite to LM learners’ long-term development of English-reading comprehension, and whether early English word-reading ability contributes to the persistence of reading comprehension success or difficulties across upper elementary and middle grades.


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