Reading Psychology, 0:1–38, 2018

ISSN: 0270-2711 print / 1521-0685 online
DOI: 10.1080/02702711.2018.1471162

Routledge
Taylor & Francis Group

RELATIONSHIP BETWEEN EARLY WORD-READING AND LONG-TERM READING-COMPREHENSION GROWTH FOR LANGUAGE-MINORITY LEARNERS COMPARED TO NATIVE-ENGLISH-SPEAKING STUDENTS

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The present study used data from the Early Childhood Longitudinal Study–Kindergarten Class of 1998–1999 to examine whether the relationship between first-grade word-reading and reading-comprehension growth through eighth grade was different for language-minority learners (LMs) versus native English-speaking students (NEs). Among high word readers, LMs' reading comprehension was lower than NEs, but over time, they closed the gap, exhibiting similar levels at eighth grade. Among low word readers, LMs' reading comprehension was similar to NEs', but over time, a gap between LMs and NEs widened. Therefore, initially high word reading particularly advantaged LMs, and low word reading particularly disadvantaged LMs.

The present study examined whether the relation between first-grade English word-reading ability and English-reading-comprehension growth through eighth grade varied as a function of children's language status (language-minority learners [LMs] and native English-speaking students [NEs]). The relation was investigated for a nationally representative sample of children drawn from the Early Childhood Longitudinal Study–Kindergarten Class of 1998–1999 (ECLS-K).

Over the past few decades, public schools in the United States have experienced phenomenal and rapid growth in the number of LMs who learn to read in English as an additional language. Of particular concern is that LMs encounter considerable difficulties with reading and understanding complex text written

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in English and often lag far behind their monolingual English-speaking peers in reading (August & Shanahan, 2006). According to the 2017 National Assessment of Educational Progress (NAEP), 68% of fourth-grade and eighth-grade English-language learners in the United States performed below the basic level on NAEP reading assessments, while 28% of fourth-grade and 21% of eighth-grade monolingual students scored below the basic level (National Center for Education Statistics, 2017). Language-minority learners who achieve below a basic English-reading-comprehension level are at particular risk for difficulties in disciplinary reading and behavioral and social success in school. In addition, LMs are more likely to drop out of school than are monolingual NEs (Genesee, Lindholm-Leary, Saunders, & Christian, 2006). Consequently, fostering LMs' English-reading comprehension has become a vital goal of formal reading education at the local, state, and national levels.

Despite the pressing need to serve this ever-growing population, empirical work needed to inform educational practice and policy is somewhat limited in scope. A major issue is that little is known about the developmental pattern of LMs' English-reading comprehension in relation to early reading factors. Also, although a handful of researchers has modeled LMs' overall English-reading-ability growth (Halle, Hair, Wandner, McNamara, & Chien, 2012; Kieffer, 2008, 2011; Roberts, Mohammed, & Vaughn, 2010), little research has provided insight into LMs' English-reading-comprehension growth trajectories. In addition, prior research on LMs' English-reading development has tended to focus on elementary grade levels, and relatively less attention has been paid to middle and high school levels. Consequently, to date, it is unclear whether and to what extent early reading factors contribute to LMs' success or struggles in English-reading-comprehension development over either short or lengthy time periods.

Rationale

We argue that early word reading has been theoretically and empirically positioned in the literature as important for monolingual English-speaking children's reading growth and reading-comprehension growth in particular. However, even for monolingual children the role of early word-reading ability for reading comprehension development over a relatively long period of time is not known, and virtually nothing is known about the relation between early word reading ability and long-term reading comprehension growth for LMs.

Is Early Word Reading Related to Reading Comprehension and/or Reading-Comprehension Growth?

Although to date no cohesive theoretical position has been portrayed for LMs regarding the importance of early word-reading ability for reading-comprehension growth, early word-reading ability has been theoretically posited as extremely important for monolingual English children's reading growth. A prominent position on monolingual children's reading development is that early instantiation of word recognition strategies and word-reading automaticity are critical for movement into additional phases of reading development (e.g., Chall, 1996).

One widely accepted validation for the importance of early word-reading ability for monolingual reading is that automaticity and fluency in word reading relieve pressure on cognitive resources, especially in the area of working memory, such that attention can be devoted to other reading processes, and meaning construction is therefore facilitated (e.g., LaBerge & Samuels, 1974). Although a similar theoretical rationale could be logically advanced for LMs, including young LMs who have at least minimal oral English proficiency, the research base to support such a position for young LMs is nonexistent.

Evidence for a Relation between Early Word Reading and Reading Comprehension

Monolingual English-Speaking Students

The relation between word reading and reading comprehension has been empirically well established for monolingual readers. Static correlations between monolingual readers' word reading and reading comprehension support the theoretical link. For instance, static one-time-point correlations have been documented in the weak to moderate or strong positive range (*rs* = .18 to .83) for first grade through college students, often reflecting moderately large amounts of variance in comprehension accounted for by word reading (Gough, Hoover, & Peterson, 1996). As an example, a recent path-analytic study with a sample of 1,064 third-grade students at-risk for reading failure revealed that the direct effect of sight-word reading on state reading achievement scores predicted 41.9% of the variance in state reading achievement scores (Paige et al., 2018).

Moreover, research syntheses have noted that early word decoding ability was related to later reading comprehension, explaining 10% to 16% of the variance in later reading comprehension (NELP, 2008; Shanahan & Lonigan, 2010). However, most studies have examined the predictive power of word-reading ability for later reading comprehension only for relatively short time spans, sometimes just crossing one or two grades (e.g., Cunningham & Stanovich, 1997). In short, although a significant amount of evidence supports an association between word-reading ability and reading comprehension, the role of early word-reading ability in later reading comprehension development over a long period of time is less clear.

Language-Minority Learners

An evidenced-based case for the relation between early word-reading ability and long-term reading-comprehension growth for LMs in general has yet to be established. Some limited evidence does exist that portrays the overall English-reading-ability growth of young LMs who had at least minimal oral English at first grade (e.g., Kieffer, 2008, 2011). The overall reading ability growth took the shape of a concave quadratic curve from kindergarten through fifth and eighth grades. Language-minority learners who entered kindergarten with higher oral English proficiency displayed reading ability trajectories that approximated their NEs', but those who began with lower oral English never attained reading ability growth that their NEs attained. However, the studies were not designed to address reading comprehension growth or any early grades factors that may have contributed to reading growth.

Although no long-term studies exist on the relation between LMs' early word reading and long-term reading comprehension, there is evidence that similar to monolingual elementary-grades peers, LMs' English word reading is positively correlated with English-reading comprehension when measured at static time points (Lesaux, Crosson, Kieffer, & Pierce, 2010; Proctor, Carlo, August, & Snow, 2005). The correlations between LMs' English decoding and/or word reading and reading comprehension across the studies were in the moderate-to-strong positive range ($rs = .34$ to $.97$).

However, evidence is mixed from a few shorter-term correlational studies of early word reading with later comprehension. On the one hand, in two studies, across the short term, word reading was positively related to slightly later reading comprehension. In one study of students learning Dutch from low-income homes in the Netherlands, LM Turkish students' word-reading skills at the beginning of third grade weakly contributed to Dutch reading comprehension ($r = .17$) at the end of third grade (Droop & Verhoeven, 2003). Similarly, for a sample of Spanish-speaking LMs in the United States, third-grade English word decoding skills uniquely accounted for 30% of the variance in sixth-grade English-reading comprehension (Nakamoto, Manis, & Lindsey, 2008). There was also minimal evidence in the latter study that the strength of cross-grade relation between word reading and comprehension decreased as the length of time between measurement of word reading and comprehension increased.

On the other hand, in two short-term middle grades studies, LMs' word reading was not related to English-reading-comprehension growth. Fourth-grade Spanish-speaking LMs' English word reading was moderately positively and statistically significantly correlated with fourth-grade English-reading comprehension, but not with fifth-grade English-reading comprehension (Lesaux et al., 2010). In another study, initially poorer word readers began with the lowest reading comprehension scores as compared to moderate word readers and as compared to high-level word readers, but the growth trajectories of the three groups were parallel through the two grades

(Mancilla-Martinez, Kieffer, Biancarosa, Christodoulou, & Snow, 2011).

Finally, without a comparison group of NEs in the shorter-term studies, it is unclear as to what extent the association of initial word reading with long-term reading-comprehension growth differs between LMs and NEs (cf. Kieffer, 2011). There also remains the need to address very early word reading during the emergent reading phase in relation to longer-term reading comprehension.

Research Question

The research question for the present study was: Is the relation between first-grade English word-reading proficiency and reading-comprehension proficiency growth through eighth grade different for LMs as compared to NEs? No predominant theorized outlook exists specifically on the relation and how that relation might or might not change over time for LMs. Furthermore, no prior studies have focused on the relation for very young LMs' long-term English-reading-comprehension growth. Consequently, prior evidence does not lead to a clear directional hypothesis.

Method

Design

Nine-hundred-ninety-two first-grade LMs and 7,188 NEs were drawn from the ECLS-K dataset. Students' reading ability was assessed in the spring of first (2000), third, fifth, and eighth grades. Three ECLS-K data sources were used: (a) English-reading assessment (basic early reading skills [letter recognition and beginning and ending sounds], word reading, and reading comprehension); (b) parts of a parent interview; and (c) an oral English-language proficiency screener called the Oral Language Development Scale (OLDS) by the ECLS-K developers, which consisted of three subtests of the *Pre-Language Assessment Scales* [*PreLAS*; Duncan & DeAvila, 1998]). There were six variables in the present study. First, drawing from English-reading assessment data from the ECLS-K dataset, the following two variables were created for the present study: (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 or met a "mastery" level). In addition, the following two sets of variables were directly taken from the ECLS-K dataset: (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) a child's Time to Oral English-Language Proficiency (a child was assigned to one of five categories based on whether the child was required to take the test, and if required to do so, the time point [fall/spring kindergarten, and fall/spring first grade] at which the test was passed). Finally, a series of Hierarchical Generalized Linear Model (HGLM; Raudenbush & Bryk, 2002) analyses for longitudinal data was conducted.

ECLS-K Dataset

The current study was a secondary analysis of a subset of longitudinal data from the ECLS-K study (Tourangeau, Lê, Nord, & Sorongon, 2009), sponsored by the U.S. Department of Education, National Center for Education Statistics (NCES). Data were gathered from a large-scale, nationally representative sample of U.S. students entering kindergarten in the 1998–1999 school year and continuing through the spring of eighth grade. The ECLS-K study was a multifaceted study, designed to capture information on children, families, teachers, and schools, collected from student assessment, parent interviews, and educator surveys.

Analytic Sample

Five criteria for inclusion in the present study analytic sample were that a child had: (a) parental report of the primary language spoken in the home; (b) at least one measurement occasion of Reading-Comprehension Proficiency from the four reading data-collection points; (c) nonmissing values on Word-Reading Proficiency mastered in the spring of first grade; and (d) a non-missing sampling weight (from the ECLS-K database) on English-reading assessment for first, third, fifth, and eighth grades. (e) Finally, a child had to have passed an oral English Proficiency test by the spring of first grade. Some of the analytic sample students passed the OLDS in the fall of kindergarten, some in the spring of kindergarten, others in the fall of first grade, and some in the spring of first grade. A base level of English was required by the ECLS-K test authors in order for the reading assessment to be administered to a student.

The analytic sample consisted of 8,180 children, with 992 LMs and 7188 NEs. Both language-status subgroups were approximately evenly divided by gender. The LM group consisted of approximately 69% Hispanic, 19% Asian/Pacific Islander/Other, 11% White, and 1% Black. The NE-students group consisted of nearly 68% White, 16% Black, 10% Hispanic, and 6% Asian/Pacific Islander/Other. Note that Hispanic students in the NE group were likely second- or third-generation U.S.-born. From the ECLS-K database, it is clear that all the NE families spoke only, or primarily, English at home. Over 63% of LMs and 29% of NEs came from households in the bottom two SES quintile.

Data Source, Highest Proficiency Level Mastered Score, and Variables

DATA SOURCE: ECLS-K ENGLISH-READING ASSESSMENT

Two variables were created for the present study using children's responses to the ECLS-K English-reading assessment. Reading-Comprehension Proficiency was the dependent variable and was a categorical, two-group, variable. Word-Reading Proficiency served as a categorical, two-group, independent variable.

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. A wide variety of reading factors was measured on the test: basic skills (print familiarity, letter recognition, sounds for beginning and ending letters in words, rhyming sounds, and word recognition), vocabulary, and comprehension.

At each testing point, a two-stage adaptive testing approach was used for reading assessment such that a student entered the test with items that were at or near his/her reading level. In the first stage, students were administered a routing test. Based on the performance on the first-stage routing test, each child then received one of three reading test levels: a low, middle, or high difficulty level form (Tourangeau et al., 2009).

Especially relevant to the present study, clusters of "proficiency level" items were among the reading test items on forms, with each cluster containing four items. The proficiency level item clusters were hierarchically ordered, from knowing letters and sounds to reading sight words to reading words in context and then to increasingly complex comprehension (Tourangeau et al., 2009). There were 10 proficiency level item clusters. The lowest item cluster, proficiency level 1 assessed letter names, proficiency levels 2 and 3 assessed sound-symbol associations, level 4 addressed sight words, level 5 addressed reading words in context, and levels 6 through 10 addressed comprehension. Level 6 was aimed at inferencing using cues directly stated in the text, level 7 focused on inferencing using background knowledge, level 8 centered on understanding author's craft and making connections between the text and life problems. Level 9 addressed critical evaluation, comparing and contrasting, evaluation of nonfiction, and more, and level 10 focused on evaluation of text that included complex syntax and high-level vocabulary in biographical text. The four-item clusters in the 10 proficiency levels are the only items relevant to the present study. The 10 proficiency levels complied with the Guttman model (Guttman, 1950), such that students passing a particular skill level were assumed to have mastered all lower skill levels (Tourangeau et al., 2009).

HIGHEST PROFICIENCY LEVEL MASTERED SCORES

Before defining the two variables, it is necessary to further explain one of the ECLS-K reading scores, the Highest Proficiency Level Mastered by each student in reading. It is important to understand that there are two types of proficiency level scores in ECLS-K data: Highest Proficiency Level Mastered and IRT-based Proficiency Probability scores (Najarian, Pollack, Sorongon, & Hausken, 2009). In the present study, the Highest Proficiency Level Mastered scores were used to create the two variables, Reading-Comprehension Proficiency and Word-Reading Proficiency. No other ECLS-K reading scores were used in the present study.

The Highest Proficiency Level Mastered in reading represented a child's specific developmental level of mastery in reading, and more specifically, the highest of the 10 four-item clusters of proficiency levels that a student passed at a given time point (Najarian et al., 2009).

That is, a particular Highest Proficiency Level Mastered that a child attained at a certain point in time indicated that the student mastered all previous or lower levels and had not yet mastered higher levels (Tourangeau et al., 2009). To receive a proficiency level pass, a student must have answered three of the four items in a cluster correctly. The Highest Proficiency Level Mastered could only be achieved after mastery of all previous levels (cf. O'Connell, Logan, Pentimonti, & McCoach, 2013). For example, in the ECLS-K dataset, if at the third-grade testing time a child passed level 5 but not level 6, the child received a third grade Highest Proficiency Level of 5, indicating the child had performed well for knowledge of letter names and sound-symbol associations (levels 1, 2, and 3) and could read words well by sight and in context (levels 4 and 5 items), but did not pass the easiest, or lowest level comprehension items involving inferences from cues directly stated in text, thus not answering three of the four level-6 comprehension inference items correctly. The ECLS-K researchers provided reliability estimates for the Highest Proficiency Level Mastered for the spring of first, third, fifth, and eighth grades as .96, .96, .96, and .84, respectively (Najarian et al., 2009), indicating strong measurement reliability.

Variable: Reading-Comprehension Proficiency. Reading-Comprehension Proficiency was the dependent variable in the present study. It was a categorical dichotomous variable, which indicated whether a child had reached a designated mastery level of comprehension or not at each of the four assessment periods. The variable was created by considering the 10 proficiency-level (each level containing four items) sequence on the ECLS-K reading test and using the variable, Highest Proficiency Level Mastered, in the ECLS-K dataset. First, the ECLS- K proficiency level 8 was chosen as the reading-comprehension mastery level to be attained by eighth grade. The rationale for choosing reading-comprehension proficiency level 8 was that children passing proficiency level 8 had achieved a reasonably advanced comprehension ability. In ECLS-K terms, passing proficiency level 8 meant that a student could use explicit cues in text to make inferences, identify clues used to make inferences, use background knowledge to understand homonyms, understand why authors' make choices, understand how authors use 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 equivalent to eighth grade expectations in the NAEP eighth-grade reading framework. The NAEP expectations for eighth-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 eighth grade, the last ECLS-K assessment period, and the last assessment period considered in the present study.

Next, to create the Reading-Comprehension Proficiency variable a student's Highest Proficiency Level Mastered variable in the ECLS-K dataset for each assessment time point was used. If a student's Highest Proficiency Level Mastered was 8 or higher, the student was considered to have attained mastery level or high Reading-Comprehension Proficiency. If, at a given assessment point, the student's Highest Proficiency Level Mastered was 7 or lower, the student had not attained mastery level or was considered to have low Reading-Comprehension Proficiency.

Variable: Word-Reading Proficiency in spring of first grade. Word-Reading Proficiency was a dichotomous categorical predictor variable—a child had either low or high Word-Reading Proficiency in the spring of first grade. The Word-Reading Proficiency variable was created following similar procedures outlined by O'Connell et al. (2013) who also used the ECLS-K Highest Proficiency Level Mastered for the mathematics assessment. Children with initially low Word-Reading Proficiency were children who could have passed or failed to pass proficiency level 1 (letter recognition), 2 (beginning sounds), or 3 (ending sounds), but did not reach Highest Proficiency Level Mastered 4 (reading sight words) in the spring of first grade. On the other hand, children with initially high Word-Reading Proficiency were those whose Highest Proficiency Level Mastered was 5 (reading words in context) or above by the spring of first grade. Consequently, two clearly distinct groups of children were formed such that a group of children with moderate Word-Reading Proficiency was excluded (children who reached Highest Proficiency Level Mastered of 4, but did not achieve level 5 [reading words in context]).

DATA SOURCE AND VARIABLE: TIME

In the ECLS-K data, a child's age in months on the day the child completed the English reading assessment was provided. For the current study, the average age, centered on the first time point in the analyses, was used to denote each time point. Thus, the time variable was coded as 0, 24, 48, and 84 months for the spring of first, third, fifth, and eighth grade, respectively. Using average age and centering on first grade yielded the equivalent time point spacing as simply using months between test points, and the correct time spacing between the assessment time points resulted (Singer & Willett, 2003).

DATA SOURCE AND VARIABLE: LANGUAGE STATUS

From the ECLS-K parent interview, the language status classification for the present study was determined based on home-language information that participating students' parent/guardian provided during the first grade interview. 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 to be a LM student. In the analyses, Language Status was a dichotomous variable with a value of 0 indicating NE (the reference group) and a value of 1 indicating LM.

DATA SOURCES AND VARIABLES FOR CONTROLS

Gender, Race/Ethnicity, SES, and Time to Oral English-Language Proficiency were obtained directly from the ECLS-K dataset and included as control variables in the analyses.

Gender, Race/ethnicity, and SES. The Gender variable was represented by a dichotomous variable indicating whether a child was female or male. 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 a composite variable that captured the child's overall household income, father/male guardian's education, mother/female guardian's education, father/male guardian's occupation prestige, and mother/female guardian's occupational prestige. The household's SES variable was estimated on a continuous scale through a z-score transformation, and the range was −2.96 and 2.88.

Time to Oral English-Language Proficiency. The ECLS-K OLDS was administered to children who were identified for oral English-language proficiency screening. The OLDS consisted of three subtests of the English *PreLAS*: Simon Says, Art Show, and Let's Tell Stories. Simon Says measured listening comprehension, Art Show assessed expressive language, and Let's Tell Stories measured the ability to retell stories. The OLDS score (provided by ECLS- K authors) was the sum of the scores from the three subtests. Split-half reliability coefficients for the OLDS were .97, .96, .98, and .96 in the fall and spring of kindergarten, and the fall and spring of first grade, respectively (Najarian et al., 2009).

In the present study, the Time to Oral English-Language Proficiency variable was a categorical variable, in which LMs were categorized into five groups on the basis of the whether they were required to take the OLDS test, and if they were required to take the test, when they passed it. A cut-score of 37, determined by English *PreLAS* authors, out of a total composite OLDS score of 60 was required to pass. Children who passed a cut-score were assumed to be sufficiently proficient in English and thus were administered the English reading assessment (Najarian et al., 2009). The five groups in the present study included kindergarten children who were identified as not needing the OLDS (specified as the reference category) and children who became proficient in English (passed the cut-score of the OLDS) by the fall of kindergarten, the spring of kindergarten, the fall of first grade, and 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.

Data Analytic Approach

HANDLING MISSING DATA

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. Little's Missing Completely At Random test indicated that the current data were not missing completely at random ($\chi^2 = 195.99$, $df = 2$; $p < .001$; Little & Rubin 1987). Therefore, multiple imputations using an iterative Markov chain Monte Carlo technique were performed to include all observed data and maximize the power of analysis (Allison, 2002). During the multiple imputation processes, five imputed data sets were generated. The five imputed data sets were then combined to yield a final single set of results 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.

THE HGLM ANALYSIS

Hierarchical Generalized Linear Model (HGLM), a natural extension of the logistic regression model, was the statistical approach, as proposed by Raudenbush and Bryk (2002). The HGLM statistical modeling is used for growth modeling when the dependent variable is dichotomous (Raudenbush & Bryk, 2002). O'Connell et al. (2013) provide an exemplary analysis of the use of HGLM for growth modeling employing a dichotomous outcome variable and the same ECLS-K dataset used in the present study, but with a different sample and for a different research question. A dichotomous outcome variable violates assumptions of normality, linearity, and homoscedasticity presupposed by Ordinary Least Squares regression (Long, 1997), and consequently, Hierarchical Linear Modeling (HLM) would not be appropriate. The HGLM, a multilevel logistic regression model specifically designed for growth modeling with binary outcomes, employs a Bernoulli (or binominal) sampling model and logit link (Raudenbush & Bryk, 2002).

Hierarchical General Linear Modeling procedures outlined and illustrated in Raudenbush and Bryk (2002) and employed in O'Connell et al. (2013) and others were followed. In the two-level model, the dependent variable was Reading-Comprehension Proficiency. The independent predictor was Word-Reading Proficiency. Control variables were child Gender, Race/Ethnicity, SES, and Time to Oral English-Language Proficiency. Time (four Reading-Comprehension Proficiency assessment points) was specified at level 1. The level-1 model captured within-individual change in the log-odds (i.e., a logit; the natural log of the odds of the dependent variable occurring or not) of Reading-Comprehension Proficiency over time as a linear and quadratic function of time. Given the binary outcome with the Bernoulli distribution, the logit link function was used. Time of outcome assessment was nested in level 2, the child level. In the level-2 model, between-individual differences in linear and quadratic patterns of change were examined as a function of the main effects and interaction effects of Language Status and Word-Reading Proficiency and main effects for control variables.

A taxonomy of multilevel models for change was fitted following Raudenbush and Bryk's method (2002). First, a set of three unconditional models was fit to identify the best model to capture the shape of the growth curve (linear versus quadratic). The first unconditional model had no predictor and was conducted to estimate variance in initial status (intercept) and slope. The second unconditional model included a random intercept and a random effect for linear change with no predictors specified at level 2. In the third unconditional model, an acceleration/deceleration parameter associated with level-1 predictor was added. Finally, the fourth model was a conditional growth model. It was based on the best-fit model of the three unconditional models and included a quadratic effect for growth along with Word-Reading Proficiency, Language Status, and Word-Reading Proficiency by Language Status interaction.

Best-fit was determined through model comparisons of deviance statistics.

A composite form of the final conditional growth model was expressed as follows:

$$
\begin{aligned}
\eta_{ti} = \log\left(\frac{\varphi_{ti}}{1-\varphi_{ti}}\right) &= \gamma_{00} + \gamma_{10} TIME_{ti} + \gamma_{20} TIME^2{}_{ti} \\
&+ \gamma_{01} WRP_{ti} \times LS_{ti} + \gamma_{02} WRP_{ti} + \gamma_{03} LS_{ti} + \gamma_{04} CONT_{ti} \\
&+ \gamma_{11} WRP_{ti} \times LS_{ti} \times TIME_{ti} + \gamma_{12} WRP_{ti} \times TIME_{ti} \\
&+ \gamma_{13} LS_{ti} \times TIME_{ti} + \gamma_{14} CONT_{ti} \times TIME_{ti} \\
&+ \gamma_{21} WRP_{ti} \times LS_{ti} \times TIME^2{}_{ti} + \gamma_{22} WRP_{ti} \times TIME^2{}_{ti} \\
&+ \gamma_{23} LS_{ti} \times TIME^2{}_{ti} + \gamma_{24} CONT_{ti} \times TIME^2{}_{ti} + \zeta_{0i},
\end{aligned}
$$

where $\zeta_{0i} \sim \text{Logistic}\left(0, \frac{\pi^2}{3}\right)$ with fixed mean and variance.

In the composite final model, η_{ti} represented log-odds of achieving Reading-Comprehension Proficiency for child *i* at time point *t*, and φ_{ti} was the probability of child *i* achieving Reading-Comprehension Proficiency at time point *t*. Parameters γ_{00}, γ_{10}, and γ_{20} represented average overall initial status (spring of first grade), average true instantaneous growth rate, and average true acceleration/deceleration. Parameters γ_{01}, γ_{11}, and γ_{21} represented the interaction effect between Word-Reading Proficiency (i.e., *WRP*) and Language Status (i.e., *LS*) on the initial status, instantaneous growth rate, and acceleration/deceleration. Parameters γ_{02}, γ_{12}, and γ_{22} represented the main effect of Word-Reading Proficiency on initial status, instantaneous growth rate, and acceleration/deceleration, respectively. Parameters γ_{03}, γ_{13}, and γ_{23} represented the main effect of Language Status on the initial status, instantaneous growth rate, and acceleration/deceleration, respectively. Parameters γ_{04}, γ_{14}, and γ_{24} represented the effects of control variables (i.e., *CONT*) on the initial status, instantaneous growth rate, and acceleration/deceleration, respectively. The between-child error term, $\zeta_{0\mathrm{i}}$, represented each child's deviation from the average true initial status.

Estimates in the HGLM models were weighted by sample weights provided by the ECLS-K researchers. The weights compensated for unequal probability of selection in the sample design, and they permitted a more accurate inference to the population (Little, 1991).

A SPECIAL NOTE ABOUT INTERPRETING THE COEFFICIENTS IN THE HGLMS

An important distinction between parameter interpretation in linear regression models and the HGLM model is how coefficients(beta values) are interpreted. In HLM, a coefficient is used to interpret the magnitude and direction of effect of independent variables on a dependent variable. However, in HGLM, to use coefficients, the dichotomous dependent variable is transformed into log-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.

In HGLM, coefficients are not directly interpretable. Instead, coefficients are themselves odds-ratios, and odds-ratios aid interpretation of direction and strength of the association between a predictor variable and occurrence of the outcome variable. The odds ratio is the ratio of the probability of success in one group relative the probability of success in the other group. Consider for example, Word-Reading Proficiency. An odds-ratio greater than 1.0 indicates that the high Word-Reading Proficiency 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 is the low Word-Reading Proficiency group. An odds-ratio of 1.0 indicates that an association does not exist and that there is no difference in the odds for the high Word-Reading Proficiency group achieving Reading-Comprehension proficiency and the odds for the low Word-Reading Proficiency group. Additionally, odds-ratios for interactions are not directly interpretable in the same manner as they are for main effects.

Results

In the following sections, first preliminary analyses are discussed. Then results for the research question are presented (the statistical interaction), after which the statistically significant main effect results for Language Status and Word-Reading Proficiency are described. Results for the control variables are not described because they were in the statistical models solely to adjust for effects and were not of special interest. Only the final model results are discussed.

Preliminary Analyses

We begin by describing the LMs' OLDS performance. Table 1 displays summary results. An overall conclusion was that the LMs displayed a wide range of oral English-language proficiency by the spring of first grade, but also most of the LMs had oral English proficiency levels close the cut-off score for passing the OLDS. First, 28% ($n = 282$) of the 992 LMs were not required to take the OLDS test at all, indicating their kindergarten teachers thought their oral English was sufficient to take the reading test. Second, as late as the spring of first grade, 168 children (approximately 17% of the total LM sample) were still required to take the OLDS. The range of numbers of children not required versus those still required to take the test at end of first grade suggested wide variation in LMs' oral English ability. Third, the quartile breakouts (and frequency distributions) at each OLDS assessment period revealed that fairly large numbers of students who took the OLDS at a given time point did not pass it. For instance, at the fall of kindergarten, of the 647 LMs who took the OLDS, 50% did not pass the OLDS (see Quartiles 1 and 2 shown in column two of Table 1 with the upper score limit of 36, just under the cut score of 37). As another example, at the fall of first grade, of the 66 LMs who took the OLDS test, again at least 50% of those students did not pass the OLDS (see column 8 in Table 1 which shows the cut point for the 50th percentile in the ranked scores as 33.50). Fourth, at the fall of kindergarten only approximately 33% of the total LM sample (n = 992) passed the oral English test (not shown in Table 1). By the fall of kindergarten, only 61% of the total LM sample could be considered to have at least minimal oral English proficiency (28% did not have to take the test and 33% passed). Finally, and perhaps most importantly, when frequency distributions of OLDS scores were examined for test takers at each OLDS assessment period, most of the scores for LMs who passed the OLDS tended to aggregate near the cut-off score, creating a positive skew. Table 1 implies a similar result for each test period. For instance, at the fall of kindergarten for

TABLE 1 Oral language development screener (OLDS) number of students (percentages of language minority sample), means (standard deviations), median, range, and quartiles for LM learners who took and passed OLDS in kindergarten and first grade

	Fall Kindergarten			Spring Kindergarten			Fall Grade 1			Spring Grade 1
	LMs given OLDS	LMs who passed OLDS	LMs who did not pass OLDS	LMs given OLDS	LMs who passed OLDS	LMs who did not pass OLDS	LMs given OLDS	LMs who passed OLDS	LMs who did not pass OLDS	LMs who passed OLDS
n (%[a])	647	323	313	397	213	184	66	26	40	168
	(65.22)	(32.56)	(31.55)	(40.02)	(21.47)	(18.55)	(6.65)	(2.62)	(4.03)	(16.94)
Mean	32.23	45.89	18.60	35.30	45.33	23.70	32.38	43.50	25.15	44.85
(SD)	(16.67)	(6.06)	(12.10)	(13.12)	(6.00)	(8.84)	(11.16)	(5.16)	(7.39)	(5.82)
Median	36.00	44.00	20.00	38.00	44.00	25.00	33.50	42.00	25.00	44.00
Range	0–60	37–60	0–36	0–60	37–60	0–36	12–60	37–60	12–36	37–60
Quartile[b]										
Quartile 1	20.00[c]	41.00	8.00	26.00	40.50	18.00	22.75	40.00	19.25	41.00
(*n*; low)	(168)	(85)	(84)	(122)	(70)	(52)	(18)	(8)	(10)	(52)
Quartile 2	36.00	44.00	20.00	38.00	44.00	25.00	33.50	42.00	25.00	44.00
(*n*)	(156)	(83)	(73)	(87)	(43)	(44)	(18)	(6)	(12)	(48)
Quartile 3	44.00	50.00	30.00	45.00	50.00	31.00	41.00	46.50	31.75	48.00
(*n*)	(168)	(82)	(85)	(104)	(53)	(51)	(14)	(6)	(8)	(31)
Quartile 4	60.00	60.00	36.00	60.00	60.00	36.00	60.00	60.00	36.00	60.00
(*n*)	(155)	(73)	(71)	(84)	(47)	(37)	(16)	(6)	(10)	(37)

Notes. [a]Percentages are based on the complete LM sample ($n = 992$). [b]For the students who took the test at a given time period, rank order the students and break into quartiles. [c]The OLDS score cut point for the quartile.

the LMs who passed the OLDS, only approximately 33% of LMs passed the oral English test with a cut-off score of 37 or better (see the first row of the third column in Table 1). However, at the fall of kindergarten, the mean score of test takers at that time point was slightly higher than the median (44.00) showing a positively skewed distribution, which indicated that, on the whole, those who passed the OLDS were barely qualified to be considered to be English proficient (see column three in Table 1). Overall, while LMs in the present study had passed the OLDS cut-off score by the end of first grade, many of them likely met only a minimum threshold of oral English-language proficiency. On the whole, the LMs' oral English proficiency levels likely were not comparable to their NE peers.

Table 2 displays proportions (and standard deviations) of children achieving Reading-Comprehension Proficiency by the full sample, Language-Status subsamples, and Word-Reading Proficiency Groups within Language-Status groups across first, third, fifth, and eighth grades. As would be expected, when considering the full sample of all students, the proportion of children achieving Reading-Comprehension Proficiency for the full sample gradually increased over time, with .68 of the children achieving level-8 mastery proficiency by eighth grade (see the Marginal Means in column 4). In addition, for the full sample, regardless of Language Status, from third grade on, children with initially high Word-Reading Proficiency (column 3) tended to achieve.

Reading-Comprehension Proficiency to a far greater degree than children with initially low Word-Reading Proficiency (column 2). For example, by eighth grade, .81 of children with initially high Word-Reading Proficiency achieved Reading-Comprehension Proficiency ("mastery" level 8), whereas only .37 of children with initially low Word-Reading Proficiency had achieved Reading-Comprehension Proficiency.

Turning to the comparison of LMs' (column 7) and NEs' (column 10) Reading-Comprehension Proficiency progress across grades, regardless of Word-Reading Proficiency, there were some differences between the two groups depending on the year tested. As would be expected, the proportions of LMs and NEs who achieved Reading-Comprehension Proficiency in first grade were 0 and near 0, respectively. However, greater absolute differences between the two subgroups appeared by third grade,

TABLE 2 Proportions (standard deviations) of students achieving reading-comprehension proficiency in first, third, fifth, and eighth grades by full sample and by word-reading proficiency groups within language status groups

	Full Sample			Subsamples by Language Status					
				Language-minority learners			Native-English-speaking speakers		
Grade	Low WRP ($n =$ 2311)	High WRP ($n =$ 5869)	Marginal Mean	Low WRP ($n =$ 435)	High WRP ($n = 557$)	Marginal Mean	Low WRP ($n =$ 1876)	High WRP ($n =$ 5312)	Marginal Mean
G1	.00 (.00)	.02 (.13)	.01 (.11)	.00 (.00)	.01 (.10)	.00 (.07)	.00 (.00)	.02 (.13)	.01 (.11)
G3	.05 (.21)	.38 (.49)	.28 (.45)	.03 (.16)	.27 (.44)	.15 (.35)	.05 (.22)	.39 (.49)	.29 (.45)
G5	.18 (.38)	.56 (.50)	.44 (.50)	.13 (.34)	.40 (.49)	.26 (.44)	.19 (.39)	.57 (.49)	.46 (.50)
G8	.37 (.48)	.81 (.39)	.68 (.47)	.36 (.49)	.81 (.39)	.61 (.49)	.41 (.48)	.81 (.39)	.68 (.47)

Note. Proportion is equivalent to the mean of a variable with the value of 0 and 1 and can therefore be interpreted as a probability. WRP = Word-Reading Proficiency.

with .15 of the LMs achieving Reading-Comprehension Proficiency, but with nearly double that proportion for NEs (.29). However, by eighth grade the proportion of LMs, on the whole, attaining Reading-Comprehension Proficiency was highly similar to NEs (.61 and .68, respectively).

Table 3 shows zero-order phi-coefficient correlations among Language Status, Word-Reading Proficiency, Reading-Comprehension Proficiency, and Time to Oral English-Language Proficiency variables for the full sample and Language-Status subsamples. On the whole, for the full sample, first-grade Word-Reading Proficiency was nearly unrelated to Reading-Comprehension Proficiency at first grade ($r_\varphi = .06$), although the correlation was significant. The result is consistent with expectations in that it would be unlikely that first grade children would attain comprehension levels similar to upper middle grades students. The low correlation likely occurred due to low variance among students in reaching Reading-Comprehension Proficiency in an early grade. However, also as expected, the correlation between first-grade Word-Reading Proficiency and Reading-Comprehension Proficiency increased substantially after first grade and stabilized at moderate levels across third, fifth, and eighth grades ($r_\varphi = .34$ to $.41$). Similar results obtained for both LMs ($r_\varphi = .08$

TABLE 3 Phi-correlation coefficients among variables for full sample and language-status subsamples

	Full Sample				Language-Status Subsamples[a]								
	1	2	3	4	1	2	3	4	5	6	7	8	9
1. WRP[b] G1	—				—	**.06**	**.33**	**.32**	**.41**				
2. RCP G1	**.06**	—			.08	—	**.05**	**.08**	**.06**				
3. RCP G3	**.34**	**.06**	—		**.36**	**.16**	—	**.35**	**.28**				
4. RCP G5	**.33**	**.09**	**.36**	—	**.32**	**.11**	**.40**	—	**.29**				
5. RCP G8	**.41**	**.06**	**.28**	**.30**	**.40**	**.07**	**.25**	**.28**	—				
6. OLDS in Fall K					**.16**	.02	**.12**	**.12**	**.16**	—			
7. OLDS in Spring K					−.03	−.04	**−.12**	**−.15**	−.08	**−.32**	—		
8. OLDS in Fall G1					**−.11**	−.02	−.08	−.02	**−.12**	**−.12**	**−.12**	—	
9. OLDS in Spring G1					**−.26**	−.04	**−.13**	**−.11**	**−.27**	**−.31**	**−.30**	**−.25**	—

Note. Statistically significant correlation coefficients ($p < .05$) are in **bold**. WRP = Word-Reading Proficiency, RCP = Reading-Comprehension Proficiency, OLDS = Oral Language Development Scale, K = Kindergarten, G = Grade.

[a]The coefficients for LMs are in a lower diagonal and for NEs are in an upper diagonal.

[b]The reference category (coded as 0) is low Word-Reading Proficiency.

for first grade to .40 at eighth grade) and NEs (r_φ = .06 for first grade to .41 at eighth grade) for the rising correlational relations between Word-Reading Proficiency and Reading-Comprehension Proficiency.

Turning to the full-sample correlations among the four time-points for Reading-Comprehension Proficiency, again, as expected, correlations of first grade with upper grades were quite low (r_φ = .06 to .09). The result was again likely due to the variance constraints in the lower grades. However, with more variability in Reading-Comprehension Proficiency as grades increased, cross-time-point correlations also increased (r_φ = .28 to .36 for fourth through sixth grades). Parallel results obtained for both LMs and NEs where there were low correlations of first grade with upper grades (LM r_φ = .07 to .16; NE r_φ = .05 to .08) and higher correlations for fourth through sixth grade (LM r_φ = .25 to .40; NE r_φ = .28 to .35). In short, the correlational patterns met expectations for variable behavior.

Finally, as shown in the zero-order correlations in Table 3, among LMs, when a subset of correlations was taken as a collective, a pattern emerged suggesting a strong negative relationship between Word-Reading Proficiency and the time the OLDS test was passed. That is, children who took and passed the oral English test earlier were more likely to attain high Word-Reading Proficiency in first grade than others who took and passed the oral English test later. For the LMs who were required to take the OLDS test, the correlations of Word-Reading Proficiency (in first grade) and the four categories for Time to Oral English- Language Proficiency were .16, −.03, −.11, and −.26, respectively, for increasing lengths of time for passing the OLDS test. The shift from an earlier positive correlation to the later increasingly negative correlations signals that children who took and passed the oral English test earlier tended to have higher first grade Word-Reading Proficiency whereas children who took the OLDS test later tended to have lower first grade Word-reading Proficiency. The result supports the decision to include oral English proficiency, measured as Time to Oral English-Language Proficiency, as a control variable in the statistical analyses.

Research Question: Was the relation between first-grade Word-Reading Proficiency and Reading-Comprehension-Proficiency growth through eighth grade different for LMs as compared to their NEs?

The relation between Word-Reading Proficiency and Reading-Comprehension-Proficiency growth was different for LMs compared to their NEs. The research question was addressed in the statistical interactions. Table 4 presents the sources of variance for all models. In the final model (i.e., Model D), the relation varied statistically significantly according to children's Language Status at the intercept ($\beta = .62$, $p < .001$), for instantaneous growth rate ($\beta = -.01$, $p < .001$), and for acceleration/deceleration of growth ($\beta = .0001$, $p < .001$), controlling for children's demographic backgrounds and Time to Oral English-Language Proficiency. Figure 1 depicts the interaction, and coupled with odds ratios, it aids interpretation of the significant interaction effects. Two sections follow. First, within word-reading subgroups, LM and NEs' reading-comprehension growth trajectories are compared for high word readers and then for low word readers, parameter by parameter. Second, within word reading subgroups, LM and NE subgroups' reading-comprehension growth trajectories are compared descriptively by considering the raw odds of students' attaining reading-comprehension mastery at first, third, fifth, and eighth grade.

Taken together, the following sections portray this result: Among initially high word readers, LMs' initial reading comprehension was lower than their NE peers, but over time, they closed the gap. Among low word readers, LMs' initial reading comprehension was similar to their NE peers, but over time, a gap between LMs and NEs appeared and widened. That is, in comparison to NE peers, for long-term reading-comprehension growth, initially high word reading particularly advantaged LMs, and initially low word reading particularly disadvantaged LMs.

PARAMETER BY PARAMETER, NES' TRAJECTORIES COMPARED TO LMS' TRAJECTORIES FIRST FOR HIGH WORD READERS AND THEN FOR LOW WORD READERS

Starting with the high Word-Reading Proficiency group, the NEs and LMs exhibited concave (decelerating) and

TABLE 4 Sources of variance for fitting a taxonomy of hierarchical generalized linear models

		Model A		Model B		Model C		Model D	
		β	*OR*	β	*OR*	β	*OR*	β	*OR*
Fixed effects									
Initial status									
Intercept	γ_{00}	−.59***	.55	−3.33***	.04	−4.77***	.01	−5.06***	.01
Language Status[a]	γ_{03}							−1.18***	.31
WRP[b]	γ_{02}							2.04***	7.70
Language Status × WRP	γ_{01}							.62***	1.85
Instantaneous growth rate									
Intercept	γ_{10}			.06***	1.06	.14***	1.15	.10***	1.10
Language Status[a]	γ_{13}							−.05***	1.05
WRP[b]	γ_{12}							−.02***	.98
Language Status × WRP	γ_{11}							−.01***	1.01
Acceleration/ deceleration rate									
Intercept	γ_{20}					−.001***	.999	−.001***	.99
Language Status[a]	γ_{23}							−.001***	.99
WRP[b]	γ_{22}							.0001***	1.001
Language Status × WRP	γ_{21}							.0001***	1.001
Variance component									
Within-child		−1.33***	.01	.99***	.003	1.12***	.003	.29***	.004
Goodness of fit									
Deviance (−2LL)		11,722,70.2		8,561,193.6		8,212,451.6		7,030,645.8	
AIC		1.17e+07		8,561,200		8,212,460		7,030,726	
BIC		1.17e+07		8,561,223		8,212,491		7,031,041	

Note. All models include control variables (i.e., Gender, Race/ethnicity, Socio-economics status, and Time to Oral English-Language Proficiency). WRP = Word-Reading Proficiency. OR = odds ratio. −2LL = −2 × Log Likelihood. AIC = Akaike Information Criterion. BIC = Bayesian Information Criterion.

[a]The reference category (coded as 0) is native English-speaking students.

[b]The reference category (coded as 0) is low Word-Reading Proficiency.

†*$p < .05$, **$p < .01$, ***$p < .001$ (two-tailed tests).

converging trajectories. In the aggregate, NEs and LMs in the initially high Word-Reading Proficiency group (the top two lines in Figure 1) performed slightly differently from one another at the intercept and very slightly differently for instantaneous growth rate and deceleration. The two groups' growth curves decelerated beginning around the spring of

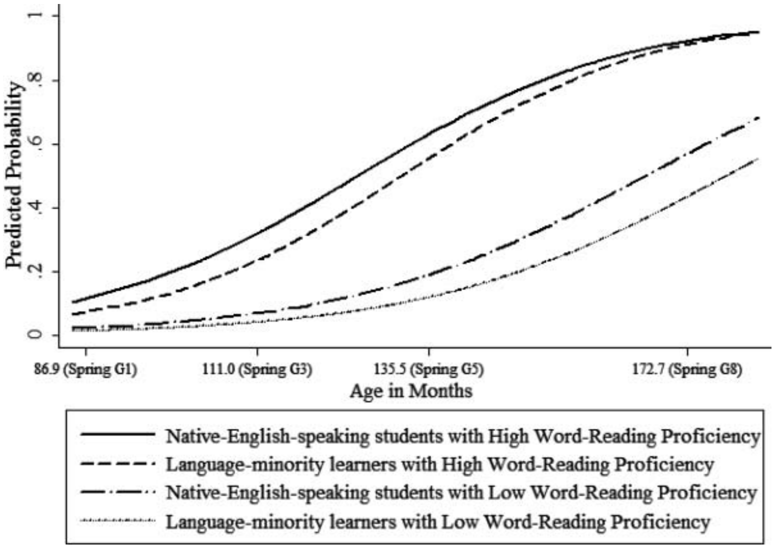

FIGURE 1 Interaction of Language Status and Word-Reading Proficiency on Expected Growth in the Probabilities of Achieving Reading-Comprehension Proficiency. Note. G1 = first grade, G3 = third grade, G5 = fifth grade, and G8 = eighth grade. Age in months was the average age of children at each test point. Average age in months at each test point is alternative language for spacing the time correctly in the graph.

fifth grade, and at least from a practical standpoint, LMs lagged behind NEs through the elementary grades. The trajectory for NEs had a very slightly higher deceleration rate than that for LMs such that by the spring of eighth grade LMs caught up with their NE counterparts.

However, to the contrary, for initially low Word-Reading Proficiency students (the bottom two lines in Figure 1), although NE and LMs' Reading-Comprehension Proficiency growth was similar at the start and through the early grades, after third grade, LMs began to lag behind NEs, and the gap continued to widen through eighth grade. For both NEs and LMs in the low Word-Reading Proficiency group, the growth pattern was convex, accelerating over time, but NEs accelerated more than their counterpart LMs with low Word-Reading Proficiency. On average, LMs with initially low Word-Reading Proficiency ended eighth grade with the lowest Reading-Comprehension Proficiency of all groups.

NATIVE-ENGLISH-SPEAKING STUDENTS' TRAJECTORIES COMPARED TO LMS' TRAJECTORIES: RAW ODDS OF ATTAINING READING COMPREHENSION MASTERY AT THE FIRST, THIRD, FIFTH, AND EIGHTH GRADE

Turning to a descriptive comparison of the four subgroups' Reading-Comprehension Proficiency progress by Language Status and high versus low Word-Reading Proficiency, Table 2 provides the odds of students' attaining mastery of Reading-Comprehension Proficiency at each of the four time points. Note that the table only provides raw score proportions of students at each static time point, and does not portray data used for the predicted growth curves per se. However, the raw score proportions are informative. Starting with the high Word-Reading Proficiency students, as would be expected, at first grade very few children in either language group attained Reading-Comprehension Proficiency (.01 and .02 for LMs and NEs, respectively). Through fifth grade, LMs with high Word-Reading Proficiency (.27 and .40, for third and fifth grade, respectively) lagged a bit behind their NE counterparts with high Word-Reading Proficiency (.39 and .57, respectively). However, by eighth grade, the proportions of LMs and NEs with high Word-Reading Proficiency were identical (.81).

For initially low Word-Reading Proficiency subgroups, the progression from first grade through third grade was highly similar for proportions of LMs (.00 to .03) and NEs (.00 to .05) attaining Reading-Comprehension Proficiency. At fifth grade, LMs (.13) lagged behind NEs (.19) slightly, and by eighth grade, LMs (.36) lagged even more (NEs = .41), again suggesting a widening gap between the two groups.

Main Effects for Language Status

There were statistically significant main effects for language status at intercept ($\beta = .73$, $p < .001$), instantaneous growth rate ($\beta = -.05$, $p < .001$), and acceleration/deceleration ($\beta = .001$, $p < .001$), controlling for children's demographic backgrounds and Time to Oral English- Language Proficiency. However, the interaction of Word-Reading Proficiency and Language Status over-rode interpretation of the main effects for all three parameters. That is, it is not accurate to say that, on the whole, one

Language Status group outperformed the other in the odds of achieving mastery of Reading-Comprehension proficiency at intercept, instantaneous growth rate, or for acceleration/deceleration. Instead, as previously described, and as can be seen in Figure 1, language group performance was dependent on initial Word-Reading Proficiency.

Main Effects for Word-Reading Proficiency

There were significant effects for Word-Reading Proficiency, again for initial status ($\beta = 2.04$, $p < .001$), instantaneous growth rate ($\beta = -.02$, $p < .001$), and acceleration/deceleration ($\beta = .0001$, $p < .001$), controlling for children's demographics and Time to Oral English-Language Proficiency. All three main effects did hold in the face of the significant interaction. There was a moderately strong effect in growth pattern differences by Word-Reading Proficiency group, regardless of language status within Word-Reading Proficiency group. As can be seen in Figure 1, at the intercept and for instantaneous rate of growth, high Word-Reading Proficiency students (the top two subgroups) very slightly outperformed low Word-Reading Proficiency students (the bottom two subgroups). Moreover, high Word-Reading Proficiency students exhibited a concave Reading-Comprehension Proficiency growth pattern, decelerating after fifth grade, while low Word-Reading Proficiency exhibited a convex growth pattern, accelerating over that same time period. The trajectory patterns of the two high word reader subgroups (the top two groups in Figure 1) were similar to one another, and the patterns of growth trajectories for the two low word reader subgroups were similar to one another (the bottom two trajectories in Figure 1), but the high word reader pattern was different from the low word reader pattern. The trajectory pattern of high word readers tended to diverge increasingly from low word readers from about fifth grade on.

Figure 2 clarifies the main effect by depicting the two Word-Reading Proficiency groups' odds of achieving mastery of Reading-Comprehension Proficiency over the grades (while ignoring the Language Status effect). At initial status, for high Word-Reading Proficiency students, the odds of achieving Reading-Comprehension Proficiency were 7.70 times ($OR = 7.70$) greater than

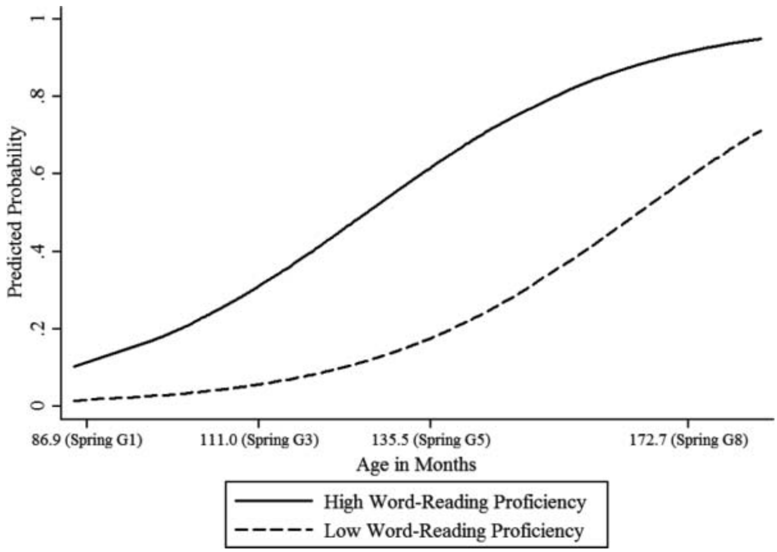

FIGURE 2 Predicted Growth in the Probabilities of Achieving Reading-Comprehension Proficiency for Children with High Word-Reading Proficiency and Children with Low Word-Reading Proficiency. Note. G1 = first grade, G3 = third grade, G5 = fifth grade, and G8 = eighth grade. Average age in months at each test point is alternative language for spacing the time correctly in the graph.

the odds for low Word-Reading Proficiency students. While the two groups were distinguished at initial status, they had very similar odds of achieving Reading-Comprehension Proficiency instantaneous growth rate (OR = .98). The largest difference between the groups was in acceleration versus deceleration between fifth grade and eighth grade. Despite the low group's acceleration, the gap between the high and low groups still remained large by eighth grade.

Conclusion, Limitation, Discussion, and Implications

Conclusion

The current study is the first to provide information about the association of early English word reading with English-reading-comprehension growth for a large nationally representative sample of LMs and NEs from first through eighth grade. The main conclusion was that the relation between early Word-Reading Proficiency and Reading-Comprehension Proficiency was different for LMs as compared to their NEs. Among initially high word readers, LMs' initial reading comprehension was lower than their NE peers, but over time, they closed the gap, with the two groups exhibiting similar comprehension levels at eighth grade. Among low word readers, LMs' initial reading comprehension was similar to their NE low word-reading peers, but over time, a gap between LMs and NEs' reading comprehension appeared and widened. That is, in comparison to NE peers, for long-term reading-comprehension growth, initially high word reading particularly advantaged LMs, and initially low word reading particularly disadvantaged LMs.

Additionally, regardless of language status, initially high word readers outperformed low word readers for reading comprehension growth. Moreover, initially high word readers demonstrated a concave reading-comprehension growth pattern, with comprehension decelerating over time, whereas initially low word readers exhibited a convex reading comprehension growth pattern, with comprehension accelerating over time.

Limitations

As conclusions and implications are considered, it is important to keep in mind that LMs in the present study were students who had passed an oral English proficiency assessment by the end of first grade. There was considerable variability in the LMs' levels of oral English proficiency, and their oral English proficiency, on the whole, was not likely comparable to their NE peers, but they did at least have minimal oral English abilities. Consequently, the results are relevant to similar students with at least minimal oral English proficiency by the end of first grade rather than to the LM population in general.

Because there was considerable variability in the LMs' oral English proficiency, it was especially important to control for initial oral English proficiency in the statistical analyses. However, although the OLDS test was reliable and valid and was extracted from another widely used oral English test, because all LMs did not take the test at one time point it was challenging to understand the children's comparative standing on the test at a single time point such as the end of first grade. Similarly, LMs' oral English abilities could not be defined in relation to their NE peers because all NEs did not take the OLDS test. Administration of an oral English test to all children, LM and NE alike, at one-time point would have enabled the comparative description of the two subgroups' oral English abilities.

Discussion

Initially high word-reading proficiency particularly advantaged lms, and initially low word-reading proficiency particularly disadvantaged lms. Both theory and prior research with monolingual English students suggest that 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 meaning from text (e.g., LaBerge & Samuels, 1974; Stanovich, 1991). The present study results extend the prior theory and research findings to LMs, but also suggest that the importance of early word-reading ability may be exacerbated for LMs as compared to monolingual NE peers.

Possible reasons for the comparatively weak reading comprehension growth for LMs who had initially low word-reading ability (as compared to NE peers who also had initially low word-reading ability) are not immediately evident from the current data, but one conjecture might be that first grade teachers of LMs who had low word-reading ability did not believe that the children were "ready" for word-reading emphases whereas they may have provided more word-reading instruction, or instruction relevant for learning to read words, for NE children.

The similarly concave reading-comprehension trajectories for the NE and LM initially high word readers was remarkable as was the fact that at the end of eighth grade the two groups performed similarly. The results suggested that young LMs can make impressive reading progress under certain conditions, one of which is the early acquisition of word-reading strategies. Given that the children were from homes where a language other than English was spoken, the LMs had not had extensive English exposure comparable to their NE peers. In that respect, their progress was particularly noteworthy.

It is also significant that the differences in the relationship between early word reading and reading-comprehension growth according to language status existed after accounting for children's gender, race/ethnicity, SES, and time to pass an oral English-language test. In particular, controlling for LMs' oral English abilities meant that oral English ability was removed from the focal relationship of early word-reading ability and reading-comprehension growth. That is, initial word-reading ability was directly related to reading-comprehension growth irrespective of LMs' oral English abilities.

Regardless of language status, initially high word readers outperformed initially low word readers on reading-comprehension growth. The result for the comparative reading-comprehension growth for initially high versus low word readers was antithetical to two prior sets of results with middle grades LMs who were predominantly native-Spanish-speaking (Lesaux et al., 2010; Mancilla-Martinez et al., 2011). In the two prior studies, middle grades LMs' English word reading was not related to English-reading comprehension from fourth through fifth grade. Moreover, in one of the prior studies, the contribution of oral English proficiency to reading comprehension was greater than the contribution of word-reading ability (Lesaux et al., 2010). One probable reason for the discrepant results was the differences in ages/grades studied. The longer-term analysis could provide a more complete portrayal of the word-reading and reading-comprehension growth relation. Another reason for the disparate results could be related to the types of reading-comprehension measures used. For instance, in the Mancilla-Martinez et al. (2011) study, the comprehension measure was a composite that included vocabulary, whereas our reading-comprehension indicator did not specifically address vocabulary. A third reason could be related to the study samples in that the two prior study samples were predominantly Latino whereas the present study sample included students with many different native languages.

The present results support prior contentions that the foundational role of word reading in reading processes may permeate throughout ensuing years. However, from the present study, it is not possible to know the nature of the foundational role of word reading. For instance, perhaps early word-reading ability serves as a mediator, such that young children who acquire strong word-reading ability early experience success in reading, they enjoy reading, and they read a lot. Wide reading in turn may enhance their comprehension and comprehension growth. Another possibility for the foundational role of word reading is that there is simply an optimal level of word-reading capacity that once established gives way to the prominence of other facets of reading such as vocabulary meanings and advanced comprehension strategies.

Initially high word readers demonstrated a concave reading-comprehension growth pattern, with comprehension decelerating over time, whereas initially low word readers exhibited a convex reading-comprehension growth pattern, with comprehension accelerating over time. The variant patterns of English-reading-comprehension growth according to initial word-reading ability in the present study may be compared to prior studies involving LMs when either reading comprehension or different reading constructs were measured over time. The initially high word readers' concave quadratic reading-comprehension growth was similar to the pattern displayed in the few prior long-term studies of LM reading-ability growth, whereas the initially low word readers' convex quadratic differed from the prior patterns. In the few prior studies of LMs' reading ability or reading achievement growth, concave quadratic patterns were revealed, with growth slowing over time. Two groups of LMs with initially higher and initially lower oral English proficiency displayed concave reading-ability growth curves from kindergarten through fifth grade (Kieffer, 2008) and through eighth grade (Kieffer, 2011), with the former subgroup's growth approximating NE peers', but the latter subgroup's growth remaining below their NE peers' on average (Kieffer, 2008, 2011). Similarly, reading achievement trajectories for subgroups of native-Spanish-speaking and Asian English-language learners, as well as their NE counterparts were concave in form from kindergarten through fifth grade (Roberts et al., 2010). Finally, in another study of LMs on short-term reading-comprehension growth from fourth through fifth grade, the growth took on the concave pattern (Mancilla-Martinez et al., 2011). The concave quadratic curve has also been documented for monolinguals in long-term reading-growth studies (involving various measures of reading) (e.g., Francis, Shaywitz, Stuebing, Shaywitz, & Fletcher, 1996; Williamson, Fitzgerald, & Stenner, 2014).

In a similar vein, previous studies have documented more similarity than difference in LM and NE reading ability or reading-achievement growth patterns for periods of time ranging from 1 to 6 years (e.g., Kieffer & Vukovic, 2013; Roberts et al., 2010), with some evidence that LMs' reading-growth performance tended to be lower than NEs' (cf. August & Shanahan, 2006, for a research review). However, the divergent reading-comprehension growth patterns according to initial word-reading ability in the present study imply a somewhat more complicated understanding than prior research revealed.

To our knowledge, no prior research has documented the convex reading growth curve witnessed in the present study for initially low word readers. Perhaps the variant growth pattern existed in prior study samples, but was disguised because moderating effects of early reading factors were not investigated. Another possible reason could be related to the different outcome measures of reading, with only one of the former relevant studies (Lesaux et al., 2010) including a distinct measure of reading comprehension.

Two final points about the variant reading-comprehension growth patterns are noteworthy. The first point was that the trajectories for the subgroups tended to end at very different reading-comprehension levels at eighth grade. In our sample, a high proportion (sample raw proportion = .81) of initially high word readers was predicted to attain mastery level reading comprehension at eighth grade, but a low proportion (sample raw proportion = .37) of initially low word readers was predicted to attain mastery at eighth grade. When considering the full sample regardless of word reading proficiency or language status, the sample raw proportion of students who attained mastery at eighth grade was only .68. The results were similar to a recent national trend reported in the NAEP (NCES, 2017) in which approximately 70% of eighth-grade students met or exceeded expectations for basic level reading, leaving 30% who fell below basic expectations.

The second point was that given that, at eighth grade, the high word-reading students' comprehension growth was decelerating, while the low word-reading students' growth was accelerating, it seems possible that if the study reached into high school, the lower performing students' comprehension might eventually catch up with their higher-performing peers.

Implications for Practice

The findings of the present study have two important practical implications. First, the significantly lower reading-comprehension performance of LMs and NEs with initially low word-reading proficiency across the elementary and middle school years highlights the need for early identification and prevention of later reading difficulties. For both groups of children, word-reading ability in the earliest grades should be thoroughly and accurately assessed to gain insight into potential challenges for later reading-comprehension development (Foorman, Francis, Fletcher, Schatschneider, & Mehta, 1998).

Another implication is that educators might keep at the forefront enhanced instructional opportunities and approaches to word-reading skills. Teachers may tend to assume that young LMs who have lower oral English proficiency than their NE peers may not benefit from English-reading instruction that is provided for their NEs. One might question whether an inclusive approach to early reading instruction that accommodates word recognition strategies might benefit even LMs who have lesser oral English proficiency, instruction modulated of course for the special needs of LMs. For LMs who had relatively lower first-grade word-reading abilities, instructional exposure may need to be sufficiently persistent to accelerate their reading-comprehension growth. They may be candidates for more intensive, systematic, and sustained reading instruction that could include either word recognition development or development of abilities that lead to, or reinforce, word reading such as concepts of print or phonological awareness.

Future Research

The study findings raise questions that warrant further investigation to advance the understanding of LMs' reading comprehension development. First, further research that explores the impact of LMs' other early reading subskills such as vocabulary and morphological and syntactic skills in comparison to those for NEs would provide a fuller picture of potential complexities involved in later reading-comprehension development. Second, more attention is needed to understand the association of early reading factors with LMs' reading-comprehension growth through the secondary level of schooling. Third, replication of the present study but with LMs disaggregated by ethnicity or native language group could reveal further differences in the relationship of early word-reading ability with long-term reading-comprehension growth according to native language group.

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