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Modeling Oral Reading Fluency Development in Latino Students: A Longitudinal Study Across Second and Third Grade

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Abstract

This study examines growth in oral reading fluency across 2nd and 3rd grade for Latino students grouped in 3 English proficiency levels: students receiving English as a second language (ESL) services (n = 2,182), students exited from ESL services (n = 965), and students never designated as needing services (n = 1,857). An important focus was to learn whether, within these 3 groups, proficiency levels and growth were reliably related to special education status. Using hierarchical linear modeling, the authors compared proficiency levels and growth in oral reading fluency in English between and within groups and then to state reading benchmarks. Findings indicate that oral reading fluency scores reliably distinguished between students with learning disabilities and typically developing students within each group (effect sizes ranging from 0.96 to 1.51). The growth trajectory included a significant quadratic trend (generally slowing over time). These findings support the effectiveness of using oral reading fluency in English to screen and monitor reading progress under Response to Intervention models, but also suggest caution in interpreting oral reading fluency data as part of the process in identifying students with learning disabilities.

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Keywords

reading fluency; English language learners; response to intervention; reading development; progress monitoring

Over the past decade the number of students in the United States who speak a language other than English at home has rapidly increased to 5.5 million (Donovan & Cross, 2002; U.S. Department of Education, 2003). Spanish is the first language for more than 70% of these students (McCardle, Mele-McCarthy, Cutting, Leos, & D'Emilio, 2005), and Latinos are now the fastest growing minority ethnic group in American schools (U.S. Census Bureau, 2003). There is widespread concern that by fourth grade, two out of every three Spanish-speaking students are unable to read English at basic levels necessary for success in school (August & Hakuta, 1998; Sanchez, Bledsoe, Sumabat, & Ye, 2004). Latino students are more often retained (Shepherd, 2000), are disproportionately represented in special education programs (Artiles & Trent, 2000; Donovan & Cross, 2002; Shepherd, 2000), and are 3 times more likely to drop out of school than White students (August & Hakuta, 1998; National Center for Education Statistics, 2004).

Reading difficulties are the reason that the vast majority of Latino students receive special education (U.S. Department of Education, 2003), and these difficulties limit their future participation in workplaces and in society, generally. The National Research Council report (Donovan & Cross, 2002) on disproportionate minority placement in special education faulted public policy that has traditionally required students to wait to receive reading interventions until they demonstrate a severe discrepancy between reading achievement and intelligence even though converging research has shown that remediating reading difficulties becomes increasingly difficult after third grade. This criticism and widespread support for preventive, early reading intervening services has led to recent changes in American general and special education legislation. Both the Reading First Initiative of the No Child Left Behind Act (2002) and the Individuals with Disabilities Education Act (1997) have the common ambitious goal of preventing reading difficulties by teaching all children to read by third grade. However, meeting these ambitious requirements is particularly challenging for schools serving the rapidly growing number of linguistically diverse students who are frequently from disadvantaged socioeconomic backgrounds (August & Hakuta, 1998; Donovan & Cross, 2002).

Specifically, the Individuals with Disabilities Education Improvement Act (IDEA; 2004) allowed districts to use up to 15% of special education funds for prevention of reading problems. This shift in federal law supports interventions for struggling readers *before* they fail to meet grade-level achievement standards and, as such, is an alternative to the previous requirement that a student qualify for reading support on the basis of low achievement that was unexpected (i.e., discrepant) relative to the student's intelligence. The discrepancy approach meant that many children had to wait to receive specialized reading intervention until they were one or more standard deviations behind in reading achievement; the modal age at which children received services was 11. The alternative and more proactive, preventive approach, called Response to Intervention, means that a local education agency

"may use a process that determines if the child responds to scientific, research-based intervention as a part of the evaluation procedures" (IDEA, 2004, § 614(B)(6)).

Within a Response to Intervention paradigm, schools provide children with research-based early reading instruction and use ongoing progress-monitoring data to assess whether students demonstrate adequate response or need additional, more intensive interventions. Many schools currently use brief curriculum-based measures, such as oral reading fluency, to screen students to determine their level of performance relative to classmates and to monitor students' ongoing performance and progress to evaluate the effectiveness of their reading instruction. Oral reading fluency is assessed by asking students to read a previously unseen grade-level passage to assess the number of words students read correctly in a minute; thus it addresses rate and accuracy. Good readers who can recognize words in text accurately and with a certain degree of fluency are able to focus on the meaning of the text better than students with weaker skills (L. S. Fuchs, Fuchs, Hosp, & Jenkins, 2001). A considerable research base exists regarding typical, developmental trajectories in oral reading fluency for monolingual English speakers that can inform instructional decisions (Deno, 1985; Good, Simmons, & Kame'enui, 2001; Hasbrouck & Tindal, 2006).

However, no research studies have yet examined Latino students' early reading fluency developmental trajectories, so it is unclear how they might be expected to perform compared with monolingual English speakers at grade-level benchmarks (Good et al., 2001). Further, this lack of information makes it difficult to screen Latino students accurately, early in their school careers, to identify who may need early reading intervention. It also complicates efforts to understand whether Latino students are responding adequately to intervention, which is an important issue because the research base guiding reading instruction and interventions for English language learners (August & Shanahan, 2006) is far less developed than the extensive database on preventing reading difficulties among native English-speaking students (e.g., National Reading Panel, 2000; Snow, Burns, & Griffin, 1998). To our knowledge, only one recent intervention study provides some tentative guidance; Vaughn, Linan-Thompson, and Hickman (2003) have suggested that unless Latino students increase the number of words read correctly in 1 min by at least one word per week, they should not be exited from interventions. Further research is needed to learn whether oral reading fluency is an effective means of screening and monitoring progress for Latino children with varying levels of English proficiency.

Hence, the primary goal of the present study was to identify differences in proficiency levels and growth rates for oral reading fluency of Latino students who were (a) proficient in English, (b) not proficient and receiving English as a second language (ESL) services, and (c) proficient enough to have exited from ESL services. We hypothesized that those students not proficient in English who were receiving ESL services would be less fluent than students with proficient English. Therefore, within each English proficiency group, we sought to examine differences in fluency among subgroups of children in general education, students identified with learning disabilities, and students with speech or language delays. To address this goal, we examined a large longitudinal statewide database of high-poverty schools that allowed us to describe the rate of growth in oral reading fluency for about 5,000 Latino students across second and third grade relative to grade-level benchmarks. When the present

study was conducted, Florida's policy in determining whether a child had a reading-related learning disability still involved testing to demonstrate a discrepancy (of at least one standard deviation) between IQ and reading achievement. Our intent was not to validate this flawed discrepancy approach but rather to provide a first step toward learning whether oral reading fluency has promise in measuring Response to Intervention for Latino students with varying levels of English proficiency.

Relevance of Using a Response to Intervention Approach for Latino Students

Response to Intervention has the potential to help school personnel disentangle reading disabilities from other factors related specifically to Latino students' sociocultural and socioeconomic environment and their language acquisition in the first and second languages (August & Hakuta, 1998; Garcia & Ortiz, 1988; Klingner & Artiles, 2006). This approach could prevent reading underachievement for many Latino students that may be caused by inadequate instruction by ensuring that all students receive evidence-based classroom reading instruction (Francis, Rivera, Lesaux, Kieffer, & Rivera, 2006; Vellutino et al., 1996; Vellutino, Scanlon, Small, & Fanuele, 2006). It could also reduce the incidence of reading disabilities by providing those students who still struggle to read, despite receiving well-implemented classroom instruction, with additional, increasingly intensive and individualized interventions (for a more thorough discussion, see Al Otaiba & Torgesen, 2007). Response to Intervention is a more proactive and dynamic process than measuring a student's reading ability at one point in time and comparing this with an intelligence test, particularly given concerns about the cultural inappropriateness of intelligence tests (Ortiz, 1997; Wagner, Francis, & Morris, 2005). The dynamic nature of Response to Intervention is also important because the designation or status of English proficiency and special education are temporary and are therefore, unlike gender, ethnicity, or even IQ, expected to change over time (Jenkins et al., 2006).

Florida's Reading First Context and the Progress Monitoring and Reporting Network

There are a few additional statewide issues that are important to the context of the present study. Florida became a majority minority state in 2006. There are optional dual-language programs within the state of Florida; however, all the participants in the present study were in Reading First schools and received their reading instruction only in English. Regulations in Florida require that all students whose parents identify another language is spoken in the home be tested within 20 days of registering at a school through a state-approved English proficiency test. If students are determined to need ESL services and if their parents agree, they begin to receive services in ESL within the school or district. Within our research sample, most students were removed from the mainstream class and given ESL services in small groups or one to one.

Students' English proficiency is reassessed periodically. When they have gained sufficient English proficiency, they are exited from ESL services. These students are then monitored

for at least 2 years or until it is determined that they can be successful within the general education classroom and not fall behind academically. It is noteworthy that Florida requires all primary language providers (language arts, elementary, early childhood, and special education teachers) to hold the state endorsement in ESL in addition to their primary teacher licensure. Hence, every elementary school teacher is also trained in methods for teaching ESL.

Additional issues pertain to Florida's Reading First implementation. Schools are required to select a core reading program from a state-approved list to ensure that instruction is aligned with current reading research and to provide explicit and systematic instruction in the key components of reading that were identified by the National Reading Panel (2000; for a description of these core reading programs, see Al Otaiba, Kosanovich-Grek, Torgesen, Hassler, & Wahl, 2005). All teachers, reading coaches, and principals in these schools (kindergarten through third grade) attend 2-week professional development institutes that provide training about research-based methods of instruction and the need to use student data to differentiate instruction.

To support Florida's Reading First implementation, a statewide Web-based data management system has been created, known as the Progress Monitoring and Reporting Network. This database includes demographic information about all students (kindergarten through third grade), including gender, date of birth, free and reduced lunch status, ethnicity, special education status, and whether students are currently receiving ESL services or have been exited within the past 2 years. The Dynamic Indicators of Basic Early Literacy Skills (DIBELS; Good & Kaminski, 2002) was selected by Florida to monitor reading progress because the tests are good predictors of later reading achievement, have alternate forms for monitoring progress, have multiprobe reliability exceeding .95, and are sensitive to responsiveness to early literacy interventions (see Kaminski & Good, 1996).

Well-trained district- and school-level teams administer the measures, and then students' scores are entered into the Progress Monitoring and Reporting Network so that teachers and principals may access the data to make instructional decisions. Procedures are followed to ensure adequate inter-rater reliability. It is also important to note that in Florida, during the 2003–2005 school years, DIBELS were administered four times per year rather than the more typical three-time administration. In addition, benchmarks have been developed to describe students' risk levels (high risk, moderate risk, low risk or grade level, and above average), with greater risk identified for those children who, without intervention, may not achieve at grade-level expectations. By the end of first grade, the cutoff for grade-level performance (i.e., the benchmark) is to read a minimum of 40 words correct per minute, and by the end of second and third grade, the respective benchmarks are 90 and 110 (see Good et al., 2001). Schools are also required to administer the Peabody Picture Vocabulary Test–III (PPVT-III; Dunn & Dunn, 1997) as an outcome measure at the end of each year to measure receptive vocabulary; these scores are also entered into the Progress Monitoring and Reporting Network.

Two main research questions guided the study. First, we sought to learn what were typical levels and rates of growth on oral reading fluency for Latino students grouped by English

proficiency level across second and third grade. Second, we asked whether there were significant differences in proficiency level and growth that were related to their special education status. We hypothesized that students who never received special services would perform at levels equivalent to their grade-level peers. We also anticipated that students who received special services or who had completed (i.e., exited) special services would demonstrate reading fluency levels below grade expectations. This would indicate that progress-monitoring assessments are generally appropriate for young Latino students, although some benchmark adjustments might be necessary.

Method

Participants

The data for the present study were drawn from the Progress Monitoring and Reporting Network database for 2003–2004 and 2004–2005. From over 29,600 third graders who were in the database across both years, we selected all students whose parents identified their ethnicity as Hispanic on school records (N = 5,240) and for whom 2 years of data existed. These included students from a variety of home cultures including Mexican, Puerto Rican, Cuban, and Central and South American. Students' language proficiency status was identified by schools as one of three categories: Latino students who had never needed ESL services (hereafter Latino students), students currently receiving ESL services (ESL students), and students who had been successfully exited from ESL services (ESL-exited students). Thus our typical student was a Latino student in general education (hereafter a Latino Gen Ed student).

Through a data screening process, we excluded approximately 5% of students who had additional disabilities such as cognitive disabilities, autism spectrum disorders, visual impairments (low vision or blind), hearing impairments, emotional and behavior disorders, or other significant health impairments. Thus the final sample (N = 5,004) included 4,198 students not identified as needing special education (Gen Ed), 408 students with learning disabilities (LD), and 398 students with speech and language delays (SL). This sample represents 293 schools and 33 districts, including both urban and rural areas across the state.

Table 1 provides demographic information and the mean receptive English language standard scores for each of the three English proficiency groups and their respective subgroups, including Latino Gen Ed students, Latino students with LD, Latino students with SL, ESL Gen Ed students, ESL students with LD, ESL students with SL, ESL-exited Gen Ed students, ESL-exited students with LD, and ESL-exited students with SL.

Measures

Oral reading fluency—The oral reading fluency subtest of the DIBELS (Kaminski & Good, 1996) is a test of accuracy and fluency on grade-level-connected text. Student performance is measured by having students read a previously unseen grade-level passage aloud for 1 min. Words omitted, words substituted, and hesitations of more than 3 s are scored as errors. Words self-corrected within 3 s are scored as accurate. The number of correct words per minute from the passage is the oral reading fluency rate. Speece and Case

(2001) reported parallel forms reliability coefficient of .94 and predictive criterion-related validity coefficient of .78 (October–May) with the Basic Reading Skills Cluster score. These data correspond with other reports of strong technical adequacy of oral reading fluency measures in terms of interscorer reliability (e.g., Good & Shinn, 1990; Good et al., 2001; D. Marston & Deno, 1981) and concurrent validity with widely used commercial reading tests (L. S. Fuchs & Fuchs, 1992; M. Marston, 1989).

Research has also demonstrated good predictive validity of oral reading fluency to high-stakes state reading tests and reported correlations ranging from .65 to .80 across a variety of states (Barger, 2003; Buck & Torgesen, 2003; Good et al., 2001; Shaw & Shaw, 2002; Vander Meer, Lentz, & Stollar, 2005; Wilson, 2005). Furthermore, researchers have found that oral reading fluency has adequate discriminative validity to differentiate students with reading disabilities from their peers (Shinn, Tindal, Spira, & Marston, 1987) and can be used to establish reasonable growth standards for students with learning disabilities (Deno, Fuchs, Marston, & Shin, 2001).

Receptive vocabulary—The PPVT-III (Dunn & Dunn, 1997) is a widely used individually administered norm-referenced test of English receptive vocabulary. Children are shown four pictures and asked to point to the one that best describes the target word spoken by the examiner. The split-half reliability for children ages 6–8 years ranges from .77 to .99, and the test–retest reliability ranges from .67 to .82. As is common in many states, schools were allowed to use a variety of nationally accepted English proficiency tests to assess a student's eligibility for ESL services, and we used these district determinations to classify students as an English language learner. However, these scores are often not very sensitive, describing students' English proficiency only in broad terms. Therefore, the end-of-second-grade PPVT-III scores in Table 1 are provided to describe students' English proficiency. No measures in Spanish were administered.

Procedures

Data collection—Assessments were conducted, and data were entered into the database by well-trained district personnel rather than classroom teachers. There were four assessment periods: the first occurred within the first 20–30 days of school, the second between the 65th and 75th days of school, the third between the 110th and 120th days of school, and the fourth between the 155th and 165th days of school. Receptive vocabulary (PPVT-III) was a year-end-only measure; thus performance is reported for end of second grade.

Data analytic method—Hierarchical linear modeling (HLM) was used to model student growth curves from second through third grade for a number of reasons. First, repeated measures of students' oral reading fluency were nested in students, which were, in turn, nested within schools. Although this third (i.e., school) level was subsequently dropped from the model because it did not account for significant variation, failing to initially examine the nested structure of the data can lead to misestimated standard errors (Raudenbush & Bryk, 2002). Second, because the oral reading fluency passages are more difficult in third grade than in second, oral reading fluency growth is not a continuous trajectory across grades.

Thus, we used an extension of traditional HLM growth curve modeling, piecewise growth curve modeling. Using piecewise growth curve modeling allowed us to create a two-rate model of oral reading fluency growth curves for students in second and third grade within the same model (Chou, Yang, Pentz, & Hser, 2004). Third, using HLM allowed us to model the growth curves for each of our three English proficiency groups and subgroups (Francis, Shaywitz, Stuebing, Shaywitz, & Fletcher, 1996; Raudenbush & Bryk, 2002).

Although children were nested within classrooms, there were nearly as many classrooms as children, so there was no substantial classroom variation to model. Thus, we initially tested an unconditional three-level HLM model with repeated measures over time nested in children nested in schools. However, these preliminary analyses indicated that the school level did not account for a statistically signification portion of variance, and school was subsequently dropped from the model.

Our subsequent data analyses focus on the more appropriate and parsimonious two-level model. To provide ease in interpretation, data were recoded to show growth by month. We modeled student performance over the course of the academic year at Level 1, centered at the first testing time in third grade (September). Thus the intercept represents the mean student oral reading fluency score at the beginning of the third-grade year. Both linear and quadratic growth trends were tested because four data points for each grade were available. Student characteristics (i.e., language group and special education subgroup) were entered at Level 2. Models were built systematically beginning with the unconditional model, then with the Level 1 time variables, and then with the Level 2 student English proficiency groups. Nonsignificant variance components were fixed to achieve greater power in model estimation. Furthermore, we tested both a linear slopes model and a model that contained linear and quadratic parameters to determine whether curvilinearity existed in the data. Results from the − 2 log likelihood test suggested that the addition of the quadratic parameter improved the description of model growth, $\chi^2(11) = 5{,}306.41$.

Table 2, the raw data and coding from second through third grade for one student, shows how the time variable is coded for each assessment period to achieve piecewise growth curves (Raudenbush & Bryk, 2002). The unconditional two-level model is reported in Appendix A, in which the Grade 3 growth curve serves as the fixed reference growth curve and the Grade 2 coefficients represent the fitted deflection from that curve for second-grade students. Thus the intercepts and coefficients π_{0j}, π_{1j}, and π_{2j}, which are latent variables and expressed in the Level 2 models as β_{00}, β_{10}, and β_{20}, respectively, together represent the third-grade student trajectory (intercept, linear, and quadratic trends). The second-grade coefficients, β_{30}, β_{40}, and β_{50}, respectively, are added to these coefficients to obtain the second-grade student growth trajectory. In this way, we have the power of the entire data set to model both second- and third-grade growth trajectories. The variances for the conditional and unconditional models are in Table 3; the fixed effect results from the Level 1 model are in Table 4, and the results of the final model are provided in Table 5.

Standard interpretation of a slope component is the expected change in the outcome for every month change in the predictor. Adding a quadratic term tests whether students' progress is linear or whether there are periods when learning rates are accelerating (positive

quadratic term) or decelerating (negative quadratic term). A significant quadratic trend changes the interpretation of the linear term. Raudenbush and Bryk (2002) provided the following to evaluate the growth at any given point:

$$\text{Growth rate at a given time} = \pi_{1i} + 2\pi_{2i}t, \quad (1)$$

where π_{1i} is the linear slope for person *i*, 2 π_{2i} is the change in slope for person *i*, and *t* is the number of months after September of third grade.

As an example, if growth in oral reading fluency was measured at the beginning of the school year (e.g., September of third grade), with time centered at the beginning of the study (i.e., 0) and our estimation for growth during December (i.e., 3), our calculation would be *linear* + 2(*quadratic*)(3). Estimated growth across the months (and weeks) was calculated as function of this formula, to provide a more reliable representation of group growth over the year. Linear growth and quadratic change may be viewed in Appendixes B and C, which provide estimated monthly growth. Because our data were centered in September of third grade, the fitted linear growth value can be viewed in the September column in both tables. Similarly, the quadratic rate can be observed by taking the difference between any 2 months —for example, the second-grade differences for Latino Gen Ed students between October and September in Appendix B—and dividing by 2: that is, (6.41 – 7.07)/2 = −0.33. This example would indicate that the rate of deceleration for the Latino Gen Ed students was −0.33.

The proportion reduction in variance by modeling student characteristics was calculated with

$$\frac{\widehat{\tau}_{qq}(UC) - \widehat{\tau}_{qq}(C)}{\widehat{\tau}_{qq}(UC)},$$

where $\hat{\tau}_{qq}(UC)$ represents the tau estimate for a given parameter (e.g., intercept) for the unconditional model and $\hat{\tau}_{qq}(C)$ is a tau estimate for the conditional model (Raudenbush & Bryk, 2002).

A further issue with estimating curvilinear relationships is the calculation of effect sizes that can be compared within and across the grade cross section (Hedges, 2006). Although such measures have been developed specifically for multilevel models (Lee & Loeb, 2000; Roberts & Monaco, 2006), several are designed to evaluate the proportion of variance explained for a given level (Hox, 1995; Roberts & Monaco, 2006). The contrasts for fixed effects in the piecewise growth curve model result in a chi-square statistic, which indicates the degree to which intercept and slope means differed for the within-English proficiency subgroup comparisons (e.g., ESL Gen Ed students vs. ESL students with LD).

Results

To show the growth trajectories for each subgroup relative to grade-level performance benchmarks and to typical development, fitted growth curves of the students in Gen Ed,

students with LD, and students with SL are presented in Figure 1–Figure 3, respectively. In these figures, the cutoff for grade-level performance is represented by the solid line. Because of the complexity of the findings that are due to the quadratic trends in the data, we calculated a more traditional effect size (Cohen's *d*) on the observed data (Cohen, 1988) solved with $d = (M_1 - M_2)/\sigma_{pooled}$, highlighting the differences between the students with LD and their Gen Ed peers within each English proficiency subgroup. Effect size results represent group standard deviation units, with estimates > 0.50 as large, 0.3–0.5 as moderate, and 0.1– 0.3 as small (Rosenthal & Rosnow, 1984). Table 6 provides the effect size comparisons to describe the magnitude of observed differences at the beginning and end of each year.

Our research questions were, What are typical levels and rates of growth for Latino general education students, and what were the differences in proficiency level and growth that were related to student English proficiency and special education status? First, we describe the typical growth of Latino students in second and then third grade. We then discuss the differences observed for children identified as SL and LD.

Modeling Growth of Latino Student Group

The intraclass correlations indicated that significant variance in students' scores was observed across both second and third grade. Estimates indicated that 24% and 26% in intercept, 35% and 37% in slope, and 30% and 45% in quadratic parameter variance in student oral reading fluency scores were initially observed in second and third grade, respectively.

Second grade—HLM results from the conditional model indicated that, on average, Latino students who never received ESL or special education services (i.e., the typical Latino Gen Ed students) began second grade reading more fluently than any other group. As seen in Figure 1, their fitted mean scores indicate that their oral reading fluency performance was securely above the grade-level benchmark (53 words correct per minute). Their steepest growth was observed across the first 3 months of school, when weekly growth averaged about 1.6 words correct per minute, indicating they were among the two fastest improving subgroups. However, their quadratic trend was negative (− 0.33), so their rate of weekly growth decelerated from 1.77 words in September to 0.61 words in April (see also Appendixes B and C for the estimated weekly growth for all subgroups across second and third grade).

On average, the Latino students with SL also started second grade at grade level (fitted mean of 44 words correct per minute). The Gen Ed students and the students with SL had significantly higher fluency scores than students with LD ($\chi^2 = 4.6$, $p < .05$ vs. $\chi^2 = 23.08$, $p < .001$). Notably, the Latino students with LD (fitted mean of 24 words correct per minute) were still reading substantially below the end-of-first-grade benchmark of 40 words correct per minute.

An inspection of Figure 1 shows that throughout second grade, the Latino students in the SL subgroup consistently performed just below the level of the Gen Ed students and well above the students with LD. Also as seen in Appendix B, the average weekly rate of growth for

students in the SL group at the beginning of the year (1.61 words) was slightly less than that of their Gen Ed peers, and their decelerating trend had a slightly less steep term (−0.25; χ^2 = 0.36 $p > .05$); as a result, their weekly growth tapered off to 0.72 words by April. In contrast, the Latino students with LD showed the slowest growth rates initially (0.61 words correct per minute), but their growth trajectory over the school year accelerated to a weekly gain of 0.92 words correct per minute by April. Their estimated gain was steeper though not significantly greater than estimates for both the Gen Ed students ($\chi^2 = 0.26$, $p > .05$) and the students with SL ($\chi^2 = 0.31$, $p > .05$). Although their growth rate is encouraging, as seen in Figure 1, students with LD did not show sufficient growth to close the gap relative to any of their peers or to the second grade-level benchmark.

Third grade—Results from the conditional model indicated that the typical Latino Gen Ed students began third grade with a fitted mean oral reading fluency score of approximately 75 words correct per minute (see Figure 1), which was at grade level and higher than that of any other subgroup. However, it should be noted that this initial score indicates a drop of about 8 words correct per minute from their fluency scores at the end of second grade (as seen in Figure 1). On average, these third graders gained this back across September (weekly gains of 2.75 words correct per minute) and continued to demonstrate faster gains than they had in second grade until about January, when growth dropped to about 1 word correct per minute. As seen in Figure 1, their third-grade trend was mediated by a much steeper deceleration (−0.87), nearly 3 times greater than their second-grade trend. Consequently, their weekly gains diminished over the school year. This pattern of strong growth in fall, decelerating after December, was consistent with the third-grade trajectories of most Gen Ed students and students with SL in the ESL and ESL-exited subgroups.

Latino students in the SL group began third grade reading an average of about 64 words correct per minute, 11 words fewer than mean for the Latino Gen Ed group ($\chi^2 = 20.37$, $p < .001$). Similar to that of the Latino Gen Ed students, their fitted linear growth rate was larger between September and December, when compared with growth from January to April. They were also observed to have a less pronounced rate of deceleration (−0.74; $\chi^2 = 32.12$, $p < .001$), and so had slightly higher estimated weekly growth than their Gen Ed peers across all assessment periods after November as seen in Appendix C.

At the start of third grade, Latino students in the LD subgroup read an average of about 35 words correct per minute (see Figure 1), significantly less than their peers in Gen Ed (χ^2 = 236.40, $p < .001$) and peers with SL ($\chi^2 = 66.21$, $p < .001$). Recall that the end-of-first-grade benchmark is 40 words correct per minute. These students with LD had relatively larger linear growth in third grade than in second grade, but they were still among the slowest improving groups from September to December (average weekly gains of about 1.6 words). Furthermore, their third-grade growth was mediated by a moderate decelerated trend (−0.45), so their gains tapered off during the second half of the school year (declining to weekly growth of only 0.32 words correct per minute by April).

Modeling Growth of the ESL Student Group

Second grade—At the beginning of second grade, the mean oral reading fluency score of the ESL Gen Ed students was about 38 words correct per minute, or about 15 words correct per minute fewer than the score of Latino Gen Ed students. These ESL Gen Ed students scored higher in oral reading fluency than ESL students in the SL subgroup ($\chi^2 = 20.77$, $p < .001$). Furthermore, they read twice as many words as their peers with LD (fitted $M - 17$ words correct per minute; $\chi^2 = 128.96$, $p < .001$). Even though they performed at the highest level among the ESL student subgroups, it is noteworthy that unlike their Latino and ESL-exited peers, these ESL Gen Ed students remained struggling readers, according to oral reading fluency scores, throughout the school year (see Figure 2). Their developmental trend, despite its slight deceleration, resulted in relatively stronger linear growth than was estimated for their ESL peers in the SL ($\chi^2 = 20.77$, $p < .01$) or LD ($\chi^2 = 1.28$, $p > .05$) subgroups throughout second grade.

Similar to the ESL Gen Ed students, students in the SL subgroup had growth trajectories that appeared to be largely linear, with a fairly small deceleration rate (−.02; see Figure 2). They remained at a level of moderate risk for underachievement throughout the year, never reaching the grade-level benchmarks during second grade. In contrast, the growth rates for the ESL students with LD were lowest in September (0.24), which is when those of their peers grew the fastest. However, given their acceleration rate (0.29), their improvement culminated in weekly growth over slightly more than one word correct per minute during March and April, making them among the three fastest of all groups for that period.

Third grade—ESL Gen Ed students' fitted mean score at the beginning of third grade was 61 words correct per minute (see Figure 2), which was larger than the mean of their ESL peers in either the SL ($\chi^2 = 13.61$, $p < .001$) or the LD ($\chi^2 = 368.87$, $p < .001$) subgroup. Their average weekly growth across third grade (1.31 words correct per minute) was the greatest of any groups at any grade, but they followed the same asymptotic trend as the Latino Gen Ed students. Compared with their relatively steady linear growth in second grade, in third grade their trajectory initially appeared as a steeper linear trend (2.71 words correct in September) that flattened out across third grade owing to the effect of the large negative quadratic trend (−0.80; see Figure 2).

ESL students in the SL subgroup had a mean initial oral reading fluency score of approximately 53 words correct per minute (see Figure 2), close to the score of their ESL peers in Gen Ed but still 22 words fewer than that of the typical Latino students in Gen Ed. As shown in Figure 2, these students remained below grade level throughout third grade. Their linear trend was strong, averaging over 1 word correct per minute during the year; however, whereas they had a near zero quadratic trend in second grade, in third grade they showed a large negative deceleration (−0.67). Consequently, as shown in Appendix C, their average weekly growth during February–April of third grade was significantly lower than their second-grade growth rates.

ESL students with LD started third grade reading only 29 words correct per minute (see Figure 2), which is still well below the benchmark of 40 words correct per minute for end of first grade, and they continued their pattern of the lowest oral reading fluency performance

among all subgroups. As shown in Figure 1–Figure 3, as with the third-grade development of all the students, the ESL students with LD improved their fluency most between September and December (by about 1.5 words per week), and subsequent growth tapered off across the year (averaging a little more than half-a-word gain per week). This is markedly different from their growth trajectory in fall of second grade when they initially gained 0.24 words per week but steadily improved (averaging weekly growth across the year of 0.75 words correct per minute).

Modeling Growth of ESL-Exited Student Group

Second grade—Among the students no longer receiving ESL services, the ESL-exited Gen Ed students, who read an average of about 52 words correct per minute, performed closest to the typical Latino Gen Ed students at the start of second grade; on average, they read on grade level until March (see Figure 3). The ESL-exited Gen Ed students also demonstrated relatively faster rates of oral reading fluency growth compared with their peers with SL ($\chi^2 = 15.96$, $p < .001$) or LD ($\chi^2 = 28.78$, $p < .001$). Moreover, from January through April, the ESL-exited Gen Ed group had even faster growth than their Latino Gen Ed counterparts.

The initial fitted mean reading score of the ESL-exited students in the SL subgroup was about 50 words correct per minute, but because of their decelerating quadratic trend (−0.18), they were no longer on grade level by February. In contrast, the ESL-exited students in the LD subgroup read an average of only 24 words correct per minute, which was significantly lower than the scores of both the Gen Ed students ($\chi^2 = 108.55$, $p < .001$) and the students in the SL subgroup ($\chi^2 = 5.20$, $p < .05$), and was the same as the starting mean scores of the students with LD in the Latino group. In common with the Latino students with LD, they had a positive, or accelerated, quadratic term (0.18), but on average the oral reading fluency for neither group ever reached grade level.

Third grade—Similar to the Latino Gen Ed students, the ESL-exited Gen Ed students started third grade with oral reading fluency scores nearly on grade level, at 75 words correct per minute (see Figure 3), which was greater than the scores of both their peers with SL ($\chi^2 = 2.01$, $p > .05$) and with LD ($\chi^2 = 108.55$, $p < .001$). These students continued to perform above the benchmark throughout most of the year and, consistent with the third-grade trajectory for most Gen Ed students, showed the largest rates of linear growth in September (2.73 words correct per minute per week), which steeply declined owing to large deceleration effects (−0.80).

ESL-exited students with SL began third grade reading 70 words correct per minute (see Figure 3), similar in level, slope, and decelerating quadratic trend (−0.83) to their Gen Ed peers but significantly greater than students in the LD subgroup ($\chi^2 = 49.97$, $p < .001$), who read only 38 words correct per minute. Like other third graders, the students with LD showed the slowest growth from February to April compared with other periods during the school year, which differs from their second-grade trend, when their slowest growth occurred between September and January.

Effect Size Comparisons of Observed Differences Between Students With LD, Students With SL, and Gen Ed Peers by English Proficiency

Because of the complexity of the findings, and particularly because the quadratic trends were significant, we also calculated an effect size to highlight the observed differences between the subgroup of students with LD and their Gen Ed peers within each English proficiency group for the start-of-year and end-of-year status. As shown in Table 6, the effect sizes provide a comparison of the magnitude of within-groups differences at the beginning and end of second and third grade (i.e., initial status and end-of-year status). The effect sizes for the Gen Ed compared with the SL students were small to moderate and ranged from 0.08 to 0.40. Not surprisingly, the largest comparisons were for the Gen Ed and LD contrast (ranging from 0.96 to 1.51). With few exceptions (most notably the ESL-exited students with LD), the effect size comparison grew across time, confirming that the magnitude of differences increased developmentally and that there was little evidence of students with LD catching up to their Gen Ed peers.

Discussion

Necessary precursors to scaling up implementation of Response to Intervention include identifying universal screening and progress-monitoring instruments and developing guidelines for operationalizing adequate response to culturally diverse students. Response to Intervention has the potential to address concerns about overrepresentation of Latino students in special education if it could help identify children for early intervening services that could prevent most reading disabilities. However, reasonable growth expectations in oral reading fluency do not yet exist for the rapidly growing number of Latino students who attend high-poverty schools and who receive English-only reading instruction. Although it is vital to help all students read on grade level, bilingual and bilingual special education researchers have argued against using middle-class White students as the only referent against which Latino students' academic achievement and responsiveness to instruction are judged (Artiles, Klingner, & Tate, 2006; Garcia & Ortiz, 1988; Ortiz, 1997). Even though we provided the grade-level benchmarks for growth, an important and unique contribution of this study was that our analyses were based on a very large database of Latino students with varying English proficiency receiving free and reduced lunch. Importantly, the size of the database allowed us to make comparisons *within* English proficiency groups to learn about potentially important and reliable differences in oral reading fluency development related to special education status.

Thus, the first question guiding our research related to understanding typical oral reading fluency growth rates for Latino students attending high-poverty schools across second and third grade. On average, the 1,615 Latino Gen Ed students started both second and third grade reading on grade level but ended each year just short of the grade-level benchmark. The weighted average for their weekly oral reading fluency growth was about one word correct per minute throughout second (1.19) and third grade (1.23). Each year, compared with other assessment periods, they consistently demonstrated the fastest rates of growth between September and December, which may be partly attributable to catching up after summer recidivism and to a reintroduction to a predominantly English environment after

spending summers in potentially mixed Spanish–English or predominantly Spanish environments.

Given that these Latino Gen Ed students received systematic and explicit instruction in reading and that their receptive language scores were within normal range, it is of concern that their second grade growth rates were about a half a word less than the weekly growth rates recommended by Deno et al. (2001) of 1.66 words correct per minute, even though they were slightly above the recommended rate at third grade (1.18 words correct per minute). However, because Deno et al.'s findings are from a cross-sectional study of native English speakers, which did not report the socioeconomic status of participants, it is difficult to make direct comparisons between findings from their study and our present study.

Having described the developmental trajectory for the typical reading performance across second and third grade, we next asked whether there were significant differences in level or growth in oral reading fluency related to student ESL and special education status. Answering this question contributes to discussions about methods of identifying students who need early intervention and of students who no longer need specialized help. Some researchers studying Response to Intervention have recommended that students be identified for early intervention who do not achieve grade-level benchmark (e.g., Good et al., 2001); others have recommended using a dual-discrepancy approach to determine students different from their peers in both level and slope of growth (e.g., D. Fuchs & Fuchs, 1998; Speece & Case, 2001).

Differences in Growth Trajectories

Differences in level and growth trajectories related to ESL status

With regard to ESL status, on average, throughout second and third grade the 2,182 ESL students in the study consistently read below grade level. As hypothesized, all subgroups of ESL students read less fluently than their peer subgroup among Latino and ESL-exited students. This difference in level of oral reading fluency performance appears commensurate with the ESL students' mean receptive language scores, which were a standard deviation below national norms (standard scores ranging from 80 to 83). Low levels of vocabulary would impede their oral reading fluency and comprehension.

However, we were encouraged that starting in January of second grade and again in November of third grade, the ESL Gen Ed students demonstrated slightly greater weekly gains in oral reading fluency than their Gen Ed peers in the Latino and ESL-exited subgroups. This finding of relatively accelerated growth may be cause for cautious optimism about the role of ESL services in closing the reading achievement gap. At the same time, these findings validate concern expressed by other researchers (Francis et al., 2006; McCardle et al., 2005; Vaughn et al., 2003) that students exited from ESL services need additional, specialized support to manage increased demands for reading (and academic language) at third grade and beyond. Thus, an important implication of our results is that oral reading fluency data could be useful in screening and monitoring Response to Intervention to determine which students, including ESL and ESL-exited students, continue to need individualized interventions.

Differences in growth trajectories related to special education status—Students receiving special education services for speech– language impairments and learning disabilities had different trajectories in oral reading fluency development than did their Gen Ed peers; this trend held across all levels of English proficiency. Specifically, weekly growth for students with speech–language impairments was generally slightly slower than for their Gen Ed peers. At the start of second grade, on average, Latino and ESL-exited students with SL began reading at grade level. However, as a consequence of slower growth than that of their Gen Ed peers, by third grade fitted mean scores for all of the SL subgroups were below grade level.

As is visible from Figure 1 and Figure 2, of all students with SL, the smallest initial gap in performance relative to their Gen Ed peers was found in the ESL and ESL-exited subgroups; these gaps widened over time, particularly for exited students. Larger and relatively stable gaps in oral reading fluency performance were apparent within the Latino subgroups across second and third grade. This finding suggests that when ESL services were withdrawn, students with SL were less well served by mainstream classroom instruction. Thus, ESL services may have a relatively important protective effect for Latino children with SL. Another explanation for this finding may be that the students with SL may have needed more individualized reading instruction than could be provided by the Gen Ed teachers, even though all teachers who provide primary reading instruction are endorsed in ESL.

Perhaps the most notable and troubling findings of this study were the remarkably low oral reading fluency scores and growth rates for students with LD. As previously mentioned, our intent was not to validate the label of learning disabled that schools had identified by establishing that students manifested a discrepancy between IQ and achievement of at least one standard deviation. Rather, we hoped to learn whether oral reading fluency could reliably screen and measure Response to Intervention to help schools identify Latino children needing more intensive instruction. Throughout second and third grade, oral reading fluency scores consistently distinguished students with LD from their Gen Ed peers (effect size ranging from 0.96 to 1.51) and their peers with SL (0.94 to 1.23) regardless of English proficiency. Recall that the end-of-first-grade benchmark is 40 or more words correct per minute; at the start of second grade, the ESL students with LD read only 18 words correct per minute, on average, and at the start of third grade, they read only 29 words correct per minute. Latino and ESL-exited students with LD, respectively, read an average of 24 words correct per minute at the start of second grade and about 36 words correct per minute at the start of third grade.

Another trend that distinguished students with LD from their peers, regardless of their English proficiency, was that in second grade, when their peers showed strongest rates of reading growth from September to December, students with LD demonstrated their slowest rate of growth for this period. By contrast, their steepest growth in second grade occurred toward the end of the year from February to April. Furthermore, the effect size difference between students with LD and their Gen Ed peers grew larger each year (effect size increased by 0.31, 0.46, and 0.29 for the Latino, ESL, and ESL-exited groups, respectively).

These lower levels and slower rates of growth for students with LD relative to peers is consistent with findings reported by Deno et al. (2001) showing that monolingual English-speaking students with learning disabilities demonstrated lower levels and slower weekly growth than did their peers in second and third grade (decreasing from 1.18 words correct per minute in second grade to 0.58 in third grade). However, compared with Deno et al.'s sample, ours demonstrated that students' weekly growth rates were somewhat slower in second grade (ranging from 0.75 for the ESL students to 0.93 for the ESL-exited students) and somewhat faster in third grade (ranging from 1.08 for the ESL-exited to 1.10 for the Gen Ed and ESL students). Deno et al. concluded that, in contrast to general education students, "special education students were behind after their first year of reading instruction and continued to fall farther behind through the early grades" (p. 513). Our findings were more complex because, compared with second-grade students, during third grade our students with LD maintained or slightly improved their average weekly oral reading fluency scores. Nevertheless, their growth was never sufficient to help them catch up to their peers.

Limitations and Directions for Future Research

In the present study, on average, Latino students, regardless of ESL and special education status, improved their oral reading fluency across second and third grade. However, describing and comparing their developmental trajectories was complex because the quadratic trends change the interpretation of the linear term, indicating gradually increasing deceleration across second and third grade. On the basis of oral reading fluency norms for monolingual English speakers (e.g., Hasbrouck & Tindal, 2006), we would not expect this trend to be caused by a ceiling effect by the spring semester, because children continue to increase in fluency rates (albeit at slower rates) until eighth grade.

Our findings are consistent with a small number of studies that have collected more than three time points per year and have reported quadratic terms that allow interpretation of curvilinearity of oral reading growth patterns. For example, Mathes et al. (2005) conducted a first-grade reading intervention study and reported that first graders' growth significantly accelerated during the year and that treated students showed significantly greater acceleration than controls. Puranik, Petscher, Al Otaiba, Catts, and Lonigan (2008) also reported significant acceleration across first grade that gradually slowed in second and third grade in a sample of Reading First students with and without speech and language impairments. Similarly, the negative quadratic trend we found in second and third grade in the present study converges with findings from several recent studies that describe oral reading fluency trajectories in Reading First schools. In these studies, children's growth was found to decelerate somewhat in second grade and more markedly toward the end of third grade (Crowe, Connor, & Petscher, in press; Kim, Petscher, Schatschneider, & Foorman, 2008; Petscher, Schatschneider, & Kim, 2008; Puranik et al., 2008). However, these studies have all been conducted in Florida; thus additional research in other states and with other oral reading fluency measures is needed to understand more about why the rate of growth slowed and to explain more about individual differences in rates and curvilinearity of growth patterns.

Our findings suggest that the Latino participants in the present study rarely exhibited a strictly linear trend and that to capture the complexity of developmental trajectories within and between subgroups, it was important to examine and describe quadratic trends. This caveat has implications for using Response to Intervention as a way to identify Latino students for special education services. Oral reading fluency appears to be one practical and efficient way to monitor responsiveness because students with LD show very different growth trajectories compared with their peers. Nevertheless, at particular times of the school year, their slope may be steeper than that of their Gen Ed peers. Thus, it would be vital to examine a body of data before making eligibility decisions.

This study has several limitations. Chief among these is that we have used data from a state database and, thus, have relied on school-administered assessments and on school identification of English proficiency and special education status. Although school assessors were well trained, reliability of testing may be somewhat lower than had research staff administered the assessments. Although using this database allowed us to describe growth of over 5,000 Latino children across an important window of reading development, caution should be taken in generalizing findings to other populations. It is important to consider the Florida context in which data were gathered. All students attended high-poverty Reading First schools and received explicit and systematic reading instruction only in English; students with an ESL designation received additional pull-out services. Thus findings may not generalize to children receiving bilingual reading instruction or receiving their primary reading instruction in Spanish.

Students in the present study were taught by teachers who had received training supported by Florida's Reading First implementation about the science of reading, training to use their specific curricula, and training in using ESL teaching methodology. All districts provided schools with a reading coach and ESL specialist. Furthermore, students in the present study attended public school for at least 2 years (second and third grade), and therefore caution is warranted against generalizing findings to newcomers.

Although the HLM models provided a good fit for the data, substantial variability in student performance has still not been explained. Future research that includes measures of oral or reading proficiency in Spanish may be helpful in explaining additional variance. Another limitation is that we measured only reading fluency; this skill was measured only four times per year. Additional research is needed to examine growth across a broader constellation of reading skills through the use of measures that could describe the dynamic relations among development in fluency, comprehension, and vocabulary development. Specifically, we plan to examine the relation between oral reading fluency scores and passing high-stakes state reading assessments within each of the three subgroups. Because a relatively small proportion of the variance between students was attributable to schools, we have begun to contact school districts to learn more about the specific reading curricula and ESL teaching methodologies that were used. For example, we have no information about whether students received fluency interventions similar to those successfully used in the Vaughn et al. (2003) study. We also plan to identify schools that beat the odds to contrast instructional and assessment procedures in schools associated with better and weaker trajectories of reading development within the subgroups used in the present study.

Conclusions

In summary, this study demonstrates that oral reading fluency assessment has a promising role to play in screening and ongoing progress monitoring of Latino students as part of Response to Intervention models. The present study provides a first step toward ensuring that students get the support they need before falling far behind in reading by increasing knowledge about Latino students' early reading fluency developmental trajectories and by developing grade-level benchmarks comparable to existing norms for monolingual English speakers (Good et al., 2001). Without such information, it has been difficult to screen Latino students accurately, early in their school careers, to identify who may need early reading intervention and to verify whether Latino students are responding adequately to intervention. In a recent study of intensive intervention for Latino ESL students, Vaughn et al. (2003) suggested that unless students are growing at the rate of at least one word per week, they should not be exited from intervention. Our findings confirm, on a larger scale, that one-word-per-week growth in words correct per minute may be a reasonable goal, but it is not likely to be ambitious enough to help them catch up to peers. A consistent pattern of findings across all English proficiency subgroups revealed that oral reading fluency level, but not always slope, reliably differentiated students with LD from students with SL and Gen Ed students. Using linear slope would be a less reliable indicator in light of the significant acceleration and deceleration in rates of growth observed. Reading difficulties are the core problem for the majority of ESL students receiving special education services (National Institute of Child Health and Human Development–Early Child Care Research Network, 2003; U.S. Department of Education, 2003); as this study shows, English oral reading fluency status can be used by researchers and practitioners to make valid comparisons between students with and without learning disabilities who have similar levels of English proficiency. In view of the changing status of English proficiency and special education, oral reading fluency assessments may also provide a means of guiding switchback: identifying students who are no longer formally designated as ESL but who need additional specialized reading and language support. An implication of this research is the need to help teachers and principals understand how to differentiate instruction not only within special education but also within the context of general education and ESL pull-out settings. This is particularly timely in the United States, as the No Child Left Behind Act holds general educators increasingly accountable for helping all children read on grade level.

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Appendix A

Two-Level Model

Level 1

$$Y_{ti}=\pi_{0i}+\pi_{1i}(MONTH)_{ti}+\pi_{2i}(MONTH^2)_{ti}+\pi_{3i}(2nd\ grade\ INT)_{ti}+\pi_{4i}(2nd\ grade\ MONTH)_{ti}+\pi_{5i}(2nd\ grade\ MONTH^2)_{ti}+e_{ti}$$

Level 2 Conditional

$$\pi_{0i}=\beta_{01}(Latino|GenEd)_i+\beta_{02}(Latino|LD)_i+\beta_{03}(Latino|SL)_i+\beta_{04}(ESL-exited|GenEd)_i+\beta_{05}(ESL\ exited|SL)_i+\beta_{06}(ESL-exited|LD)_i+\beta_{07}(ESL|GenEd)_i+\beta_{08}(ESL|SL)_i+\beta_{09}(ESL|LD)_i+r_{0i}$$

$$\pi_{1i}=\beta_{11}(Latino|GenEd)_i+\beta_{12}(Latino|LD)_i+\beta_{13}(Latino|SL)_i+\beta_{14}(ESL-exited|GenEd)_i+\beta_{15}(ESL-exited|SL)_i+\beta_{16}(|\mathrm{ESL}-exited|\ LD)_i+\beta_{17}(ESL|GenEd)_i+\beta_{18}(ESL|SL)_i+\beta_{19}(ESL|LD)_i+r_{1i}$$

$$\pi_{2i}=\beta_{21}(Latino|GenEd)_i+\beta_{22}(Latino|LD)_i+\beta_{23}(Latino|SL)_i+\beta_{24}(ESL-exited|GenEd)_i+\beta_{25}(ESL-exited|SL)_i+\beta_{26}(ESL-exited|LD)_i+\beta_{27}(ESL|GenEd)_i+\beta_{28}(ESL|SL)_i+\beta_{29}(ESL|LD)_i+r_{2i}$$

$$\pi_{3i}=\beta_{31}(Latino|GenEd)_i+\beta_{32}(Latino|LD)_i+\beta_{33}(Latino|SL)_i+\beta_{34}(ESL-exited|GenEd)_i+\beta_{35}(ESL-exited|SL)_i+\beta_{36}(ESL-exited|LD)_i+\beta_{37}(ESL|GenEd)_i+\beta_{38}(ESL|SL)_i+\beta_{39}(ESL|LD)_i+r_{3i}$$

$$\pi_{4i}=\beta_{41}(Latino|GenEd)_i+\beta_{42}(Latino|LD)_i+\beta_{43}(Latino|SL)_i+\beta_{44}(ESL-exited|\mathrm{GenEd})_i+\beta_{45}(ESL-exited|SL)_i+\beta_{46}(\mathrm{ESL}-exited|LD)_i+\beta_{47}(ESL|GenEd)_i+\beta_{48}(ESL|SL)_i+\beta_{49}(ESL|LD)_i+r_{4i}$$

$$\pi_{5i}=\beta_{51}(Latino|GenEd)_i+\beta_{52}(Latino|LD)_i+\beta_{53}(Latino|SL)_i+\beta_{54}(ESL-exited|\mathrm{GenEd})_i+\beta_{55}(ESL-exited|SL)_i+\beta_{56}(ESL-exited|\mathrm{LD})_i+\beta_{57}(ESL|GenEd)_i+\beta_{58}(ESL|SL)_i+\beta_{59}(ESL|LD)_i+r_{5i}$$

Where each of the variables are coded 1 = belongs to group, 0 = all others. Note that the Level 2 intercepts have been removed, so the coefficients represent the group mean score, linear trend, or quadratic trend, respectively, for each group. Thus the β_{01} coefficient value would be the Grade 3 intercept or fitted mean at the beginning of the year for Latino students in general education. To compute the second-grade intercept for Latino students in general education, the β_{31} coefficient would be added to the β_{01} coefficient (i.e., β_{01} +β_{31}).

Note. Latino Gen Ed = Latino general education students; Latino LD = Latino students with learning disabilities; Latino SL = Latino students with speech or language delays; ESL Gen Ed = English as a second language general education students; ESL LD = English as a second language students with learning disabilities; ESL SL = English as a second language students with speech or language delays; ESL-exited Gen Ed = English as a second language exited general education students; ESL-exited LD = English as a second language exited students with learning disabilities; ESL-exited SL = English as a second language exited students with speech or language delays.

Appendix B

Estimated monthly and weekly growth by assessment: Second grade

Group	September	October	November	December	January	February	March	April	Average (week)
Latino									
Gen Ed	7.07 (1.77)	6.41 (1.60)	5.75 (1.44)	5.09 (1.27)	4.43 (1.11)	3.77 (0.94)	3.11 (0.78)	2.45 (0.61)	1.19
LD	2.45 (0.61)	2.62 (0.66)	2.80 (0.70)	2.97 (0.74)	3.14 (0.79)	3.32 (0.83)	3.49 (0.87)	3.66 (0.92)	0.76
SL	6.42 (1.61)	5.91 (1.48)	5.40 (1.35)	4.90 (1.23)	4.39 (1.10)	3.88 (0.97)	3.37 (0.84)	2.87 (0.72)	1.16
ESL									
Gen Ed	5.16 (1.29)	5.09 (1.27)	5.02 (1.26)	4.96 (1.24)	4.89 (1.22)	4.83 (1.21)	4.76 (1.19)	4.70 (1.18)	1.23
LD	0.96 (0.24)	1.54 (0.39)	2.12 (0.53)	2.70 (0.68)	3.27 (0.82)	3.85 (0.96)	4.43 (1.11)	5.01 (1.25)	0.75
SL	4.48 (1.12)	4.44 (1.11)	4.39 (1.10)	4.34 (1.09)	4.29 (1.07)	4.24 (1.06)	4.20 (1.05)	4.15 (1.04)	1.08
ESL-exited									

Estimated monthly and weekly growth by assessment: Second grade									
Group	**September**	**October**	**November**	**December**	**January**	**February**	**March**	**April**	**Average (week)**
Gen Ed	6.92 (1.73)	6.37 (1.59)	5.81 (1.45)	5.26 (1.32)	4.71 (1.78)	4.16 (1.04)	3.60 (0.90)	3.05 (0.76)	1.25
LD	2.45 (0.61)	2.81 (0.70)	3.18 (0.80)	3.55 (0.89)	3.92 (0.98)	4.28 (1.07)	4.65 (1.16)	5.02 (1.26)	0.93
SL	5.56 (1.39)	5.21 (1.30)	4.85 (1.21)	4.50 (1.13)	4.15 (1.04)	3.80 (0.95)	3.45 (0.86)	3.09 (0.77)	1.08

Note. Values in parentheses show weekly growth. Gen Ed = general education; LD = learning disabled; SL = speech or language delayed; ESL = English as a second language.

Appendix C

Estimated monthly and weekly growth by assessment: Third grade									
Group	**September**	**October**	**November**	**December**	**January**	**February**	**March**	**April**	**Average (week)**
Latino									
Gen Ed	10.99 (2.75)	9.25 (2.31)	7.51 (1.88)	5.77 (1.44)	4.03 (1.01)	2.29 (0.57)	0.55 (0.14)	−1.19 (−0.30)	1.23
LD	7.51 (1.88)	6.62 (1.66)	5.73 (1.43)	4.84 (1.21)	3.95 (0.99)	3.05 (0.76)	2.16 (0.54)	1.27 (0.32)	1.10
SL	10.36 (2.59)	8.88 (2.22)	7.39 (1.85)	5.90 (1.48)	4.41 (1.10)	2.92 (0.73)	1.44 (0.36)	−0.05 (−0.01)	1.29
ESL									
Gen Ed	10.83 (2.71)	9.23 (2.31)	7.63 (1.91)	6.02 (1.51)	4.42 (1.11)	2.82 (0.71)	1.22 (0.31)	−0.39 (−0.10)	1.31
LD	7.34 (1.84)	6.49 (1.62)	5.65 (1.41)	4.80 (1.20)	3.96 (0.99)	3.12 (0.78)	2.27 (0.57)	1.43 (0.36)	1.10
SL	9.81 (2.45)	8.47 (2.12)	7.13 (1.78)	5.78 (1.45)	4.44 (1.11)	3.10 (0.78)	1.76 (0.44)	0.42 (0.11)	1.28
ESL-exited									
Gen Ed	10.90 (2.73)	9.20 (2.30)	7.49 (1.87)	5.78 (1.45)	4.08 (1.02)	2.37 (0.59)	0.66 (0.17)	−1.04 (−0.26)	1.23
LD	6.85 (1.71)	6.13 (1.53)	5.40 (1.35)	4.68 (1.17)	3.95 (0.99)	3.22 (0.81)	2.50 (0.63)	1.77 (0.44)	1.08
SL	10.57 (2.64)	8.92 (2.23)	7.26 (1.82)	5.61 (1.40)	3.95 (0.99)	2.29 (0.57)	0.64 (0.16)	−1.02 (−0.26)	1.19

Note. Values in parentheses show weekly growth. Gen Ed = general education; LD = learning disabled; SL = speech or language delayed; ESL = English as a second language.

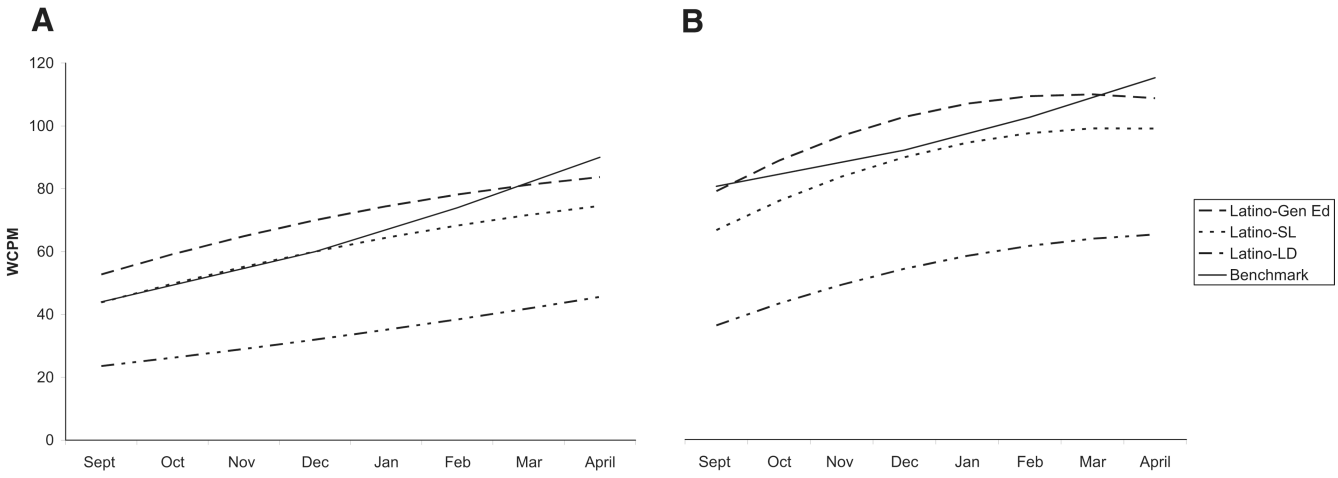

Figure 1.

(A) Second- and (B) third-grade Latino students' oral reading fluency growth. WCPM = words correct per minute; Gen Ed = general education; SL = speech or language delayed; LD = learning disabled.

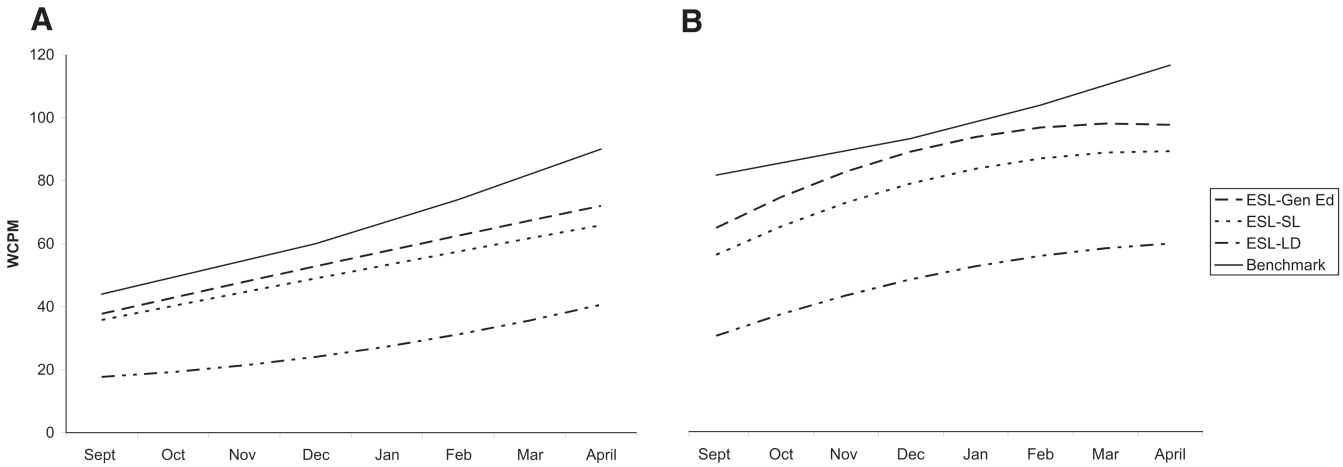

Figure 2.

(A) Second- and (B) third-grade English as a second language (ESL) students' oral reading fluency growth. WCPM = words correct per minute; Gen Ed = general education; SL = speech or language delayed; LD = learning disabled.

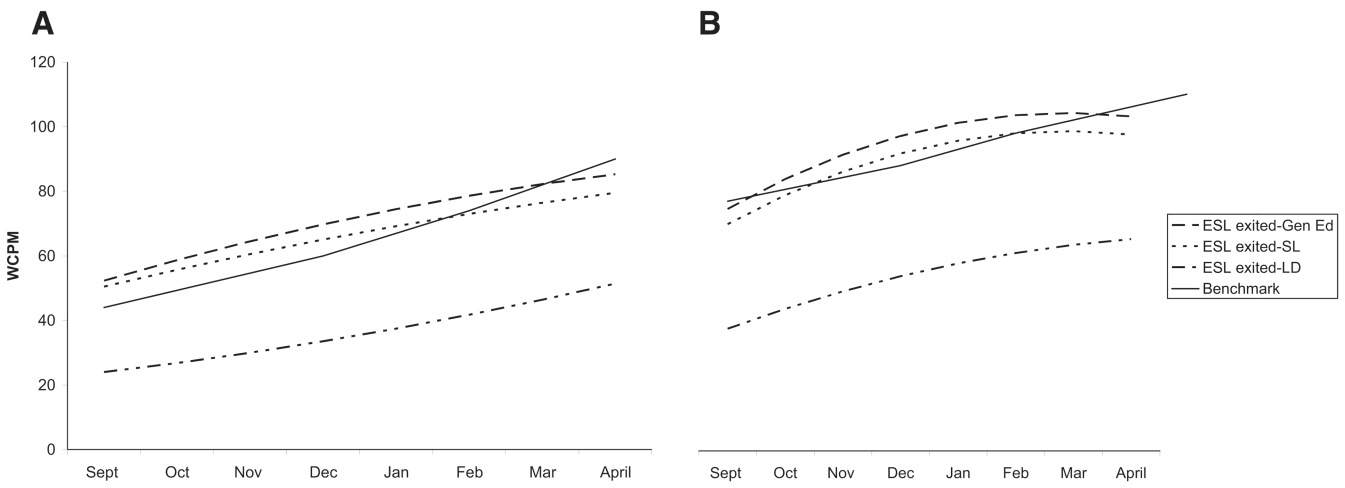

Figure 3.

(A) Second- and (B) third-grade English as a second language (ESL) exited students' oral reading fluency growth. WCPM = words correct per minute; Gen Ed = general education; SL = speech or language delayed; LD = learning disabled.

Table 1

Student Demographics and Receptive Language Standard Scores by Subgroup

	Students		PPVT-III			
Special education	***n***	**%**	***M***	***SD***	**% Female**	**% FARL**
Latino						
Gen Ed	1,615	87.0	94.90	13.89	53.0	79.7
LD	106	5.7	89.26	11.11	41.5	84.9
SL	136	7.3	91.85	12.28	32.3	82.2
Total	1,857	100				
ESL						
Gen Ed	1,767	81.0	80.12	14.65	50.5	81.7
LD	232	10.6	83.88	10.88	29.6	82.9
SL	183	8.4	79.58	12.69	40.4	80.2
Total	2,182	100				
ESL-exited						
Gen Ed	816	84.6	89.97	11.83	52.0	81.5
LD	70	7.3	75.86	13.04	25.7	85.9
SL	79	8.1	89.83	10.39	32.9	87.3
Total	965	100				

Note. PPVT-III = Peabody Picture Vocabulary Test (3rd ed.) scores; FARL = free and reduced lunch; Gen Ed = general education; LD = learning disabled; SL = speech or language delayed; ESL = English as second language.

Table 2

Example of Part of the Data Set (Student 5 at School 1) Used to Conduct Piecewise Growth Curve Modeling

Oral reading fluency	Assessment	Month	Month^2	Grade 2 intercept	Grade 2 linear	Grade 2 quadratic
51	1	0	0	1	0	0
57	2	3	9	1	3	9
76	3	5	25	1	5	25
73	4	7	49	1	7	49
66	5	0	0	0	0	0
98	6	3	9	0	0	0
89	7	5	25	0	0	0
92	8	7	49	0	0	0

Note. For month, 0 = September; 3 = November; 5 = February; 7 = April.

Table 3

Variances for the Unconditional and Conditional Models

	Unconditional model			Conditional model			
Random effect	**Variance**	**χ^2**	***p***	**Variance**	**χ^2**	***p***	**% Var. Red.**
Second grade							
Intercept, r_{0i}	163.31	8,905.45	.000	124.68	6,863.90	.000	23.7
Linear slope, r_{1i}	17.53	5,106.63	.000	11.39	4,436.71	.000	35.0
Quadratic slope, r_{2i}	0.30	5,037.52	.000	0.19	4,685.35	.000	36.7
Third grade							
Intercept, r_{3i}	928.47	62,310.98	.000	687.06	48,105.08	.000	31.8
Linear slope, r_{4i}	12.77	6,072.62	.000	8.05	4,917.85	.000	36.9
Quadratic slope, r_{5i}	0.20	5,734.03	.000	0.11	4,609.07	.000	45.0
Error variance	69.75			69.69			

Note. % Var. Red. = proportion of reduction in the variance explained.

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Table 4

Fixed Effect Results From Level 1 Model

Fixed effect	Coefficient	*SE*	*t*-ratio
Third grade			
Intercept, π_0	65.520787	0.447329	146.471
Linear slope, π_1	10.520730	0.094826	110.947
Quadratic, π_2	−0.789583	0.012846	−61.464
Second grade			
Intercept, π_3	−21.553888	0.252689	−85.298
Linear slope, π_4	−4.838996	0.128241	−37.734
Quadratic, π_5	0.645948	0.017573	36.758

Table 5

Results of Final Model for Oral Reading Fluency Scores: Fixed Effects Results

Fixed effect	Coefficient	*SE*	*t*-ratio
Fixed referent third-grade intercept, π_0			
Latino Gen Ed	75.537	0.726	103.988
Latino SL	63.715	2.501	25.471
Latino LD	34.661	2.834	12.230
ESL Gen Ed	61.138	0.695	88.023
ESL SL	53.162	2.156	24.657
ESL LD	28.769	1.916	15.016
ESL-exited Gen Ed	74.653	1.021	73.123
ESL-exited SL	70.100	3.289	21.316
ESL-exited LD	37.856	3.490	10.849
Fixed referent third-grade linear slope, π_1			
Latino Gen Ed	10.981	0.165	66.502
Latino SL	10.307	0.568	18.156
Latino LD	7.447	0.649	11.480
ESL Gen Ed	10.823	0.157	68.933
ESL SL	9.744	0.483	20.189
ESL LD	7.308	0.429	17.025
ESL-exited Gen Ed	10.852	0.229	47.333
ESL-exited SL	10.497	0.747	14.056
ESL-exited LD	6.821	0.778	8.770
Fixed referent third-grade quadratic, π_2			
Latino Gen Ed	−0.868	0.022	−38.683
Latino SL	−0.735	0.077	−9.548
Latino LD	−0.437	0.088	−4.936
ESL Gen Ed	−0.799	0.021	−37.510
ESL SL	−0.664	0.065	−10.143
ESL LD	−0.418	0.058	−7.188
ESL-exited Gen Ed	−0.844	0.031	−27.099
ESL-exited SL	−0.820	0.101	−8.121
ESL-exited LD	−0.361	0.105	−3.441
Second-grade intercept, π_3			
Latino Gen Ed	−22.545	0.446	−50.561
Latino SL	−19.648	1.505	−13.060
Latino LD	−10.831	1.759	−6.158
ESL Gen Ed	−23.167	0.421	−54.986
ESL SL	−17.409	1.286	−13.541
ESL LD	−11.073	1.154	−9.594
ESL-exited Gen Ed	−22.283	0.608	−36.643
ESL-exited SL	−19.544	1.961	−9.965

Fixed effect	Coefficient	*SE*	*t*-ratio
ESL-exited LD	−13.548	2.082	−6.508
Second-grade linear slope, π_4			
Latino Gen Ed	−4.065	0.226	−17.976
Latino SL	−3.954	0.768	−5.148
Latino LD	−5.001	0.890	−5.620
ESL Gen Ed	−5.786	0.213	−27.133
ESL SL	−5.234	0.651	−8.042
ESL LD	−6.333	0.582	−10.874
ESL-exited Gen Ed	−3.965	0.309	−12.851
ESL-exited LD	−4.462	1.051	−4.244
ESL-exited SL	−4.973	1.001	−4.968
Second-grade quadratic, π_5			
Latino Gen Ed	0.554	0.031	17.917
Latino SL	0.485	0.105	4.603
Latino LD	0.518	0.122	4.252
ESL Gen Ed	0.778	0.029	26.735
ESL SL	0.635	0.089	7.129
ESL LD	0.705	0.079	8.864
ESL-exited Gen Ed	0.571	0.042	13.515
ESL-exited SL	0.647	0.137	4.727
ESL-exited LD	0.554	0.144	3.854

Note. Results for random effects are provided in Table 3. Gen Ed = general education; SL = speech or language delayed; LD = learning disabled; ESL = English as a second language.

Table 6

Effect Size Contrasts for Observed Mean Differences

Contrast group		Second grade		Third grade	
1	**2**	**Initial status**	**End-of-year status**	**Initial status**	**End-of-year status**
Latino Gen Ed	Latino SL	0.39	0.32	0.40	0.34
Latino Gen Ed	Latino LD	1.19	1.35	1.44	1.51
Latino SL	Latino LD	0.94	1.05	1.15	1.09
ESL Gen Ed	ESL SL	0.15	0.23	0.30	0.33
ESL Gen Ed	ESL LD	0.96	1.19	1.16	1.32
ESL SL	ESL LD	0.98	1.03	0.96	0.94
ESL-exited Gen Ed	ESL-exited SL	0.08	0.22	0.17	0.24
ESL-exited Gen Ed	ESL-exited LD	1.19	1.27	1.27	1.48
ESL-exited SL	ESL-exited LD	1.23	1.09	1.13	1.16

Note. Cohen's *d* with $d = (M1 - M2)/\sigma_{pooled}$, highlighting the differences between the students with learning disabilities (LD) and their general education (Gen Ed) peers within each English proficiency subgroup. SL = speech or language delayed; ESL = English as a second language.

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