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Predicting First Grade Reading Performance from Kindergarten Response to Tier 1 Instruction

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Abstract

Many schools are beginning to implement multi-tier response to intervention (RTI) models for the prevention of reading difficulties and to assist in the identification of students with learning disabilities (LD). The present study was part of our larger ongoing longitudinal RTI investigation within the Florida Learning Disabilities Center grant. This study used a longitudinal correlational design, conducted in 7 ethnically and socio-economically diverse schools. We observed reading instruction in 20 classrooms, examined response rates to kindergarten Tier 1 instruction, and predicted students' first grade reading performance based upon kindergarten growth and end of year reading performance (n = 203). Teachers followed an explicit core reading program and overall, classroom instruction was rated as effective. Results indicate that controlling for students' end of kindergarten reading, their growth across kindergarten on a variety of language and literacy measures suppressed predictions of first grade performance. Specifically, the steeper the students' trajectory to a satisfactory outcome, the less likely they were to demonstrate good performance in first grade. Implications for future research and RTI implementation are discussed.

Keywords

response to intervention; beginning reading; classroom observations; reading growth

In recent years, many schools have begun to implement response to intervention (RTI) models for the prevention of reading difficulties and to assist in the identification of students with learning disabilities (LD). Implementation of RTI models has shown promise for improving overall reading outcomes and decreasing the number of students with reading difficulties in the elementary grades (e.g., Gersten et al., 2008). However, there are still unanswered questions related to the implementation of RTI including the reliability and validity of the decision-making process for determining student response to instruction and referral for more intensive instructional regimes. One of the primary foci of RTI models is prevention and a large corpus of research demonstrates the positive effects of early and targeted reading interventions for students at-risk for reading difficulties (Cavanaugh, Kim, Wanzek, & Vaughn, 2004; Mathes et al., 2005; Torgesen et al., 1999; Vellutino, Scanlon, Small, & Fanuele, 2006; Vellutino, Scanlon, Zhang, & Schatschneider, 2008;). Consequently, the accurate identification of students who need early intervention has become a key factor in the prevention of reading difficulties (Adams, 1990; Snow, Burns, & Griffin, 1998). Kindergarten is often the first opportunity school personnel have to provide instruction and to evaluate students' responsiveness. Thus, in the present study, we examine

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response to kindergarten classroom reading instruction, and evaluate its predictive relation to students' first grade reading skills.

Kindergarten end of year reading and behavioral outcome measures have been shown to predict reading trajectories from first to fourth grade (Spira, Bracken, & Fischel, 2005). Furthermore, research suggests that even in fall of kindergarten, students' pre-reading skills such as letter naming fluency, phonological awareness, and oral vocabulary and their behavior predict subsequent reading performance (Al Otaiba & Fuchs, 2006; Bishop & League, 2006; Coyne, Kame-enui, Simmons, & Harn, 2004; NELP, 2008). However, other researchers have suggested that the examination of reading difficulty in an RTI model should not only take into account reading status at particular points in time, but also reading growth over time (e.g., Baker et al., 2008; McMaster, Fuchs, Fuchs, & Compton, 2002; Speece & Ritchey, 2005; Vellutino et al.; 2008). For example, Compton, Fuchs, Fuchs & Bryant (2006) compared the utility of prediction models with status only and status plus growth and found that a model including the level and slope of 5 weeks of progress monitoring on word identification fluency provided more accurate identification of second grade reading difficulty than did initial first grade phonological awareness, rapid naming, oral language, and word identification fluency. Similarly, Baker et al.(2008) examined the link between oral reading fluency growth across first and second grade with high-stakes reading tests within Oregon's Reading First data set (n = 2,400), First grade oral reading fluency slope predicted an additional 10% of the variance in Grade 2 SAT-10, after controlling for initial oral reading fluency and first grade SAT-10 scores.

However, findings from another recent large scale study suggest that end of year status may provide the most reliable information related to student response, as measured by performance on high-stakes statewide reading tests. In a large study of more than 23,000 first graders, end of first grade scores on oral reading fluency uniquely predicted end of first grade reading comprehension, beginning of second grade oral reading fluency, and end of second grade reading comprehension (Schatschneider, Wagner, & Crawford, 2008). Growth on first grade oral reading fluency did not provide uniquely contribute to the prediction of the outcomes.

Given these equivocal findings about the relative importance of status and growth in predicting future risk for reading difficulties and subsequent need for additional intervention, the present study was designed to examine whether students' end of kindergarten and first grade reading performance were predicted by their growth and/or end of kindergarten status on several measures of reading and reading readiness. We were particularly interested in the first grade performance of students who started kindergarten with relatively weak initial reading readiness. We extend previous research by carefully examining the nature of Tier 1 instruction, which, has received surprisingly little attention in prior studies, There is broad agreement among researchers that Tier1 kindergarten instruction should target skills that help students decode words by teaching them code focused skills (i.e., phonological awareness and phonics), while also building meaning focused skills (i.e., oral vocabulary and listening comprehension; NRP, 2000). We therefore investigated the amounts, types, and implementation of Tier 1 instruction with the anticipation that if students demonstrated strong growth within well-implemented Tier 1 kindergarten instruction, then, as good responders, they would likely maintain a successful reading developmental trajectory. Testing this hypothesis is central to scaling up RTI implementation.

Method

Research Design and Participants

Design and school settings—We used an observational design to examine student growth and status over a two-year longitudinal period across kindergarten and first grade in a mid-size city in northern Florida. As state legislation had just been passed requiring RTI to be in place by 2009, the district was very motivated to collaborate with us. So, with the help of the district reading coordinator we recruited 7 schools that served families from diverse ethnic and socioeconomic backgrounds. Four of the 7 schools received Title I funding, two schools received Reading First support, and all schools had a reading coach. The schools served a culturally diverse population, but, as is typical within this district, the percentage of the schools' students identified as Limited English Proficient (LEP) was notably small (from 0.0% to 4.5%).

Schools provided full day kindergarten with a minimum block of 90 minutes of instructional time for reading and language arts. All but one school utilized *Open Court*, published by SRA (Bereiter, et al., 2002), as the core reading program. The remaining school used *Reading Mastery Plus* published by SRA (Engelmann & Bruner, 2002). Thus, program materials used by teachers included explicit and systematic instructional techniques and incorporated both code- and meaning-focused activities. Specifically the core programs provided phonological awareness, alphabetics (letter naming and letter sound), decoding and word recognition in the domain of code-focused. The meaning-focused activities included vocabulary and listening comprehension and beginning reading comprehension, To our knowledge, there were no formalized Tier 2 or 3 interventions for kindergarten.

Teachers and students—A total of 21 credentialed teachers (ranging from one to four teachers per school), agreed to participate; as two teachers co-taught, the sample represented 20 classrooms. These teachers were female; a majority (15) were Caucasian, five were African American, and one was Hispanic. Four teachers held graduate degrees (19%) and the majority held Bachelor's degrees (81%). On average, teachers had taught for 5.71 years (SD = 5.06) and only one was a first-year teacher.

Parents of 247 students gave consent; slightly more than 70% also provided information about their own education, home literacy practices, and their child's preschool attendance. During kindergarten, 23 students moved and an additional 21 students moved during first grade; there were no significant differences in demographics or pretreatment scores between students who moved versus those who remained. Of the 203 remaining students, 58% were African American, 33% were Caucasian, 2% were Hispanic and 7% were of other ethnicities. Slightly more than half the sample was female (56.65%) and a similar proportion received free or reduced price lunch (57.64%). Students' mean age in fall was 5.4 years (SD = .48). About 20% of parents had a high school diploma or had not completed high school and the majority reported having at least some college or vocational training or had earned a college degree (51.72%), the remainder had a graduate degree. All but one parent reported reading to their child before they entered kindergarten, and nearly 60% began doing so before the child was a year old. Of parents who read to their children, 67.48% report reading up to 30 minutes per day. Most of our students had at least one year of preschool; only 12.81% percent had less than a year of preschool.

At the time of the study, the IQ-achievement discrepancy approach was still in place within the district, but none of the participating students met this criterion at any point during the study. However, 13.3%, received speech and or language therapy, 4.9% had a label of intellectual or developmental disability, and about 1% had mild sensory impairment. In

phone interviews with all therapists and special educators, we learned they did not provide any systematic literacy intervention, and that services were similar across schools.

Student Measures

Initial child characteristic predictor measures—To assess students' cognitive ability, we administered the brief intelligence cluster (verbal comprehension, visual matching, and concept formation) of the Woodcock-Johnson III (WJ-III) Cognitive Test (Woodcock, McGrew, & Mather, 2001). This test is a norm-referenced, standardized test with established reliability (i.e., .71 to .99 for ages 5–10), and validity (Woodcock et al., 2001).

To assess phonological, print knowledge, and alphabetic skills, we used several tasks. The first, which assessed phonological memory, was the Non-word Repetition subtest of the Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgesen, & Rashotte, 1999). Students listen to a spoken nonsense word and repeat it aloud. Internal consistency is .80; concurrent validity with word identification is .66. Second, we used the blending and elision tasks from the Test of Preschool Early Literacy (TOPEL: Lonigan, Wagner, Torgesen, & Rashotte, 2007).The TOPEL Phonological Awareness task measures students' word elision and blending abilities and has a reliability of α=.87. Third, we measured environmental print and alphabetic knowledge using the Print Knowledge subtest of the TOPEL. Coefficient alpha for this subtest is .90, and interrater reliability is above .90. This subtest has 36 items divided into three parts: (1) the examiner gives students four pictures and ask a question and the student is told to point to the correct answer; (2) the examiner gives the student a specific letter or letter sound asks him to point to the correct letter, and (3) the examiner asks the student to name the letters or tell the sound it makes.

We assessed initial oral vocabulary using another subtest of the TOPEL, the Definitional Vocabulary subtest. This is a highly reliable measure (α=.98) of both single-word oral vocabulary and definitional vocabulary, which measures both surface and deep vocabulary knowledge appropriate for preschool and beginning kindergarten. There are 70 items of increasing difficulty. Examiners show students pictures and ask one of the following questions: What is this? What do you do with it? What does it do? Is it fast or slow? Where does it live? To learn more about students' behavior, we asked teachers to complete the Social Skill Rating System (SSRS) checklist (Gresham & Elliott, 1990). This measure is a nationally standardized rating scale with 57 items that yields scores in problem behavior, academic competence, and social skills. Internal reliabilities of the scales were .90 or higher.

Kindergarten vocabulary, alphabetic, phonological, and reading growth and end of year status—To assess students' expressive vocabulary growth, we used the Picture Vocabulary subtest of the WJ-III (Woodcock et al., 2001). In this subtest, students name pictured objects which increase in difficulty. Testing is discontinued after 6 consecutive incorrect items. According the WJ-III test authors, reliability of this subtest is . 77. Then, to assess students' word reading growth, we selected the Letter-Word Identification subtest of the WJ-III (Woodcock et al., 2001). This subtest consists of 76 increasingly difficult items beginning with identifying letters and then reading words. Testing is discontinued after 6 consecutive incorrect items. Reliability is .91. For kindergarten, concurrent correlations with the Word Attack and Passage Comprehension subtests of the WJ-III are .80 and .79 respectively.

To reduce testing time, we also acquired data from the district-administered Dynamic Indicators of Basic Early Literacy Skills (DIBELS; Kaminski & Good, 1998). Letter Naming Fluency (LNF) and Initial Sound Fluency (ISF). LNF was administered in fall, winter, and spring; ISF was measured fall and winter. The LNF task assesses the number of

letters a child can name in one minute. Test authors report alternate-form reliability of .99. The ISF measures phonological awareness; the student sees four pictures (e.g., sink, cat, gloves, and hat) and the examiner names each picture, and asks the child to show which picture begins with a target sound (e.g., /s/). The examiner also asks the student to say a beginning sound of a word that matches one of the four pictures (e.g., cat). The score is the number of correct initial sounds correct in a minute. Alternate form reliability is .72.

To address general kindergarten reading ability, we also collected students' scores on the district-administered Stanford Achievement Test-Tenth Edition (SAT-10; Harcourt Brace Educational Measurement, 2003). The SAT-10 SESAT-2 is a group-administered comprehensive measure of reading, which includes the following subtests: Sounds and Letters (skills include: phonological awareness, orthographic awareness, and alphabetic principal), Word Reading/Reading Vocabulary (skills include: printed word to spoken word, printed word to picture, multiple printed words to picture, and dictated word to printed word), and Sentence Reading/Reading Comprehension (skills include: predictable text, onset-rime, simple sentence). Test authors report the mean test-retest reliability is .81.

First grade reading growth and end of year status—To assess students' ability to fluently and accurately read grade level passages, we collected district- administered DIBELS Oral Reading Fluency data. While a student reads connected text; the examiner measures the number of words read correctly in one minute. Test-retest reliability for elementary students is .92 (Tindal, Marston, & Deno, 1983). Following standard procedures, examiners administered three passages and the median score was reported. At the end of first grade, students complete the SAT-10 Primary 1, which includes the following subtests: Word Study Skills (skills include: structural and phonetic analysis), Word Reading (skill includes: multiple printed word to picture), Sentence Reading and Reading Comprehension (skills include: predictable text, onset-rime, two simple sentences, two sentence stories, cloze, short passages with questions, literary, informational, functional, initial understanding, interpretation, and critical analysis and strategies). We also accessed this data from the district as a measure of end of year reading comprehension.

Classroom Tier 1 Observations: Amounts and Effectiveness of Reading Instruction

Amounts—Trained research staff videotaped reading instruction in all 20 classrooms in fall, winter, and spring; video recordings ranged in length from 60 – 120 minutes and averaged 90 minutes. To code, tapes were downloaded into the Noldus Observer program. All coders had or were pursuing a graduate level degree in education or communication disorders and were trained over a 1 month period involving: a 2 day training session, small group training about the coding scheme (Connor et al, 2009), shadowing the lead coder, and independently coding a tape. Noldus software calculates the Cohen's kappa to measure inter-rater agreement between each possible pair of raters. Coders could not code independently until they met a kappa of .80. The reliability of the coders ranged from .77–.83 with a mean of .80.

Implementation—To address the effectiveness of *implementation*, we trained coders to use an adapted version of the English Language Learners (ELL) Classroom Observation Instrument (Haager, Gersten, Baker, & Graves, 2003). This observation instrument was selected because Haager et al. reported good inter-rater reliability (above 70%). Coders completed global ratings of how teachers in the videos implemented instruction using 15 target behaviors. In addition raters reported the effectiveness of code focused (letter-sound, decoding, and phonological awareness) and meaning focused (vocabulary, comprehension, and fluency) components of reading instruction. Again, Cohen's kappa coefficient was

calculated for each subscale for each possible pair of raters and was consistently strong with $k > .78$.

Procedures

Data collection and scoring procedures—Trained project staff administered most student measures individually in a quiet area near the students' classroom. Because students were young, testing was divided into 30 minute sessions; resulting in three sessions in fall, one in winter, and two in spring. Test protocols were carefully scored, data were entered, and then, for relevant WJ-III (Woodcock et al., 2001) subtests, a computerized scoring program was used to calculate standard and W scores. W scores are Rasch ability scores, which provide equal-interval measurement characteristics; they are centered at 500, which represents typical achievement for a 10 year old. Trained district teams, including reading coaches, administered DIBELS across kindergarten and first grade and entered data at each of the three assessment periods. Classroom teachers administered the SAT-10 assessments.

Data analysis—SPSS (SPSS, inc. Version 16) was used to rule out floor and ceiling effects on the measures by examining skewness and kurtosis, and to calculate descriptive statistics, correlations, and partial correlations. A hierarchical linear modeling program (HLM; Raudenbush, Bryk, & Congdon, 2008, Version 6.06) was used to obtain OLS regression estimates of student growth and for all HLM analyses. Student level growth was estimated for kindergarten Letter-Word Reading, Picture Vocabulary, and LNF to be used as predictors or independent variables; students' growth in first grade ORF was estimated as an outcome or dependent variable. OLS estimates were chosen over empirical Bayesian estimates because the OLS estimates would more realistically reflect how student growth would be estimated by a teacher or school (Good & Shinn, 1990). The OLS value for slope in this study describes the rate of change in student performance per month. In this paper, the value of change for word reading and vocabulary is in W scores which are transformed IRT-based Rasch ability scores with equal-intervals that are appropriate for measuring growth (Bryk & Raudenbush, 1987). The value of change for LNF and ORF tasks are correct items (letter names or words) per minute each month. Here after status refers to the predicted end of year status as the estimated intercept from the OLS regressions, and growth refers to the estimated slope from the OLS regressions; outcome refers to actual end of year outcome from actual end of year observed data.

Results

Kindergarten Tier 1 Instruction and Response Rates

Amounts, types, and effectiveness of Tier 1 instruction

In investigating the amounts and effectiveness of instruction, first we were interested to know how much code- and meaning-focused instruction students received. On average, students received 27.28 minutes (SD = 10.44 minutes) of code- and 21.51 minutes (SD = 11.00) of meaning-focused instruction each day. Overall, teachers spent relatively more time on code-focused instruction and less on meaning-focused instruction. Teachers' mean overall instructional effectiveness rating on the Classroom Observation Instrument (Gersten et al., 2005; Haager et al., 2003) was 2.22 ($SD = .35$), suggesting that across the year, instruction was generally rated as effective to highly effective. With regard to reading instruction more specifically, teachers were similarly effective ($M = 2.26$, $SD = .38$). However, their code-focused instruction was rated as more effective than meaning-focused instruction (respective $M = 2.56$, $SD = .44$ and $M = 1.80$, $SD = .59$).

Response to kindergarten Tier1 instruction

Table 1 displays descriptive statistics of child characteristics, kindergarten growth and outcomes, and first grade growth and outcomes. On average, kindergarten students ended the school year with mean Letter-Word Identification standard scores of 110.65 (*SD* = 13.45). This finding, that the sample mean was relatively higher than national norms, should be considered noteworthy in light of the students' diversity, participation in free and reduced lunch program, and relatively low mean IQ (89.08, *SD* = 13.55). We considered used a criteria of 93 on the WJ-III Letter-Word Identification subtest in examining responsiveness rates to Tier 1 instruction. On average, 92.30% of students in classrooms met this criteria. The percentage of students meeting the criteria within classrooms ranged from 80% (*n* = 2) to 100% (*n* = 8). In summary, both the classroom instruction amount, types, and quality data and student outcomes support that Tier 1 instruction was robust and that most students responded adequately to Tier 1 instruction.

Predicting First Grade Reading Performance from Kindergarten Growth and Status

Given the observed overall instructional effectiveness of kindergarten Tier 1 and the relatively strong student reading outcomes in kindergarten, we examined whether first grade reading performance could be predicted from kindergarten reading growth or status. Table 1 displays the descriptive statistics of predicted status and estimated growth for Letter Word Identification, LNF, Picture Vocabulary, and first grade ORF. The average predicted end of year W score for Letter Word Identification was 409.10, which represents an age equivalent of approximately six years and ten months and a grade equivalent of 1.5. On average, students gained 4.82 W score points per month. Similarly, the predicted end of year W score for Picture Vocabulary was 476.40, which represents an age equivalent of approximately 6.7 and a grade equivalent of approximately 1.2. Students' vocabulary growth was much slower; on average, students gained 0.76 W score points per month on Picture Vocabulary. At the end of kindergarten, the average predicted LNF was 60.89 letters per minute; students gained an average 5.60 letters per minute each month. In first grade the average predicted end of year ORF was 77.8 words per minute; students gained an average of 7.59 words per minute each month.

After calculating growth and status, we investigated the zero-order correlations between predictors or independent and outcomes or dependent variables; Table 2 displays the correlations. The correlations between outcomes ranged from .33 and .78, all were significant at the .01 level. The correlations between predictors ranged from −.08 to .50. The correlations between predictors and outcomes ranged from −.08 to .83. Correlations were typically positive, except for vocabulary growth, which was negative though not significant. Additionally, the correlations with LNF growth were weak and not significant.

Next, to see whether students' first grade reading performance could be predicted by kindergarten reading growth and status, multiple hierarchical linear modeling (HLM) analyses were conducted. We used HLM to account for the nested nature of the data and used the individual growth and status from kindergarten measures of letter-word reading, letter-naming fluency, and Picture Vocabulary, to predict reading achievement at the end of kindergarten and first grade. First, we investigated the unconditional grand mean model for all dependent variables using three-level HLM models (students nested within classroom within school). The school level intraclass correlation (ICC) which represents the amount of variance attributable to schools was fairly small (.05 for kindergarten SAT-10, .03 for first grade ORF, .01 for first grade ORF Growth, and .08 for first grade SAT-10).

We inspected the results of the three-level unconditional HLMs for the four dependent variables to determine the variance accounted for at the student, teacher, and school level.

We found no significant variance for any of the variables at the teacher level (all ICCs were .00), but we did find significant variance at the school level for both kindergarten and first grade SAT-10 (p <.01), marginally significant variance at the school level for end of year first grade ORF (p = .056), and no significant variance at the school level for first grade ORF growth. The school level ICC for kindergarten SESAT, first grade ORF, first grade ORF growth, and first grade SAT-10 were very low (.05, .03, .01, and .08, respectively).

Because of the importance of accounting for the nested nature of data and parsimony, we built the conditional models to investigate the predictive utility of growth and status in kindergarten as they predicted achievement in first grade as 3-level models, with random intercepts and fixed growth at the teacher level and with random intercepts and growth at the school level. We conducted a separate HLM for each dependent variable (kindergarten SAT-10, first grade ORF, first grade ORF Growth, and first grade SAT-10) three times – once for each type of predictor (Letter-Word Identification, Letter-Naming Fluency, and Picture Vocabulary) for a total of 12 HLM analyses. Each model contained both status and kindergarten growth as predictors using the following mixed model equation:

$$\text{outcome}=\gamma_{000}+\gamma_{100}*\text{growth}+\gamma_{200}*\text{status}+r_0+u_{00}+u_{10}*\text{growth}+u_{20}*\text{status}+e.$$

Because of the multiple HLM analyses, we used the Benjamini-Hochberg linear step-up procedure to control for the false discovery rate (Benjamini & Hochberg; 1995). This was applied to all 36 fixed effects including intercepts and the parameter estimates for growth and status.

Table 3 displays the fixed effects from the HLM analyses. In predicting kindergarten SAT-10, growth and status in Letter Word Identification, LNF, and Picture Vocabulary were significant, but the effect of growth was negative, or suppressive. This implies that after controlling for end of year performance, students who had to grow faster to reach that specific level had worse outcomes the following year. Similar results were seen in predicting first grade ORF, with the one exception that LNF growth did not significantly predict first grade ORF. In predicting first grade ORF growth, kindergarten growth never significantly predicted, but there was significant positive predictability from kindergarten status in Letter Word Identification and LNF. Neither Picture Vocabulary growth nor status predicted first grade ORF Growth. First grade SAT-10 was significantly predicted by growth and status in all models, and again, growth had a negative relation with first grade SAT-10. This consistent pattern of kindergarten growth being negatively related to outcome after controlling for final status implies that the faster a student had to grow to get to a final outcome, the more at-risk the student was for lower academic performance. To investigate this phenomenon further, we looked at correlates of student growth on a number of student characteristics after partialling out final status.

Post-hoc Analyses of the Correlates of Kindergarten Growth

Based upon our reading of the research and our own prior investigations, within the larger LD Center project, we had assessed a large number of potentially important child characteristics (e.g., language, maternal education, socioeconomic status, home literacy experiences, behavior). Thus we were able to conduct a post-hoc analysis to learn which were associated with growth after controlling for end of year performance.

Table 4 displays the partial correlations between kindergarten estimated growth and child characteristics, after partialling out end of year performance. As we hypothesized, home literacy characteristics were significantly correlated with kindergarten growth in letter naming, decoding, and most strongly, with expressive vocabulary. Partial correlations

ranged from −.3 to .21. Years of preschool was most strongly correlated with growth in general (r = −.30 to −.26). Students with less preschool showed faster growth in kindergarten, which suggests that the students with less preschool experience were less academically prepared, thus, controlling for where they ended kindergarten, they had more room to grow and they grew faster than children with more preschool. Expressive vocabulary growth seemed to be influenced the most by home literacy characteristics with negative partial correlations between parental education (r = −.16) and years of preschool (r = −.22), and with positive partial correlations with the age parents read aloud to students (r = .17) and the time spent on reading each day (r = .21).

Child characteristics at kindergarten entry were significantly correlated with kindergarten growth on expressive vocabulary, Letter-Word reading and LNF. We found that IQ had significant partial correlations with Picture Vocabulary growth (r = −.30) and LNF growth (r = −.21), but not with Letter Word growth. Letter Word Identification reading growth in kindergarten was more strongly correlated to verbal IQ measures (r = −.44 to −.09) than nonverbal IQ (r = −.14 to −.05). The strongest partial correlates with Letter Word growth were measures of phonological awareness (r = .−.26 to −.23), print knowledge (r = −.30), and teacher's evaluation of academic competence (r = −.33). Similar patterns were seen with correlates of LNF growth, and the addition of teachers' evaluation of social skills was also correlated with LNF growth (r = −.16), though much weaker than that of academic competence behaviors. Picture vocabulary growth was the only growth measure that was significantly partially correlated with Nonword Repetition (r = −.25) or Definitional Vocabulary (r = −.28) in addition to other phonological awareness measures (r = −.27 to −.19), though not significantly correlated with print knowledge (r = −.13). We found a significant, albeit weak, positive partial correlation with vocabulary growth and teachers' evaluation of problem behavior (r = .15), but no significant association with academic competence or social skills.

Discussion

In this correlational two-year longitudinal study, we sought to extend RTI research by establishing that kindergarteners received a well-implemented Tier 1, exploring student response rates to this instruction and examining whether outcomes or growth reliably predicted students' first grade reading performance. We also conducted a post-hoc analysis toexamine initial child characteristics related to kindergarten growth.

Insights from Examining Kindergarten Tier 1 Responsiveness

Through observations of the language arts block, we found that teachers did provide explicit and systematic instruction and that they followed a core reading program that is consistent with definitions of "evidence-based" recommendations of the NRP (2000) and with "high-quality" defined by the IES RTI Practice Guide (Gersten et al., 2008). Moreover, through these observations, we established that Tier 1 instructional implementation was generally rated as "effective", which is a necessary precursor toward establishing treatment validity at any tier. However, teachers were more effective in teaching code-focused than meaning-focused reading skills. This finding is consistent with our own prior observational research in kindergarten Reading First classrooms (Authors, 2008).

The second piece of converging evidence that Tier 1 was effective was that at the end of the year, most kindergarteners read at grade level. Our student sample was diverse, had a fairly low mean IQ (M = 89.08, SD = 13.55), and more than half received free and reduced price lunch. Thus, we were encouraged that, on average, most kindergarten students demonstrated grade level word reading skills (M = 110.65; SD = 13..45). In a typical class, over 90% of students had standard scores above 93, which represents the fortieth percentile nationally.

Predicting First Grade RTI from Kindergarten Growth and End of year Status

We predicted first grade reading fluency and comprehension performance from kindergarten growth and status on several measures of reading and reading readiness. In our sample, when predicting first grade ORF growth, pseudo-*r*-squares (Kreft & de Leeuw, 1998; Singer, 1998) ranged from .01 to .06; when predicting first grade ORF outcome, pseudo-r-squares ranged from .08 to .37. As can be seen by our models, relatively less is known about predicting first grade fluency and comprehension performance than word reading performance, and it is particularly difficult to reliably predict growth

We anticipated that if students with the weakest initial skills demonstrated strong growth within a well-implemented Tier 1 Kindergarten instruction, then these "good responders" would likely continue on a successful reading developmental trajectory. Testing this hypothesis is central to RTI efforts. Thus, it was disheartening to learn that when we controlled for students' reading scores at the end of kindergarten, students who had the steepest slopes in kindergarten were disadvantaged in first grade oral reading fluency and comprehension relative to their peers with slower growth. This finding led us to question, how could good response to good instruction suppress accurate predictions of first grade reading performance?

One explanation is that kindergarten entry skills may be too variable to reliably predict reading, particularly fluency and comprehension, and that a longer window of evaluation is needed because there have been some equivocal findings in kindergarten studies (e.g., Gersten et al., 2008). Differences may also be related to the lack of supplemental intervention in our study or to measures used to define response criteria across studies. For example, Coyne and colleagues (Coyne et al., 2004) reported that students who had responded well to a Tier 2 kindergarten intervention achieved first grade level word reading expectations but that fewer met expected levels on measures of oral reading fluency and comprehension. Bishop and League's results (2006) differed from our findings in that they showed similar predictive accuracy for kindergarten fall or winter scores (alphabetics, rapid naming, and phonological awareness skills) in predicting students' end-of-first grade reading achievement (comprehension, fluency, sight word recognition, and phonetic decoding efficiency) as well as oral reading fluency outcomes in later grades.

In a previous study, Al Otaiba and Fuchs (2006) compared the response to peer tutoring or to typical classroom instruction in kindergarten and first grade, followed the responders and non-responders, and found that by the end of third grade, the majority of students who had been unresponsive across both years were identified as needing reading special education services. By contrast none of the students who had responded consistently well both years needed special education. If first grade response, or a combination of kindergarten and first grade response, is more accurate than kindergarten alone, then ongoing longitudinal research with our sample will allow us to explore more carefully which is most reliable. Several researchers have established that predictions from first and second grade are relatively accurate predictors of reading performance in subsequent years (e.g., Compton et al., 2006; Juel, 1988; McCardle, O'Connor & Jenkins, 1999; Fuchs, Fuchs, & Compton, 2004).

Another point of convergence related to the reliability of end of kindergarten outcomes is found in another longitudinal study conducted by Spira and colleagues (Spira et al., 2005). These investigators examined end-of- kindergarten measures to predict fourth grade reading outcomes for students who demonstrated reading difficulties in first grade. Kindergarten measures of emergent literacy, expressive language, and classroom behavior explained 35% of the variance in second grade reading outcomes for the students above and beyond measures in first grade. These studies suggest that end of kindergarten status could be used to predict future reading performance and, therefore, used to identify students who may be

at-risk for poor reading outcomes; however these researchers did not compare growth and status.

Our findings converge with recent research that end of year status may provide the most reliable information related to student response. Schatschneider and colleagues (Schatschneider et al., 2008) studied 23,000 first graders and reported their end of first grade scores on oral reading fluency uniquely predicted end of first grade reading comprehension, beginning of second grade oral reading fluency, and end of second grade reading comprehension. In contrast, oral reading fluency growth did not provide independent contribution beyond end of year scores to the prediction of any outcomes at first or second grade. The present study extends this finding downward to kindergarten, but additional research directly comparing the efficacy of status and growth for identifying response to Tier 1 instruction is needed.

Child Characteristic Correlates of Kindergarten Growth: It's Not Just Where You End but How Fast You Had to Grow to Get there that Matters

Our data suggest that it is important to consider that even seemingly good response to kindergarten Tier 1 instruction is not an inoculation and that additional tiers of intervention in first grade may be needed to sustain good response. It is important to consider how steep childrens' growth needed to be to end at grade level, which indicates how hard they (and presumably their teachers) worked to get there. This finding was replicated across three measures on several different reading outcomes and concerned us, so we closely examined the correlates of growth. We collected a fairly thorough array of information about our students' cognitive, linguistic, and behavioral characteristics, and about their prior school and home literacy experiences.

In our sample of students, growth was associated with initial characteristics that are more typically associated with poor response; namely less maternal education, fewer home literacy experiences, less preschool, weaker verbal intelligence and vocabulary, weaker phonological awareness and memory, weaker print knowledge, weaker social skills and academic competence, and relative more problem behaviors. A likely explanation is that students that entered kindergarten with weaker readiness skills for reading or with less home literacy experiences may have grown faster in kindergarten than their more advantaged peers because there was more "room for growth". As evidenced in our first research questions, all of our students were exposed to relatively effective Tier 1 instruction in kindergarten, and the instruction was adequate for the majority of students to respond to instruction.

So an important implication is that if we consider kindergarten growth as good response, or consider that only students who are dual-discrepant (slow and end low) are at-risk and in need of intervention, we would miss the "false negatives," students whose end of year performance suggests they would not need additional assistance, but yet who perform poorly in first grade. Unfortunately, the students' relatively strong growth trajectories in kindergarten did not hold in first grade. In fact, students who grew the fastest in kindergarten, had weaker than expected fluency growth and comprehension outcomes in first grade. Students who entered kindergarten having experienced a home literacy environment (e.g., read to at an later age, read to less frequently) grew more rapidly in kindergarten, they were less prepared to continue growing at a steady pace and achieve higher in first grade.

Our findings do replicate several studies that have demonstrated initial child characteristic variables predict later reading achievement for students (Al Otaiba & Fuchs, 2002; Nelson et al., 2003). What differs, however, is that in the present study, the characteristics – namely

LNF, phonological awareness, language and vocabulary were examined as correlates of growth. Whereas some students, who started kindergarten with relatively stronger skills demonstrated slow and steady growth towards an outcome, others who began with weaker skills had to show much faster growth to reach the same outcome. This finding reminded us of the adage, “slow and steady wins the race,” when the finish line is at the end of first grade and represents reading fluently and reading with grade level comprehension.

Challenges and Implications for Future Research

As with any educational research conducted in schools, we faced several challenges, which limit interpretation of our findings, but also inform future research projects. Chief among our limitations is that our research design was correlational; thus we can not offer causal conclusions about whether the strength of Tier 1 was responsible for response rates. We have begun a two-year large scale randomized control trial to investigate whether individualizing kindergarten Tier 1 leads to more stable reading trajectories, especially for the most vulnerable students. In addition, we have consent to follow this present sample to determine whether first grade response rates will, in turn, predict future reading trajectories and outcomes on the high stakes state-wide reading comprehension test. Another important limitation is that we only observed kindergarten instruction and that we have no direct evidence about the nature or variability of instruction in first grade; a stronger design would incorporate ongoing observation.

Furthermore, our schools were relatively high performing, teachers provided explicit and systematic instruction guided by an evidence-based core reading curriculum, and, at the time, all schools had reading coaches; some also had Reading First funding and supports. Additional research examining the efficacy of Tier 1 and kindergarten-first grade responsiveness is warranted across different core reading programs, different levels of classroom reading instructional effectiveness, and of course, different student populations (Fuchs & Deshler, 2007). For example, replication with populations that include more English Language Learners is needed.

Implications for Practice

Our results raise concerns about using kindergarten growth alone to accurately evaluate who needs additional intervention in kindergarten or in first grade, at least in schools similar to those we studied. Clearly in schools serving children from diverse backgrounds, it could appear that good instruction leveled the playing field; but this was, apparently, illusory. Longer-term evaluations of growth are likely needed, without which eligibility for intervention could vary as a function of school. Furthermore, children who end kindergarten on grade level, but who had a long way to grow should be closely monitored in first grade, or until their growth trajectory is stabilized.

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Table 1

Descriptive Statistics of Measures

		Fall		*Fall to Winter Gain*		*Winter*		*Winter to Spring Gain*		*Spring*		**Fall to Spring Gain**	
	N	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***
KG Child Characteristic Measures													
Brief Intelligence Assessment[WJ]*	203	89.08	13.55										
Verbal Comprehension[WJ]*	203	91.84	17.92										
Concept Formation[WJ]*	202	95.59	16.19										
Visual Matching[WJ]*	163	89.72	11.39										
Nonword Repetition[C]*	203	8.93	4.27										
Phonological Awareness[T]*	203	20.41	4.93										
Definitional Vocabulary[T]*	203	53.95	9.79										
Print Knowledge[T]*	203	32.43	5.26										
Problem Behavior[SS]**	203	95.88	13.33										
Academic Competence[SS]**	203	95.96	12.04										
Social Skills[SS]**	203	105.38	15.70										
Initial Sound Fluency[D]***	194	14.03	9.55			25.35	13.24						
Phoneme Segmenting Fluency[D]***	143					33.75	20.87			42.62	17.41		
Nonsense Word Fluency[D]***	143					27.42	18.37			43.22	23.71		
KG Growth & Outcome Measures													
Letter-Word[WJ]*													
W score	203	379.30	25.09	13.50	11.67	392.80	23.32	10.53	10.64	403.33	25.95	24.03	14.29
Standard Score	107.84	13.04			110.15	12.45			110.65	13.45			
Letter Naming Fluency[D]***	194	26.45	16.08	15.82	13.19	42.39	16.65	9.23	10.19	50.70	17.90	26.54	13.84
Picture Vocabulary[WJ]*													
W score	203	471.56	9.54	2.68	9.42	474.25	11.92	1.13	8.59	475.38	9.29	3.82	6.89
Standard Score	100.29	9.32			101.95	11.74			101.50	9.13			
KG SE-SAT ****													

		Fall		*Fall to Winter Gain*		*Winter*		*Winter to Spring Gain*		*Spring*		Fall to Spring Gain	
	N	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***
Standard Score	201									457.06	47.57		
National Percentile Ranking										60.81	27.35		
G1 Growth & Outcome Measures													
Oral Reading Fluency[D]***	179	31.72	26.61			42.11	30.38			61.09	32.40		
G1 SAT-10 ****													
Standard Score	203									569.74	59.40		
National Percentile Ranking										63.23	29.23		

Note. KG = Kindergarten; G1 = First Grade; WJ = Woodcock Johnson; D = Dynamic Indicators of Basic Early Literacy Skills (DIBELS); C = Comprehensive Test of Phonological Processing; T = Test of Preschool early Literacy; SS = Social Skills Rating System;

* Individually administered by project staff.

** Survey completed by classroom teacher;

*** Individually administered by district personnel.

**** Group administered by school personel.

Table 2

Correlations between Predictors and Outcomes Included in HLM Analyses

		1	2	3	4	5	6	7	8	9	10
1	KG SE-SAT Standard Score	-	.33**	.78**	.67**	.21**	.83**	0.06	.45**	−0.08	.42**
2	ORF G1 Growth (words per wave) [D]		-	.69**	.55**	0.01	.22**	0.12	.24**	−0.07	0.12
3	G1 Predicted End of Year ORF Status[D]			-	.74**	.25**	.75**	0.08	.43**	−0.07	.34**
4	G1 SAT-10 Standard Score				-	0.1	.69**	0.1	.41**	−0.05	.45**
5	KG Letter-Word Growth (W scores per month) [WJ]					-	.46**	0.02	0.09	−0.05	−0.07
6	KG Predicted End of Year Letter-Word Status[WJ]						-	0.06	.50**	−0.08	.36**
7	KG LNF Growth (LNs per month) [D]							-	.79**	0.02	0.09
8	KG Predicted End of Year LNF Status[D]								-	−0.06	.26**
9	KG Vocabulary Growth (W scores per month) [WJ]									-	.44**
10	KG Predicted End of Year Vocabulary Status[WJ]										-
	Mean	457.06	7.59	77.8	569.74	4.82	409.1	5.6	60.89	0.76	476.4
	Standard Deviation	47.57	4.01	40.3	59.4	2.86	26.78	4.36	24.78	1.39	10.16

Note. Predicted status and estimated growth based on the OLS regression intercepts and slopes.

KG = Kindergarten; ORF = DIBELS Oral Reading Fluency; G1 = First Grade; LNF = Letter Naming Fluency; WJ = Woodcock Johnson; D = Dynamic Indicators of Basic Early Literacy Skills (DIBELS);

All p-values are based on 2-tail tests.

** = Correlation is significant at the .01 level;

* = Correlation is significant at the .05 level

Table 3

Results of Fixed Effects from HLM Analyses

		Letter-Word				Letter-Naming Fluency				Picture-Vocabulary			
Outcome	**Effect**	**Coefficient**	***SE***	***t*(6)**	***p***	**Coefficient**	***SE***	***t*(6)**	***p***	**Coefficient**	***SE***	***t*(6)**	***p***
Kindergarten SE-SAT													
	Intercept, γ_{000}	455.97	1.89	241.83	<.001*	458.03	4.42	103.63	<.001*	456.86	2.89	157.89	<.001*
	Growth, γ_{100}	−4.23	0.89	−4.74	.002*	−9.19	1.24	−7.41	<.001*	−11.43	2.35	−4.87	.002*
	EOKG Status, γ_{200}	1.70	0.11	15.02	<.001*	2.23	0.23	9.62	<.001*	2.66	0.320	8.34	<.001*
First Grade Oral Reading Fluency Status													
	Intercept, γ_{000}	66.63	2.40	27.82	<.001*	7.39	0.41	17.84	<.001*	68.59	2.47	27.74	<.001*
	Growth, γ_{100}	−2.43	0.73	−3.32	.019*	−0.14	0.12	−1.19	.280	−8.14	2.11	−3.85	.011*
	EOKG Status, γ_{200}	1.30	0.10	13.62	<.001*	0.07	0.03	2.70	.036*	1.80	0.29	6.20	<.001*
First Grade Oral Reading Fluency Growth													
	Intercept, γ_{000}	7.48	0.35	21.40	<.001*	7.39	0.41	17.84	<.001*	7.54	0.30	24.93	<.001*
	Growth, γ_{100}	−0.18	0.12	−1.45	.198	−0.14	0.12	−1.19	.280	−0.50	0.26	−1.94	.100
	EOKG Status, γ_{200}	0.05	0.02	3.02	.025*	0.07	0.03	2.70	.036*	0.09	0.04	2.41	.052
First Grade SAT-10													
	Intercept, γ_{000}	571.74	5.70	100.40	<.001*	574.20	8.13	70.60	<.001*	572.72	5.00	114.63	<.001*
	Growth, γ_{100}	−4.79	1.15	−4.16	.007*	−8.49	1.29	−6.57	<.001*	−12.03	4.40	−2.73	.034*
	EOKG Status, γ_{200}	1.75	0.13	13.00	<.001*	2.32	0.25	9.39	<.001*	3.29	0.55	5.95	<.001*

Note. EOKG = End of Kindergarten

* = p-values declared significant at the .05 level after Benjamini-Hochberg Correction applied

Table 4

Partial Correlations between Kindergarten Growth and Child Characteristics

	Letter-Word Reading Estimated Growth		Picture Vocabulary Estimated Growth		Letter-Naming Fluency Estimated Growth	
	r_{ab}	$r_{ab.c}$	r_{ab}	$r_{ab.c}$	r_{ab}	$r_{ab.c}$
Parent education, home literacy, and amount of preschool						
Parental education	−0.03	−.18*	−0.13	−.16*	0.08	−0.11
Age first read to	−0.02	0.08	0.03	.17*	0.07	0.07
Daily time spent reading	0.05	−0.02	.177*	.21**	−0.06	−.17*
Years of preschool	−0.14	−.26**	−0.09	−.22**	−0.11	−.3**
Child Characteristics						
Brief Intelligence Assessment[WJ]	−0.02	−0.11	−0.05	−.3**	0.07	−.21**
Verbal Comprehension[WJ]	0.07	−0.09	−0.06	−.44**	−0.06	−.25**
Concept Formation[WJ]	−0.02	−0.10	−0.01	−.26**	0.02	−0.11
Visual Matching[WJ]	0.07	−0.05	−0.06	−0.07	−0.06	−0.14
Nonword Repitition[C]	0.06	−0.13	−0.10	−.25**	−0.03	−0.15
Problem Behavior[SS]	−0.11	0.03	.149*	.15*	−0.11	0.01
Academic Competence[SS]	0.04	−.33**	−0.09	−0.15	−0.02	−.59**
Social Skills[SS]	0.04	−0.07	−.147*	−0.12	0.10	−.16*
Definitional Vocabulary[T]	0.03	−0.12	−0.04	−.28**	0.12	−0.11
Print Knowledge[T]	−0.03	−.30**	−.213**	−0.13	0.09	−.39**
Phonological Awareness[T]	0.02	−.23**	−0.11	−.27**	0.04	−.3**
Initial Sound Fluency[D]	0.03	−.26**	−0.07	−0.19*	0.01	−.41**

Note. r_{ab} = Standard Pearson's Correlations; $r_{ab.c}$ = Pearson's correlations when controlling for end of kindergarten outcomes. KG = Kindergarten; G1 = First Grade; WJ = Woodcock Johnson; C = Comprehensive Test of Phonological Processing; SS = Social Skills Rating Scale; T = Test of Preschool Early Literacy; D = Dynamic Indicators of Basic Early Literacy Skills (DIBELS);

* = p-value <.05;

** = p-value < .01;