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Early Reading in Bilingual Kindergartners: Can Educational Television Help?

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This study examines individual growth rates in phonological awareness and letter-word identification skills over an academic year for 150 Latino English-language learners. In October, February, and June of their kindergarten year, participants completed standardized measures of phonological awareness skills. Before the second and third assessments, one third of the children watched *Arthur* three times a week during school hours, and another third viewed *Between the Lions.* The last third did not view either show during school hours. Individual growth modeling analysis show that children who viewed *Between the Lions* had steeper growth trajectories than those who viewed *Arthur* for several of the phonological awareness measures. The findings suggest viewing *Between the Lions* is beneficial to children's early literacy skills.

Phonological awareness (i.e., an awareness of speech sounds) and letter recognition have been identified as being two of the best predictors of subsequent reading achievement for English-speaking monolingual children (Adams, 1990; Juel, 1991; Scarborough, 1989; Stanovich, Cunningham, & Cramer, 1984; Storch & Whitehurst, 2002; Whitehurst & Lonigan, 1998). For most English-speaking children, phonological awareness gradually develops over the preschool years (Chaney, 1992), and performance on kindergarten phonological awareness is a significant predictor of subsequent decoding abilities not just in the early grades but also throughout the school years (MacDonald & Cornwall, 1995; Perfetti, Beck, Bell, & Hughes, 1987; Shankweiler, Crain, Katz, & Fowler, 1995). In addition, decoding abilities are further linked to reading comprehension (Juel, 1991; Wagner, Torgesen, & Rashotte, 1994).

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Hence, phonological awareness and letter naming have been subject to the impact of interventions in the preschool period. Research has shown that programs designed to train phonological awareness and early reading skills in young children have been successful (e.g., Ehri, Nunes, Stahl, & Willows, 2001) and are strongly recommended, particularly during the early childhood years (Torgesen, Wagner, & Rashotte, 1994). For example, children who are taught to segment spoken words into phonemes do better in learning to read and to spell than children not taught (Cunningham, 1990). Effects have been shown to persist even after instruction ended.

Moreover, past research has shown educational television programs, in particular *Between the Lions* (Stoia, 2002), to be an effective intervention for phonological awareness and letter identification development (Linebarger, 2000; Prince, Grace, Linebarger, Atkinson, & Huffman, 2002).[1] Linebarger (2000) investigated the effects of viewing *Between the Lions* on 164 kindergarten and first-grade children, the majority of which were monolingual English speakers. After watching 17 episodes, kindergarten viewers had significantly higher mean scores as well as greater rates of growth on phonological awareness and letter-sound correspondence tasks when compared to classmates who had not viewed *Between the Lions*. The kindergartners who had viewed *Between the Lions* also had significantly higher mean scores for letter identification at the end of the viewing phase when compared to their nonviewing classmates. Fewer effects were seen for first graders. These results suggest the value of *Between the Lions* for children during the kindergarten years.

In another study, Prince et al. (2002) examined literacy effects for *Between the Lions* viewing with nearly 1,000 children in three age groups (preschool, kindergarten, and first grade) in the Choctaw and Indianola communities, where the rates of childhood poverty are high. The children in these areas are considered to be at high risk for reading failure when they begin school. The effects they found were not as strong as those seen in the Linebarger (2000) study. As the children from the Choctaw and Indianola communities started with very low initial scores, the authors suggested that the children may not have had enough prior literacy knowledge to benefit optimally from the program.

Many English language learner (ELL) children are at added risk for poor English-language development (Snow, Burns, & Griffin, 1998). Given this gap in English-language skills between native and nonnative speakers of English, finding ways of maximizing children's experiences with phonological awareness is important. Thus, this study tests whether *Between the Lions* can be successful in accom-

[1]Educational television refers to shows that have a core educational or informational purpose. In 1990, the Federal Communications Commission passed the Children's Television Act, which required commercial broadcasters to air programming that has a core educational and informational purpose targeted to children under age 16 (Hill-Scott, 2001). Such programs must be regularly scheduled, weekly broadcasts of at least 30 min aired between 7:00 a.m. and 10:00 p.m.

plishing this with ELLs. In addition, to assess the effects of *Between the Lions* accurately, another program that provides equivalent exposure to English, *Arthur* (Valette, Taylor, & Taylor, 2002) was chosen as a control. Both *Between the Lions* and *Arthur* are 30-min educational programs broadcast on PBS stations across the country and targeted to preschool and kindergarten audiences.

Although the two shows are similar in their intended audiences and their relation to books, key differences exist in their educational philosophies. *Between the Lions* is a skills-oriented program that is designed to foster the literacy skills of its viewers and puts emphasis on text structure, individual words, and other print features. Phonological awareness and reading fluency are heavily emphasized. Each *Between the Lions* episode follows a whole–part–whole framework, adopted as the approach to literacy instruction. The story line of each *Between the Lions* episode begins with a read-aloud experience as the "whole," during which portions of the text are displayed on the screen and words are highlighted as they are read (Rath, 2000). Then the "parts" are emphasized to point the viewers' attention to such topics as phonological awareness, letter-sound correspondence, word meanings, punctuations, and other conventions of written English (Rath, 2000). At the end, the "whole" text is revisited, and the "parts" are reviewed (Rath, 2000).

On the other hand, the *Arthur* television episodes do not highlight literacy skills such as phonological awareness and letter-sound correspondence. Instead, they are based on storybooks, and children are exposed to various stories with moral points of interest to children. Each episode presents two stories, each with a plot, conflict, and resolution. Each story is about growing up. The characters in *Arthur* learn to make thoughtful decisions and resolve problems in each episode. Arthur and his friends face similar problems to the ones the viewers may face at home and at school.

The focus and educational philosophies of the two shows are clearly different. Thus, by contrasting groups of children who watch *Between the Lions* with children who watch *Arthur* and children who do not view either show, we can examine whether any literacy growth rate is related to the actual content of *Between the Lions* or whether it is simply connected to television watching. In particular, the shows were used to address the following questions:

1. What are the patterns of growth in phonological awareness and letter-word identification skills of early bilingual students during kindergarten?
2. What is the impact of viewing *Arthur* and *Between the Lions* on the early reading skills of kindergarten children?
3. Are other factors, such as vocabulary knowledge, home environment, and gender, related to differences in their early reading skills?

This study employs individual growth modeling techniques (IGM; Singer & Willett, 2003; Willett 1994) to analyze the children's early reading development.

As IGM makes use of repeated waves of data and conceptualizes change as a continuous process of development (Willett, 1994), it yields a more accurate picture of change over time than traditional techniques, such as ordinary regression methods.

METHOD

Participants

One hundred fifty children (70 girls, 80 boys) attending 10 public schools in a large urban district located on the East Coast participated in the study. The average ages of these children in October was 5.7 years. The average age for boys was 5.7 years, and the average for girls was 5.6 years.

Spanish–English bilingual kindergarten classrooms were selected from these schools. In all classrooms, instruction occurred in both English and Spanish. All children were from primarily Spanish-speaking homes and lived in neighborhoods that are heavily populated by Spanish-speaking people. District demographics and school data indicate that 80% or more of the participating students qualified for free lunch. Teachers were informed that the study was investigating language growth but were not aware of the specific goal of the study.

To gain background information about the students, a parental questionnaire in both English and Spanish was sent home (see summary, Table 1). The number of older siblings of the target child ranged from zero to 5, with the average child having 1.2 older siblings. Years living in the United States ranged from 3 months to 7 years, with the average being 4.8 years. The majority of those whose parents responded had been born in the United States; only 26% had been born outside of the United States. Although variation in the number of children's books in the home was large (from zero to 300 books, $SD = 33$ books), parents responded that on average 23 books were in the home, including both English and Spanish books. Concerning prekindergarten experiences, 75 of 150 parents responded that their children had gone to either prekindergarten or a Head Start program. One third (46 of 150 parents) said they took their children to libraries on a frequent basis. In terms of home viewing, 61.3% of the children viewed *Arthur* at home, and 28% watched *Between the Lions* at home.

Information about the mothers was also collected. Educational levels of the mothers ranged from no education to professional degrees; the average parental educational level was some secondary education. The top 10% of all parents had received some higher education, whereas the bottom 10% had not completed primary education. The remaining 80% fell somewhere in between, with the majority completing primary education.

The English vocabulary levels of the target children were measured with the Peabody Picture Vocabulary Test (Dunn & Dunn, 1997) in October before the in-

TABLE 1
Background Information and Vocabulary Scores for All Children and for Children by Viewing Group and Gender

	Total			*Arthur*		*Between the Lions*		*No Viewing*		*Boys*		*Girls*	
Variable	*M (SD)*	*n*	*Range*	*M (SD)*	*n*	*M (SD)*	*n*	*M (SD)*	*n*	*M (SD)*	*n*	*M (SD)*	*n*
Parental education[a]	3.75 (1.64)	124	0-8	3.76 (1.76)	45	3.63 (1.63)	48	3.94 (1.50)	31	3.61 (1.71)	66	3.91 (1.56)	58
No. of older siblings	1.20 (1.12)	122	0-5	1.09 (1.27)	44	1.23 (1.06)	48	1.33 (.99)	30	1.22 (1.08)	65	1.19 (1.17)	57
Years lived in USA	4.79 (1.89)	130	.3-7	4.87 (1.85)	48	4.90 (1.78)	51	4.50 (2.14)	31	4.93 (1.80)	70	4.93 (1.80)	60
No. of Spanish books at home	14.30 (26.55)	122	0-250	7.39 (6.79)	46	17.51 (37.77)	45	19.90 (23.67)	31	11.05 (12.72)	65	11.05 (12.72)	57
No. of English books at home	9.12 (10.64)	123	0-55	5.60 (5.44)	47	12.57 (14.29)	45	9.45 (8.82)	31	8.47 (10.01)	66	8.47 (10.01)	57
No. of total books at home	23.48 (33.39)	123	0-300	13.11 (9.55)	47	30.02 (47.70)	45	29.35 (27.54)	31	19.65 (20.06)	66	19.65 (20.06)	57
Receptive vocabulary score													
Initial English vocabulary	40.04 (20.23)	142	0-91	40.94 (20.47)	49	38.73 (20.76)	51	40.60 (19.69)	42	42.80 (18.49)	74	37.04 (21.71)	68
Initial Spanish vocabulary	32.17 (13.35)	149	2-69	32.65 (12.49)	51	31.51 (14.06)	57	32.49 (13.66)	41	31.15 (13.29)	79	33.31 (13.42)	70
	No. of Yes	*n*		*No. of Yes*	*n*	*No. of Yes*	*n*	*No. of Yes*	*n*	*No. of Yes*	*n*	*No. of Yes*	*n*
Preschool experience (yes/no)	75	118		26	44	30	45	19	29	36	61	39	57
Library experience (yes/no)	46	123		13	47	21	45	12	31	27	65	19	58
Arthur home viewing (yes/no)	92	150		35	51	34	57	23	42	46	80	46	70
Between the Lions home viewing (yes/no)	42	150		17	51	19	57	6	42	23	80	19	70

Note. $N = 150$. Background information was obtained from parental questionnaires, and vocabulary scores from the Peabody Picture Vocabulary Test–Third Edition and the Test de Vocabulario en Imágenes Peabody.

[a]Parental education was on a scale from 0 to 8.

tervention started. The results of the test indicated that, on average, these native-Spanish speakers scored at the level of a 3.2-year-old monolingual English child in October (Dunn & Dunn, 1997).

The Spanish vocabulary levels of the target children were also measured in October with the Test de Vocabulario en Imágenes Peabody (Dunn, Padilla, Lugo, & Dunn, 1986), the Spanish version of the Peabody Picture Vocabulary Test. The results of this test revealed that on average, these native Spanish-speaking children entering kindergarten achieved scores expected from 4.8- to 5.0-year-old Spanish monolinguals residing in Mexico, according to the age norms of the test (Dunn et al., 1986). As the average age of children in this study was 5.6 years old, these ELL children had vocabulary levels that were slightly lower than their monolingual Spanish counterparts (see Table 1 for a summary).

Raw scores are reported for both initial vocabulary levels in Spanish and English for later use in growth modeling analysis.

Design

On the basis of a stratified random sampling, half of the students in six classrooms (51 children) were assigned to watch *Arthur* during school hours, and the other half in the same six classrooms (57 children) were assigned to watch *Between the Lions* during school hours. In each classroom, the children were first grouped according to sex, and then they were rank ordered based on their October English Peabody Picture Vocabulary Test (Dunn & Dunn, 1997) vocabulary scores. They were then randomly assigned to the two viewing conditions, matching the children as closely as possible on their vocabulary scores, yielding viewing groups with very similar composition in gender and initial English vocabulary skills. As shown in Table 1, the mean English vocabulary in October was 40.94 (SD = 20.47) for the *Arthur* group and 38.73 (SD = 20.76) for the *Between the Lions* group. Receptive vocabulary scores were chosen as a basis for stratification, as children's understanding of the shows would be most influenced by their English vocabulary.

Both groups watched one 30-min episode three times a week in a classroom at school from October to the beginning of May, for a total of 54 episodes. Each viewing group consisted of 8 to 12 children. Either the classroom teacher or researcher remained in the room to make sure the children watched the shows quietly and attentively. A frequency of three episodes a week was chosen due to the importance of repetition of interventions (Galdwell, 2000), children's liking for repetition and familiar events (Galdwell, 2000), and the feasibility and practicality of children viewing educational television during school hours. Due to time constraints and the need to keep the intervention consistent among classrooms, teachers and researchers only showed the videos and did not do follow-up activities based on the episodes with the children.

Four classrooms (42 children) did not view any shows during school hours. Two of the four control group classrooms were selected because they were the remaining two bilingual classrooms in one of the schools in which we had a viewing group. The other two classrooms were chosen because these schools were located in similar neighborhoods as the viewing classrooms.

All kindergartners were assessed with the phonological awareness and letter-word identification tasks to be described in the following discussion at three time points throughout the school year: October (before the viewing groups watched any episodes in the classrooms), February (after the viewing groups had watched 27 episodes in the classrooms), and late May/early June (after the viewing groups had watched an additional 27 episodes in the classrooms).[2] Total testing time for each individual session was 30 to 45 min. The assessors at all time points were blind to the viewing conditions.

The three viewing groups did not differ on initial English receptive vocabulary scores, $F(2, 147) = .36$, $p = .6963$, yet interestingly, marginally significant differences existed between sexes, with boys outperforming girls, $F(1, 148) = 3.47$, $p = .0645$. No differences existed in initial Spanish receptive vocabulary scores as a function of viewing group, $F(2, 146) = .11$, $p = .8935$, or sex, $F(1, 147) = .97$, $p = .3254$.

Measures

To measure phonological awareness, children were assessed on the Elision, Blending Words, and Sound Matching subtests of the Comprehensive Test of Phonological Processing (Wagner, Torgesen, & Rashotte, 1999) in English.

The Elision subtest measures whether a child can repeat a word, then say what is left of the word after removing designated sounds (Wagner et al., 1999). This subtest is made up of 20 items. For the first 2 words, the child must drop parts of compound words. For the remaining 18 words, the child must remove specific phonemes from words.

The Blending Words subtest measures the child's ability to combine phonemes to form words (Wagner et al., 1999). This subtest is made up of 20 items, increasing in the level of difficulty. The child listens to a series of audiocassette-recorded phonemes and then is instructed to put them together to form a word.

The Sound Matching subtest uses a multiple-choice procedure to measure whether a child can match initial and final sounds of words (Wagner et al., 1999). This subtest is made up of 20 items, with the first 10 matching initial sounds and the last 10 matching final sounds. A picture book is used to help the child remember the possible responses to each item. The assessor says a word and then says

[2]Children were tested on a variety of literacy measures, but only phonological awareness and letter-word identification tasks are discussed here.

three other words while pointing to the pictures. The child must then say which of the three words starts with or ends with the first word.

To measure letter-word identification skills, children were tested on the Letter-Word Identification subtest in the Woodcock Language Proficiency Battery–Revised (Woodcock, 1991), which is a standardized test that taps children's ability to read words. The first five items measure symbolic learning, the ability to match a rebus with an actual picture of the word. The next nine items require the child to read letters, uppercase or lowercase. The remaining items measure the child's identification skills with printed words, starting with high-frequency single-syllable words and moving on to more difficult and less frequently used, multisyllabic words.

Statistical Analysis

First, a descriptive analysis was conducted on the phonological awareness subtests and the Letter-Word Identification subtest for all children. Correlation analyses were also conducted to investigate the relationships among the variables. Then, to examine the difference in the level and rate of change among individuals, a series of individual growth models using the PROC MIXED procedure available in the SAS statistical package were fitted to the data (Littell, Milliken, Stroup, & Wolfinger, 1996; Singer, 1998).

RESULTS

Descriptive Data

Figures 1 through 3 show the means for all phonological awareness variables for all children. All measures show increases in scores during the kindergarten year. For the Elision task, when compared to the norming sample reported in the Comprehensive Test of Phonological Processing Test manual (Wagner et al., 1999), these bilingual children on average started off slightly behind their monolingual peers in October (M = .72, SD = 1.68) yet by June scored about the same as age-equivalent monolingual English-speaking children (M = 4.23, SD = 3.43). For the Blending subtest, the bilingual children in this sample started off slightly below age equivalence in October (M = 1.37, SD = 2.05). However, by June, they scored better than their age-equivalent monolingual English speaking peers (M = 6.11, SD = 3.70). For the Sound Matching subtest, the children started off slightly below age equivalence (M = 3.04, SD = 3.12) yet by June scored about the same as their age-equivalent monolingual counterparts (M = 8.27, SD = 5.30).

Figure 4 shows the means for the letter-word identification task for all children. The children on average scored at the level of a 4.6-year-old monolingual English child in October (M = 369.66, SD = 19.47), yet by June they were scoring only

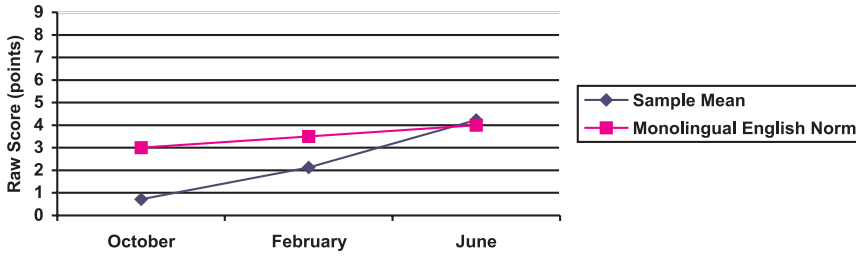

FIGURE 1 Means for the Elision subtest at all three time points (n = 150).

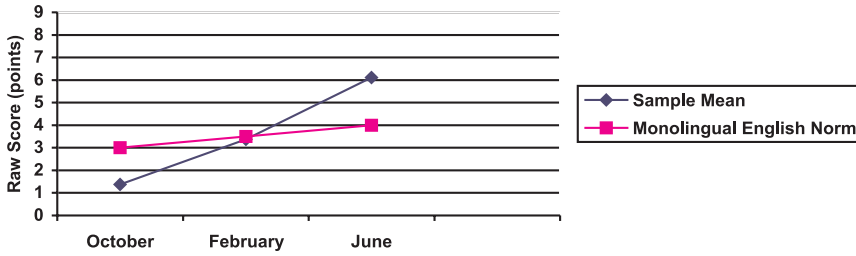

FIGURE 2 Means for the Blending subtest at all three time points (n = 150).

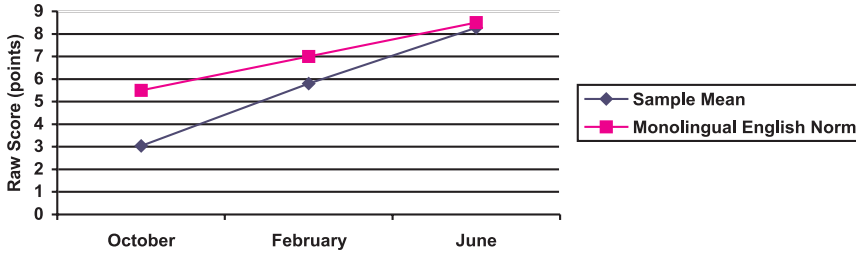

FIGURE 3 Means for the Sound Matching subtest at all three time points (n = 150).

slightly below age equivalent (M = 401.91, SD = 23.76; Woodcock, 1991). For all tests, standard deviations were high, indicating large variation among the children.

As shown in Table 2, the three phonological awareness and letter measures were moderately correlated with each other, r = .30 ~ .67, p < .001. Initial English vocabulary scores tended to be moderately correlated with phonological awareness measures at all three time points (median r = .5). Conversely, initial Spanish vocabulary scores were not correlated with most phonological scores. Only Elision and Sound Matching were weakly correlated with initial Spanish scores in

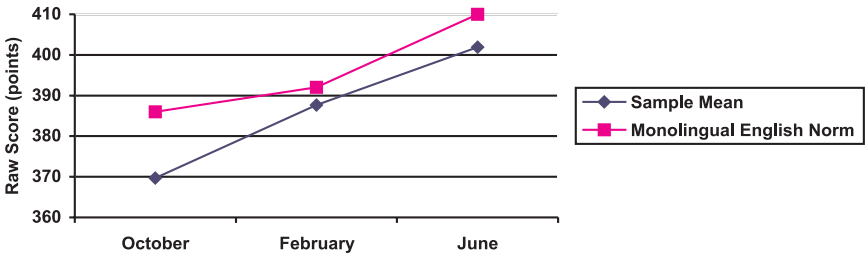

FIGURE 4 Means for Letter-Word Identification task by viewing groups (n = 150).

October and February (median r = .2). Letter-Word Identification was strongly correlated with the phonological awareness measures (r = .34–.63, p < .001) as well as with initial English vocabulary (median r = .3).

Figures 5 through 8 show the means for phonological awareness and letter-word identification variables for each viewing group at each time point. Each group shows growth in all four skills. Some group differences are noted, which are analyzed further with individual growth modeling.

Individual Growth Modeling: Effect of *Arthur* or *Between the Lions*?

To examine differences in the level and rate of change among individuals, IGM was used. IGM was the appropriate analysis tool for this dataset for several reasons. First, IGM is designed for exploring longitudinal data on individuals over time (Littell et al., 1996; Singer, 1998; Singer & Willett, 2003). Second, IGM allows for the spacing of waves of data to vary across individuals (Littell et al., 1996; Singer & Willett, 2003). In this dataset, measurements were taken at slightly different times. For some children, the times between assessments were 3 months, whereas for others it was closer to 4 months. Third, IGM can analyze datasets with varying number of waves of data (Littell et al., 1996; Singer & Willett, 2003). That is, unlike other approaches, IGM includes all participants in the estimation, regardless of missing data. The majority of children in this study had an assessment score at all three time points, yet some had only two time points. The total number of participating children in October was 143; by February, some new students increased the number to 150. However, by May/June, attrition decreased the total number to 142.

To arrive at a final model that best predicted English phonological development, a taxonomy of theoretically motivated individual growth models was built. Time was denoted in number of months rather than assessment occasions, because assessments were carried out with some variation among individuals in exact timing. As most participants had three data points each, a linear model was used (Singer & Willett, 2003; Willett, Singer, & Martin, 1998).

TABLE 2
Correlation Matrix for Vocabulary, Phonological Awareness, and Letter-Word Identification (ID) Measures

Variables	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*
1. Spanish initial vocabulary	—	.09	.18*	.17*	.10	.06	.05	–.02	.25**	.19*	.14	.09	.09	.05
2. English initial vocabulary		—	.45***	.48***	.48***	.43***	.52***	.47***	.40***	.18**	.37***	.64***	.49***	.46***
3. Elision October			—	.51***	.42***	.51***	.40***	.38***	.30***	.26**	.41***	.34***	.28***	.32***
4. Elision February				—	.68***	.37***	.66***	.58***	.39***	.53***	.61***	.53***	.51***	.57***
5. Elision June					—	.28***	.60***	.67***	.34***	.45***	.61***	.51***	.52***	.58***
6. Blending October						—	.49***	.38***	.33***	.16~	.29***	.42***	.38***	.37***
7. Blending February							—	.71***	.43***	.54***	.59***	.53***	.58***	.59***
8. Blending June								—	.33***	.47***	.59***	.48***	.59***	.63***
9. Sound Matching October									—	.37***	.39***	.50***	.36***	.32***
10. Sound Matching February										—	.53***	.40***	.46***	.47***
11. Sound Matching June											—	.44***	.47***	.60***
12. Letter-Word ID October												—	.72***	.71***
13. Letter-Word ID February													—	.84***
14. Letter-Word ID June														—

Note. $N = 150$.
$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$. $^{\sim}p < .10$.

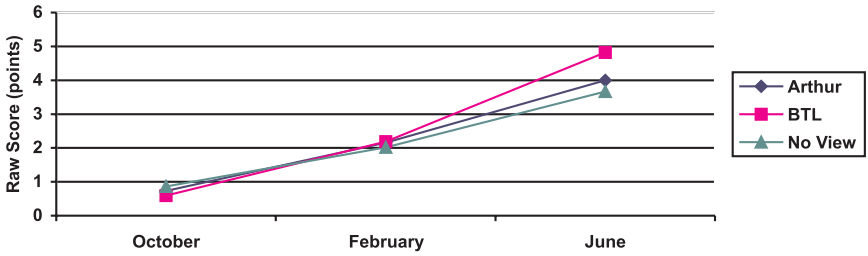

FIGURE 5 Means for Elision subtest by viewing groups (n = 150).

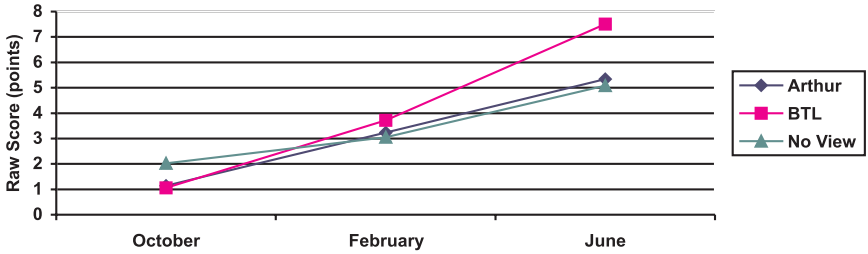

FIGURE 6 Means for Blending subtest by viewing groups (n = 150).

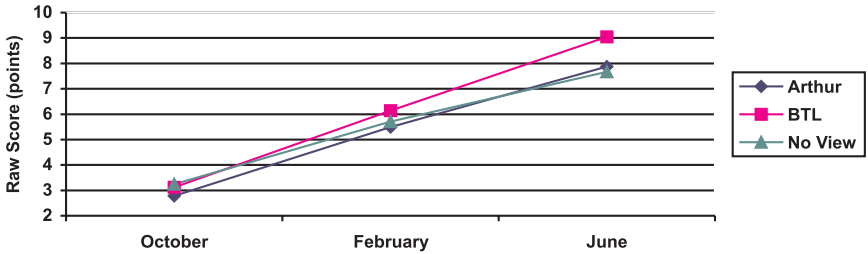

FIGURE 7 Means for Sound Matching subtest by viewing groups (n = 150).

In the first stage, an unconditional means model, which included no predictors, was fitted. This model describes variation in the outcomes (Singer & Willett, 2003). Then a growth model was fitted to examine within-person change by fitting growth trajectories for each child over time. The growth trajectories of each individual child varied. Some children showed steady growth, whereas others showed no growth. In light of the variation across children, it is important to understand the general patterns in ELL children's early reading skills. Hence, between-person variation was examined, and predictors were added to investigate whether they af-

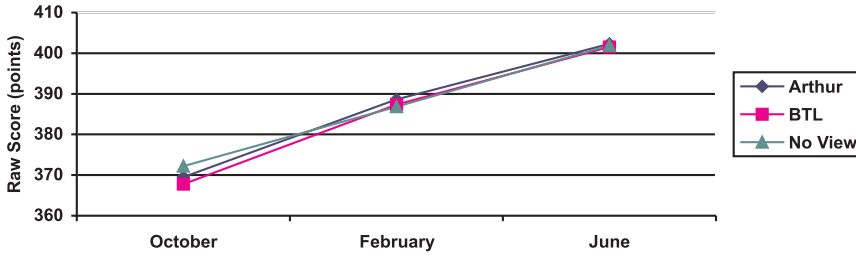

FIGURE 8 Means for Letter-Word Identification task by viewing groups (n = 150).

fected individual changes in each of the early reading measures. The predictor SHOW was first added to investigate whether individual changes in the measures were related to viewing of *Between the Lions*.

Combining the within-person and between-person models yields the following model:

$$\text{OUTCOME}_{ti} = [ß_{00} + ß_{01}\,\text{SHOW}_i + ß_{10}\,\text{TIME}_{ti} + ß_{11}\,\text{SHOW}_i\,\text{TIME}_{ti}\,] + [u_{0i} + u_{1i}\,\text{TIME}_{ti} + r_{ti}\,].$$

The parameters in this model represent the effect of SHOW on the initial level of OUTCOME ($ß_{01}$) and the effect of SHOW on the rate of change in OUTCOME ($ß_{11}$). As models that differ in their fixed effects but not their variance components were being compared, full maximum likelihood estimates were used (see Singer, 1998).

As a general modeling strategy, the full model equation was evaluated for significance. SHOW was kept in the model, even if it was not significant, as it was a key predictor. Indicators of home viewing (i.e., watching *Arthur* at home and watching *Between the Lions* at home) were also kept in the model to control for home viewing. Subsequent analyses investigated whether other variables such as sex, parents' educational history, prekindergarten experience, home educational television viewing, number of older siblings, number of years the child had resided in the United States, child's initial vocabulary level in Spanish and English, number of children's books in the home, and library exposure were significant predictors.

Classroom differences (CLASS) were also investigated. However, as all the children in the four nonviewing classrooms were also in the nonviewing group, CLASS and SHOW became confounding variables. In the viewing classrooms, students were randomly divided into the *Arthur* and *Between the Lions* groups, so within classroom differences existed, but the comparison group of nonviewing students came from different classrooms. As a result, both variables CLASS and SHOW could not be included together in the models. Models with SHOW and models with CLASS produced similar results. As the effect of SHOW is one of the main research questions, and as the results between the models with SHOW and

CLASS were very similar, only the results for the models with SHOW are presented in this study.

After fitting a baseline unconditional means model (Model 1) and baseline unconditional growth model (Model 2) for each phonological awareness and word-identification measure, a taxonomy of theoretically motivated individual growth models was built as shown in Tables 3 through 6. However, for only the Sound Matching subtest (Table 5), when an unconditional linear growth model that included both the fixed and random effects for both the intercept and the growth rate was fitted to the data, the fixed and random effects could not be estimated in the model because the error-covariance matrix was not positive definite, which may happen when a dataset is severely unbalanced or if many participants do not have enough waves of data (Caswell, 2002; Singer & Willet, 2003). To resolve the situation, the model was simplified by removing the random component of the growth rate in all further models for the Sound Matching subtest. This strategy assumes that all students have the same underlying value for the growth rate, rather than estimating the variance in growth rates across individuals. In this approach, the growth rate is regarded as fixed and average group differences can be tested for children with different characteristics.

For the Elision subtest (Table 3), the variance components in Model 1 (unconditional means model) indicate that the average child's English Elision measure varied over time and that the children differed from each other. Using the results of this model, the intraclass correlation coefficient was computed as .35. The intraclass correlation coefficient is the intercept divided by the sum of the intercept and the residual, and it "describes the proportion of the total outcome variation that lies *between* people" (Singer & Willett, 2003, p. 96). Thus, this correlation indicated that slightly over one third of the total variation in Elision was attributable to differences among children. The variance components in Model 1 for Blending (Table 4) and Sound Matching (Table 5) also indicated that the average child's English Blending and Sound Matching measures varied over time and that the children differed from each other. The intraclass correlation coefficient for Blending was .49 and for Sound Matching was .24. In addition, the variance components in Model 1 for Letter-Word Identification (Table 6) indicated that the average child's English Letter-Word Identification measures varied over time and that the children differed from each other. The intraclass correlation coefficient for Letter-Word Identification was .76.

We also see that nonzero variability exists in both true initial status and true rate of change in Model 2. This result was found for each of the outcomes (Tables 3–6), suggesting that adding more predictors into the model might explain heterogeneity in each parameter.

Because sex, preschool experience, number of older siblings, and mother's education were not significant when included as predictors, they were not included in subsequent models for any measures. Past research employs mother's education to

control for socioeconomic status. Yet in this study, most children were from low socioeconomic status homes, and the mother's education variable was not significant. Furthermore, as total number of children's books in the home appeared to measure home literacy values just as well as parental education and as total number of books was significant, total number of children's books in the home was included in the models and mother's education was removed.

For Elision (Table 3), Sound Matching (Table 5), and Letter-Word Identification (Table 6), library experience was also not significant and was thus deleted from the final models. For all phonological awareness variables (Tables 3–5), number of years in the United States was not significant and was removed from the final models. In addition, for Blending (Table 4) and Letter-Word Identification (Table 6), initial Spanish vocabulary was also not significant and was thus removed from subsequent models. After fitting further models, Model 9 was chosen as the final model for Elision (Table 3), Blending (Table 4), and Sound Matching (Table 5), and Model 8 was chosen for Letter-Word Identification (Table 6). These results are interpreted in the following sections.

Effect of show. For Elision (Table 3), the estimated coefficients for both *Arthur* and *Between the Lions* were not statistically significant, indicating that the three groups did not significantly differ from each other at the start of kindergarten after controlling for the other variables in the model. However, the estimated coefficient for the interaction between *Between the Lions* and time was positive and significant ($ß_{11} = .19, p = .0418$), after controlling for the other variables in the model. This result indicates that viewing *Between the Lions* during class hours increased scores on the Elision measure at a faster pace than viewing *Arthur* or no educational television, after controlling for initial show differences, home viewings, initial English vocabulary, initial Spanish vocabulary, and total number of children's books in the home as shown in Figure 9. The standard deviation on the Elision measure pooled across all occasions was 2.97 points. Thus, the coefficient .19 corresponds to an effect size of under one tenth of a standard deviation per month, or an effect of slightly over half of a standard deviation for the entire school year.

For Blending (Table 4), the estimated coefficient for *Between the Lions* was statistically significant ($ß_{01} = –1.01, p = .0097$), indicating that the *Between the Lions* group scored significantly lower than the other two groups at the start of kindergarten, after controlling for the other variables in the model. Moreover, the estimated coefficients for the interaction between *Arthur* and time ($ß_{11} = .23, p = .0167$) as well as between *Between the Lions* and time ($ß_{11} = .51, p < .0001$) were positive and significant, after controlling for the other variables in the model. This result indicates that both viewing *Arthur* and *Between the Lions* during class hours increased scores on the Blending measure at a faster pace than no educational television viewing, after controlling for initial show differences, home viewings, initial English vocabulary, total number of children's books in the home, and library ex-

TABLE 3
Estimates of Fixed and Random Effects from a Series of Fitted Individual Growth Models in Which Show, *Arthur* Home Viewing, *Between the Lions* Home Viewing, Initial English Vocabulary Scores, Initial Spanish Vocabulary Scores, and Total Number of Children's Books in the Home Predict the Average Elision Score at the Start of Kindergarten and Rate of Change in Elision During the Kindergarten Year for All Children

	Parameter Estimate (SE)								
	Model 1: Uncond. Means Model	*Model 2: Uncond. Growth Model*	*Model 3: Show*	*Model 4: Show × Time*	*Model 5: Home TV*	*Model 6: Initial Eng Vocab*	*Model 7: Initial Eng × Time*	*Model 8: Initial Span Vocab*	*Model 9: Total No. of Books*
Fixed effects									
Intercept, ß$_{00}$	.84***	.69***	.79**	.82**	.61*	–.78*	–.57	–1.12*	–1.05~
	(.14)	(.14)	(.26)	(.26)	(.29)	(.35)	(.35)	(.45)	(.56)
Time (months), ß$_{10}$		.50***	.50***	.40***	.40***	.40***	.14	.15	.13
		(.04)	(.04)	(.07)	(.07)	(.07)	(.10)	(.10)	(.10)
Show: *Arthur*, ß$_{01}$			–.05	–.08	–.30	–.22	–.22	–.22	–.28
			(.35)	(.35)	(.34)	(.32)	(.32)	(.31)	(.38)
Show: *BTL*, ß$_{01}$			–.21	–.27	–.47	–.29	–.30	–.28	–.36
			(.34)	(.34)	(.33)	(.31)	(.31)	(.31)	(.37)
Home TV: *Arthur*, ß$_{02}$					.11	–.14	–.14	–.16~	–.32
					(.28)	(.26)	(.26)	(.26)	(.31)
Home TV: *BTL*, ß$_{03}$					1.08***	.72*	.72*	.65*	.58~
					(.31)	(.29)	(.29)	(.29)	(.31)
Initial Eng Vocab, ß$_{04}$						.04***	.03***	.03***	.03***
						(.01)	(.01)	(.01)	(.007)
Initial Span Vocab, ß$_{05}$								.02*	.02~
								(.01)	(.01)
Total no. children's books, ß$_{06}$									.005
									(.004)

Arthur × Time, ß$_{11}$				.06	.07	.06	.06	.06	.11
				(.09)	(.09)	(.09)	(.09)	(.09)	(.09)
BTL × Time, ß$_{11}$				.21*	.21*	.21*	.22*	.22*	.19*
				(.09)	(.09)	(.09)	(.09)	(.09)	(.09)
Initial Eng Vocab × Time, ß$_{14}$							.01***	.01***	.004*
							(.002)	(.002)	(.002)
Total No. Books × Time, ß$_{16}$									.004**
									(.001)
Random effects (variance components)									
Intercept, estimate	1.14**	1.13**	1.12**	1.12**	.89**	.50~	.50~	.45~	.64*
	(2.01)	(.38)	(.38)	(.38)	(.35)	(.31)	(.31)	(.31)	(.37)
Slope, estimate	.35***	.10***	.10***	.09***	.09***	.09***	.07***	.07***	.06**
	(.05)	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)
Residual, estimate	2.11***	2.12***	2.12***	2.12***	2.12***	2.12***	2.11***	2.13***	2.18***
	(.25)	(.25)	(.25)	(.25)	(.25)	(.25)	(.24)	(.25)	(.28)
Proportional reduction in variance from Model 2									
Intercept (%)			.9	.9	21.2	55.8	55.8	60.2	43.4
Slope			NA	10	10	10	30	30	40
Akaike's information criterion	1,987.4	1,871.1	1,874.7	1,872.4	1,862.9	1,832.2	1,822.1	1,813.5	1,513.8

Note. Model 9 is the final chosen model. $N = 150$. Uncond. = unconditional; Eng = English; Span = Spanish; vocab = vocabulary; *BTL* = *Between the Lions*.
~$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

TABLE 4
Estimates of Fixed and Random Effects from a Series of Fitted Individual Growth Models in Which Show, *Arthur* Home Viewing, *Between the Lions* Home Viewing, Initial English Vocabulary Scores, Total Number of Children's Books in the Home, and Library Experience Predict the Average Blending Score at the Start of Kindergarten and Rate of Change in Blending During the Kindergarten Year for All Children

	Parameter Estimate (SE)								
	Model 1: Uncond. Means Model	*Model 2: Uncond. Growth Model*	*Model 3: Show*	*Model 4: Show × Time*	*Model 5: Home TV*	*Model 6: Initial Eng Vocab × Time*	*Model 7: Total No. of Books at Home*	*Model 8: Total No. of Books at Home × Time*	*Model 9: Library*
Fixed effects									
Intercept, $ß_{00}$	1.85***	1.32***	1.71***	1.89***	1.67***	.02	–.25	–.18	–.54
	(.16)	(.17)	(.31)	(.31)	(.35)	(.41)	(.51)	(.51)	(.45)
Time (months), $ß_{10}$		.69***	.69***	.45***	0.45***	.22*	.22*	.18~	.18~
		(.04)	(.04)	(.07)	(.07)	(.10)	(.11)	(.11)	(.11)
Show: *Arthur*, $ß_{01}$			–.54	–.66	–.85*	–.76*	–.62	–.72~	–.60
			(.41)	(.42)	(.42)	(.37)	(.43)	(.43)	(.39)
Show: *BTL*, $ß_{01}$			–.56	–.91*	–1.09**	–.86*	–.75~	–.74~	–1.01**
			(.40)	(.41)	(.41)	(.36)	(.43)	(.43)	(.39)
Home TV: *Arthur*, $ß_{02}$					.17	–.14	.06	.07	.14
					(.34)	(.30)	(.35)	(.35)	(.31)
Home TV: *BTL*, $ß_{03}$					.87*	.42	.27	.27	.26
					(.38)	(.33)	(.35)	(.35)	(.31)
Initial Eng vocab, $ß_{04}$						.05***	.04***	.05***	.05***
						(.01)	(.01)	(.01)	(.01)
Total no. of books, $ß_{05}$							.01**	.01	.005
							(.005)	(.01)	(.005)
Library experience, $ß_{06}$									.93**
									(.31)

Arthur × Time, ß$_{11}$				.15~	.15~	.15~	.17~	.23*	.23*
				(.09)	(.09)	(.09)	(.10)	(.10)	(.10)
BTL × Time, ß$_{11}$				.51***	.51***	.52***	.50***	.49***	.51***
				(.09)	(.09)	(.09)	(.01)	(.10)	(.10)
Eng Vocab × Time, ß$_{14}$						.01**	.005*	.003~	.003~
						(.002)	(.002)	(.002)	(.002)
Total No. Books × Time, ß$_{15}$								.003**	.003**
								(.001)	(.001)
Random effects (variance components)									
Intercept, estimate	2.39***	2.11***	2.01***	1.97***	1.84***	1.02**	1.08*	1.01*	.38
	(.61)	(.53)	(.52)	(.52)	(.51)	(.42)	(.50)	(.49)	(.43)
Slope, estimate	.59***	.12***	.12***	.06**	.06**	.06**	.05*	.04~	.04*
	(.08)	(.03)	(.03)	(.02)	(.02)	(.03)	(.03)	(.03)	(.03)
Residual, estimate	2.45***	2.49***	2.49***	2.53***	2.53***	2.51***	2.70***	2.73***	2.66***
	(.29)	(.29)	(.29)	(.30)	(.30)	(.30)	(.35)	(.36)	(.36)
Proportional reduction in variance from Model 2									
Intercept (%)			4.7	6.6	12.8	51.7	48.8	52.1	82
Slope (%)			NA	50	50	50	58.3	66.7	66.7
Akaike's information criterion	2,125.0	1,968.4	1,970.3	1,941.7	1,939.0	1,885.5	1,576.1	1,567.9	1,488.5

Note. Model 9 is the final chosen model. $N = 150$. Uncond. = unconditional; Eng = English; Span = Spanish; vocab = vocabulary; *BTL* = *Between the Lions*.
~$p < .10$. *$p < .05$ **$p < .01$. ***$p < .001$.

TABLE 5
Estimates of Fixed and Random Effects from a Series of Fitted Individual Growth Models in Which Show, *Arthur* Home Viewing, *Between the Lions* Home Viewing, Initial English Vocabulary Scores, Initial Spanish Vocabulary Scores, and Total Number of Children's Books at Home Predict the Average Sound Matching Score at the Start of Kindergarten and Rate of Change in Sound Matching During the Kindergarten Year for All Children

	Parameter Estimate (SE)								
	Model 1: Uncond. Means Model	*Model 2: Uncond. Growth Model*	*Model 3: Show*	*Model 4: Show × Time*	*Model 5: Home TV*	*Model 6: Initial Eng Vocab*	*Model 7: Initial Eng × Time*	*Model 8: Initial Span Vocab*	*Model 9: Total No. of Books*
Fixed effects									
Intercept, $ß_{00}$	5.66***	3.14***	2.98***	3.36***	2.98***	.85	1.58~	–.12	–.47
	(.28)	(.33)	(.55)	(.62)	(.69)	(.81)	(.89)	(1.06)	(1.23)
Time (months), $ß_{10}$		.78***	.78***	.66***	.65***	.65***	.41*	.41*	.36~
		(.06)	(.06)	(.11)	(.11)	(.11)	(.16)	(.16)	(.18)
Show: *Arthur*, $ß_{01}$			–.22	–.44	–.68	–.56	–.56	–.59	–.18
			(.70)	(.84)	(.84)	(.81)	(.80)	(.79)	(.88)
Show: *BTL*, $ß_{01}$			.62	–.17	–.36	–.07	–.11	–.10	–.23
			(.68)	(.82)	(.82)	(.79)	(.79)	(.78)	(.88)
Home TV: *Arthur*, $ß_{02}$					.47	.09	.10	.05	.16
					(.59)	(.56)	(.56)	(.54)	(.61)
Home TV: *BTL*, $ß_{03}$					.91	.34	.34	.13	–.02
					(.64)	(.61)	(.61)	(.60)	(.61)
Initial Eng vocab, $ß_{04}$						.06***	.04*	.04*	.02
						(.01)	(.02)	(.02)	(.02)
Initial Span vocab, $ß_{05}$								.06**	.07**
								(.02)	(.02)
Total no. of children's books, $ß_{06}$									.03***
									(.01)

Arthur × Time, ß$_{11}$				.07	.07	.07	.07	.08	.14
				(.15)	(.15)	(.15)	(.15)	(.15)	(.17)
BTL × Time, ß$_{11}$				.25~	.25~	.24~	.25~	.26~	.26
				(.14)	(.14)	(.14)	(.14)	(.14)	(.17)
Initial Eng Vocab × Time, ß$_{14}$							.01*	.01~	.01*
							(.003)	(.002)	(.003)
Random effects (variance components)									
Intercept, estimate	5.67***	7.42***	7.28***	7.29***	7.02***	5.60***	5.69***	5.12***	4.37***
	(1.47)	(1.34)	(1.32)	(1.32)	(1.29)	(1.14)	(1.14)	(1.08)	(1.11)
Residual, estimate	18.24***	11.22***	11.22***	11.11***	11.10***	11.12***	10.99***	11.03***	11.42***
	(1.53)	(.94)	(.94)	(.93)	(.93)	(.93)	(.92)	(.93)	(1.05)
Proportional reduction in variance from Model 1									
Intercept (%)		NA	NA	NA	NA	6.5	NA	9.7	22.9
Slope (%)		38.5	38.5	39.1	39.1	39.0	39.7	39.5	37.4
Akaike's information criterion	2,587.8	2,443.4	2,445.5	2,446.2	2,446.6	2,429.5	2,427.6	2,410.3	2,002.1

Note. Model 9 is the final chosen model. $N = 150$. Uncond. = unconditional; Eng = English; Span = Spanish; vocab = vocabulary; *BTL = Between the Lions*. ~$p < .10$ *$p < .05$. **$p < .01$. ***$p < .001$.

TABLE 6
Estimates of Fixed and Random Effects from a Series of Fitted Individual Growth Models in Which Show, *Arthur* Home Viewing, *Between the Lions* Home Viewing, Initial English Vocabulary Scores, Total Number of Children's Books in the Home, and the Number of Years in the USA Predict the Average Letter-Word Identification Score at the Start of Kindergarten and Rate of Change in Letter-Word Identification During the Kindergarten Year for All Children

	Parameter Estimate (SE)							
	Model 1: Uncond. Means Model	*Model 2: Uncond. Growth Model*	*Model 3: Show*	*Model 4: Show × Time*	*Model 5: Home TV*	*Model 6: Initial Eng Vocab*	*Model 7: Total No. of Books at Home*	*Model 8: Years in USA × Time*
Fixed effects								
Intercept, $ß_{00}$	376.62***	370.86***	371.84***	372.22***	368.91***	349.78***	347.88***	346.40***
	(1.47)	(1.51)	(2.79)	(2.85)	(3.24)	(3.43)	(4.02)	(4.52)
Time (months), $ß_{10}$		4.77***	4.77***	4.53***	4.53***	4.50***	4.34***	6.52***
		(.21)	(.21)	(.43)	(.43)	(.43)	(.53)	(.75)
Show: *Arthur*, $ß_{01}$			-.47	-.75	-2.16	-1.10	1.12	1.13
			(3.74)	(3.85)	(3.84)	(3.12)	(3.42)	(3.42)
Show: *BTL*, $ß_{01}$			-2.15	-2.87	-3.81	-1.29	1.70	1.65
			(3.65)	(3.75)	(3.74)	(3.05)	(3.38)	(3.38)
Home TV: *Arthur*, $ß_{02}$					5.11	1.57	1.77	1.75
					(3.13)	(2.59)	(2.93)	(2.96)
Home TV: *BTL*, $ß_{03}$					3.66	-1.46	-1.71	-1.84
					(3.43)	(2.86)	(2.94)	(2.95)
Initial Eng vocab, $ß_{04}$						.54***	.46***	.46***
						(.06)	(.07)	(.07)
Total no. of books, $ß_{05}$							.12**	.12**
							(.04)	(.04)
Years in USA, $ß_{06}$								.29
								(.71)

Arthur × Time, ß$_{11}$				.18	.17	.20	.33	.44
				(.56)	(.56)	(.56)	(.65)	(.62)
BTL × Time, ß$_{11}$				.45	.45	.44	.57	.71
				(.55)	(.55)	(.55)	(.66)	(.62)
Years in USA × Time, ß$_{16}$								-.48***
								(.12)
Random effects (variance components)								
Intercept, estimate	295.33***	267.46***	266.03***	266.28***	254.66***	142.14***	122.05***	120.63***
	(56.37)	(40.38)	(40.23)	(40.22)	(38.92)	(26.32)	(27.41)	(27.14)
Slope, estimate	25.89***	2.27***	2.27**	2.25**	2.23**	2.24**	2.46**	1.71*
	(3.85)	(.92)	(.92)	(.91)	(.91)	(.91)	(1.03)	(.93)
Residual, estimate	91.91***	91.86***	91.87***	91.75***	91.93***	91.85***	97.00***	96.71***
	(12.15)	(11.37)	(11.37)	(11.36)	(11.39)	(11.37)	(13.01)	(12.89)
Proportional reduction in variance from Model 2								
Intercept (%)			.5	.4	4.8	46.9	54.4	54.9
Slope (%)			NA	.9	1.8	1.3	NA	24.7
Akaike's information criterion	3,693.6	3,482.4	3,485.9	3,489.2	3,488.0	3,429.3	2,817.4	2,807.5

Note. Model 8 is the final chosen model. $N = 150$. Uncond. = unconditional; Eng = English; Span = Spanish; vocab = vocabulary; *BTL* = *Between the Lions*.
*$p < .05$. **$p < .01$. ***$p < .001$.

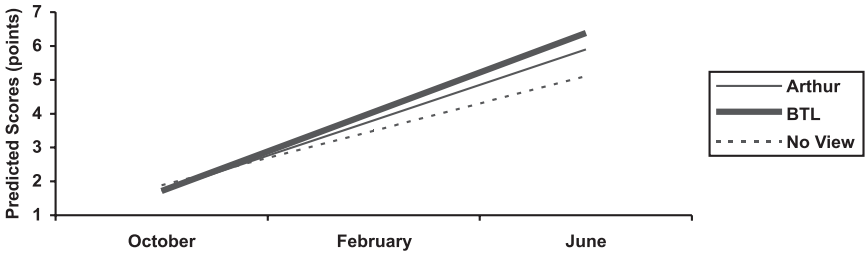

FIGURE 9 Fitting average growth trajectories describing the effect of *Between the Lions* on the change in Elision scores for ELL children who watched both *Arthur* and *Between the Lions* at home, who had an average initial English vocabulary score of 40.04 points, who had an average initial Spanish vocabulary of 32.17 points, and who had the average number of 23.48 children's books in the home (n = 150).

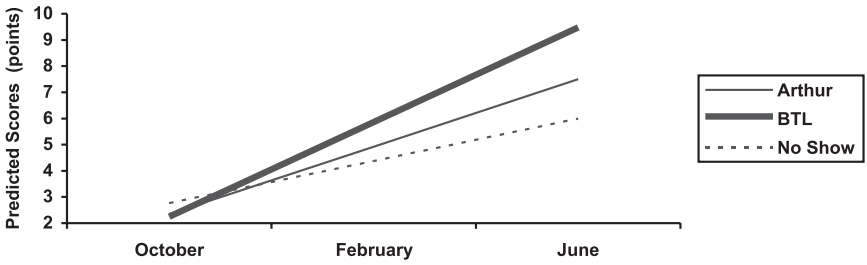

FIGURE 10 Fitting average growth trajectories describing the effect of *Between the Lions* on the change in Blending scores for ELL children who watched both *Arthur* and *Between the Lions* at home, who were taken to the library on a frequent basis, who had an average initial English vocabulary score of 40.04 points, and who had the average number of 23.48 children's books in the home (n = 150).

perience, as shown in Figure 10. The standard deviation on the Blending measure pooled across all occasions was 3.50 points. Thus, the coefficient .51 for *Between the Lions* and time corresponds to an effect size of between one tenth and two tenths of a standard deviation per month, or an effect of slightly over one standard deviation for the entire school year.

To confirm that differences were not caused simply by overall classroom differences among the viewing groups and nonviewing groups, individual growth modeling was conducted on the Blending measure with only the six classrooms (i.e., with the two viewing groups; n = 108). Results show that viewing *Between the Lions* during class hours increased scores on the Elision measure at a faster pace than viewing *Arthur* ($ß_{11}$ = .26, p = .0016) after controlling for initial show differ-

ences, classroom differences, home viewings, initial English vocabulary, total number of children's books in the home, and library experience.[3]

For Sound Matching (Table 5), the estimated coefficients were not statistically significant for either *Arthur* or *Between the Lions*, indicating that the three groups did not significantly differ from each other at the start of kindergarten, after controlling for the other variables in the model. In addition, the estimated coefficients for the interaction between *Arthur* and time, as well as between *Between the Lions* and time, were not significant, after controlling for the other variables in the model. This result indicates that all groups increased on the Sound Matching measures at about the same pace, after controlling for initial show differences, home viewings, initial English vocabulary, initial Spanish vocabulary, and total number of children's books in the home.

For Letter-Word Identification (Table 6), the results were similar: The estimated coefficients for both *Arthur* and *Between the Lions* were also not statistically significant, indicating that the three groups did not significantly differ from each other at the start of kindergarten, after controlling for the other variables in the model. In addition, the estimated coefficients for the interaction between *Arthur* and time, as well as between *Between the Lions* and time, were not significant, after controlling for initial show differences, home viewings, initial English vocabulary, years resided in the United States, and total number of children's books in the home.

Home viewing. Home viewing was kept in the model to control for extra *Arthur* or *Between the Lions* viewings. The final models for Blending (Table 4), Sound Matching (Table 5), and Letter-Word Identification (Table 6) indicate that home viewing had no effect. However, *Between the Lions* home viewing was marginally significant ($ß_{03} = .58$, $p = .0674$) for the Elision subtest (Table 3), indicating that those who viewed *Between the Lions* at home started slightly higher on the Elision subtest than the other two groups. The coefficient .58 corresponds to roughly an effect size of one fifth of a standard deviation.

Initial English vocabulary. After controlling for the other variables in the model, initial English vocabulary had a significant effect on the estimated average initial level of Elision (Table 3), Blending (Table 4), and Letter-Word Identification (Table 6). On average, every 20-point difference (one standard deviation) in initial English vocabulary was associated with a .6-point increase (effect size of one fifth of a standard deviation) in Elision, a 1-point increase (effect size of slightly under one third of a standard deviation) in Blending, and a 9.2-point increase (effect size of 1.85 *SD*s) in Letter-Word Identification at the start of kinder-

[3]When an unconditional linear growth model that included both the fixed and random effects for both the intercept and the growth rate was fitted, the fixed and random effects could not be estimated in the model because the error-covariance matrix was not positive. Thus, the growth rate was "fixed."

garten. That is, children who started kindergarten with higher initial English vocabulary scores also started with higher initial Elision, Blending, and Letter-Word Identification measures. In addition, initial English vocabulary was associated with rate of growth on all the phonological awareness measures (Tables 3–5): Elision $ß_{14}$= .004, p = .0305; Blending $ß_{14}$ = .003, p =.0818; and Sound Matching $ß_{14}$ = .006, p =.0473.

Initial Spanish vocabulary. After controlling for the other variables in the model, initial Spanish vocabulary had a significant effect on the estimated average initial level of Elision (Table 3) and Sound Matching (Table 5). On average, every 15-point increase (slightly over one standard deviation) in initial Spanish vocabulary was associated with a .3-point increase (effect size of one tenth of a standard deviation) in Elision and a 1.05-point increase (effect size of slightly over one fifth of a standard deviation) in Sound Matching at the start of kindergarten. Children who started kindergarten with higher initial Spanish vocabulary scores also started with higher initial Elision and Sound Matching measures. However, unlike the results with English vocabulary, initial Spanish vocabulary was not associated with rate of growth on any of the measures.

Total number of children's books in the home. Total number of children's books in the home had a significant effect on the estimated average initial level of Sound Matching (Table 5) and Letter-Word Identification (Table 6), after controlling for the other variables in the model. On average, children who had more children's books at home started kindergarten with higher Sound Matching and Letter-Word Identification than those who had fewer books. In addition, total number of books was associated with the rate of growth on Elision (Table 3) and Blending (Table 4). On average, more children's books in the home led to steeper trajectories on these measures.

Library experience. Library experience had a significant effect on the estimated average initial level of Blending (Table 4), after controlling for the other variables in the model. On average, children who were taken to libraries on a more frequent basis began with initial levels of Blending that were 1 point higher (slightly under one third of a standard deviation) than those children who were not taken to libraries. However, library experience was not associated with rate of growth on any of the measures.

Years in the United States. The number of years children had resided in the United States had a significant effect on the estimated rate of growth of Let-

ter-Word Identification ($ß_{06} = -.48$ $p = .0002$), after controlling for the other variables in the model (see Table 6). On average, children who had just immigrated to the United States had steeper trajectories than those who had been born in the United States. However, the number of years in the United States was not associated with the estimated average initial level of Letter-Word Identification.

DISCUSSION

Results from this yearlong study replicate and extend findings from previous research conducted with *Between the Lions* (Linebarger, 2000; Prince et al., 2002). Although, on average, the phonological awareness and letter-word identification knowledge of all the early bilinguals in the study increased at a fast pace during their kindergarten year, intervention effects were seen; children who viewed *Between the Lions* during class hours had steeper trajectories on two of the three phonological awareness measures (i.e., Blending and Elision) than those who viewed *Arthur* during class hours and those who did not view either show during class hours.

The study was designed so that half the children in the viewing group classroom watched one of the two shows; due to time constraints, it was not possible for the teacher or researchers to follow up with exercises to reinforce learning from the educational television shows. Although no reinforcement followed the viewing sessions, growth in Blending and Elision skills was greater for children who watched *Between the Lions*. Furthermore, this difference remained significant even after controlling for home viewing, initial English vocabulary, total number of children's books in the homes, initial Spanish vocabulary (Elision only), and library experience (Blending only) as shown in Figures 9 and 10.

Between the Lions spends considerable time directing viewers' attention to phonological awareness, the alphabetic principle, and letter-sound correspondence (Rath, 2000). Moreover, particular segments of the show focus on blending and elision skills. For blending, there are segments such as "Gawain's Word" and "Fred." In "Gawain's Word," two knights carrying parts of a word (e.g., Knight *w* and Knight *et*) joust and come together to create one word (e.g., *wet*). In "Fred," Fred emphasizes sounds in words by stretching sounds and repeating sounds. For example, to introduce the word *fish*, Fred repeats the /f/ sound a couple of times, then stretches the /i/ sound before adding /š/. For elision, there are songs such as "Sig and the Pig" that emphasize taking away sounds and replacing them with other sounds. Although the following lyrics are sung, the words *sig*, *pig*, and *jig* appear on the screen. In addition, the *p* is removed from *pig* and replaced with a *j* to form the word *jig*.

Sig and the Pig[4]

There once was a fellow, a fellow named Sig.
Whose dream was to dance a dance with a pig.
So he took p away and replaced it with a j.
And now he is happily dancing a jig
Sig and the pig are dancing a jig.

Hence, *Between the Lions* includes skill-building segments particularly focused on blending and elision. Furthermore, because children watched *Between the Lions* as part of scheduled class activities with adult supervision, children were required to watch the show quietly, attentively, and routinely. Effects of routine *Between the Lions* classroom viewing were not seen with Sound Matching and Letter-Word Identification, which may be because letter-sound correspondence, letter-naming of both uppercase and lowercase letters, and sight word recognition are all emphasized in kindergarten classrooms (Payzant, 2002). In addition, the letter-word identification assessment used in this study only tested a small number of letters and decodable words, which may not have been precise enough to detect detailed development. Future studies may want to examine knowledge of letter names, letter sounds, and decoding skills separately.

The total number of children's books in the home was predictive of initial levels of Sound Matching and Letter-Word Identification, as well as of the growth rate on Elision and Blending. In addition, home viewing of *Between the Lions* predicted initial levels of Elision, whereas library experience predicted initial levels of Blending. High values on all three variables define literacy-rich home environments. Moreover, it implies evidence for the value of joint book-reading experiences. This result, which is in line with previous research (Tabors, Snow, & Dickinson, 2001), indicates that home environments and activities make considerable contributions to children's literacy success.

Initial vocabulary also appears to play an influential role in early reading development. Initial English vocabulary predicted initial levels of Elision, Blending, and Letter-Word Identification. It also made a difference in the average growth rates of Elision, Blending, and Sound Matching. At the same time, initial Spanish vocabulary predicted initial levels of Elision and Sound Matching. These findings are consistent with previous research (e.g., Gottardo, 2002; Walley, Metsala, & Garlock, 2003). Gottardo found that English vocabulary and reading were related, suggesting that vocabulary knowledge supports phonological recoding skills. Walley et al. also found that spoken word recognition contributed significantly to

[4]Lyrics by Christopher Cerf. Copyright 2000–01 by Denebola Music and Listen to the Lion Music. *Between the Lions* © 2005 WGBH Educational Foundation and Sirius Thinking, Ltd. Reprinted with permission.

the variance in phonological awareness skills. For phonological awareness skills, more lexical knowledge may provide insights into patterns of language. For letter-word identification, if the child has a large lexicon, it may be easier for the child to recognize the word on decoding it.

Furthermore, similar to past findings by Bialystok, Majumder, and Martin (2003), by the end of kindergarten, on average, the bilinguals in this study performed slightly higher than age-equivalent levels for Blending and were at age-equivalent levels for both Elision and Sound Matching. Knowledge of Spanish may provide an advantage for phonological awareness tasks (Bialystok et al., 2003; Borzone de Manrique & Signorini, 1994). Borzone de Manrique and Signorini reported that both skilled and less skilled Spanish-speaking readers performed the same on a phoneme segmentation task. They suggested that the relatively transparent orthography and simple phonotactic structure of Spanish (i.e., its small number of vowels and preference for consonant–vowel syllabic structure) may promote early development of phonological awareness.

In addition, as in previous studies (e.g., Perfetti et al., 1987) phonological awareness was highly correlated with early reading. As correlation analyses do not allow us to infer causation, it will be important in future studies to investigate the nature of the relations between phonological awareness variables and letter-word identification.

Unfortunately, this study focuses on only one bilingual population; it would be of value to replicate the study with other groups of young bilinguals, particularly as studies conducted with Spanish–English and Chinese–English bilinguals found different results for the two bilingual groups (Bialystok et al., 2003). Moreover, the Chinese–English bilinguals did not show a bilingual advantage in phonological awareness tasks (Bialystok et al., 2003). More research on intervention effects for ELL children is necessary for the ultimate academic success of these children. Furthermore, these children were only followed during their kindergarten year. Stanovich's (1986) concept of Matthew effects suggests that those children who begin school with sufficient phonological awareness skills will start out relatively effortlessly on early reading instruction and through reading will be in a better position to improve their oral language skills. In addition, research shows that well-balanced and skilled phonological awareness instruction during kindergarten and first grade can dramatically decrease the number of children experiencing reading failure (Lesaux & Seigel, 2003). Hence, a longer term longitudinal study collecting data on those later outcomes would be of great value.

CONCLUSION

This study investigates how ELL children progressed on their early reading skills as a function of exposure to educational television shows that are easily available to all children. For the population of children in this study, viewing *Between the*

Lions assisted in the development of their early literacy skills. This study supports the benefits of *Between the Lions*, provided that children view the show attentively, and especially if the children also have access to literacy-rich home and school environments. *Between the Lions* can be used as a supplement to classroom instruction or as an after-school or enrichment activity. Further studies should examine the influence of other children's television shows on ELL children's literacy outcomes. More detailed understanding of ELL children's literacy processes, as well as effects of educational television, is crucial to the design of better language education practices, assessments, and interventions.

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