

# **Do The Greater Academic Gains Made by Full-Day Kindergarten Children Persist Through Third Grade?**

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*This paper is intended to promote the exchange of ideas among researchers and policy makers. The views expressed in it are part of ongoing research and analysis and do not necessarily reflect the position of the U.S. Department of Education.*

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## BACKGROUND

The kindergarten year is a time when children from all backgrounds and in all types of schools and program types gain knowledge and learn many new skills in reading and mathematics regardless of their skill levels at the beginning of the year (West, Denton, and Germino Hausken 2000). Research has found that all children do not begin kindergarten demonstrating the same reading and mathematics skills and knowledge (Fryer and Levitt 2004; West, Denton, and Germino Hausken 2000; Zill and West 2001; West, Denton, and Reaney 2001; Lee and Burkam 2002). Children with one or more family risk factors, such as having a primary home language that is non-English, growing up in low-income family, having a mother with less than a high school diploma or GED, or living in a single-parent household, have lower achievement scores in reading and mathematics when they start kindergarten than children without these factors. Additionally, Black and Hispanic children, on average, demonstrate lower achievement scores than White and Asian children.<sup>1</sup> Many of the children who start kindergarten behind also have slower academic growth over the first few years of schooling compared to others, widening the achievement gap between these groups (Rathbun and West 2004; Downey, von Hippel, and Broh 2004). For example, Black children make smaller gains in reading and mathematics from the fall of kindergarten to the end of third grade compared to White, Hispanic, and Asian/Pacific Islander children, even after controlling for children's sex, number of family risk factors, kindergarten program type (half-day or full-day), and school type (public or private) (Rathbun and West 2004).

An increasingly common strategy for providing an opportunity for children to begin formal schooling with the best chance for success is offering a full-day kindergarten program rather than the more traditional half-day program (e.g., Gullo 1990; Morrow, Strickland and Woo 1998, Galley 2002). Enrollment in full-day programs has grown from 27 percent of all kindergarten children in 1977 to 60 percent in 2001 (U.S. Department of Education 2004). Walston and West (2004) report that in the 1998-99 school year, 54 percent of public school kindergarten children attended a full-day program. In public schools, 79 percent of Black kindergarten children attended full-day programs; this is a higher rate than was found for White (49 percent), Asian (40 percent) or Hispanic (46 percent) public school kindergartners. Additionally, public school kindergartners whose family income is below the federal poverty threshold attended full-day programs at a higher rate (62 percent) than those from more affluent families (51 percent). Not all groups of children who are considered at risk for school failure attended full-day programs at relatively high rates. For example, in the 1998-99 school year, 45 percent of public school kindergartners from homes where English is not the primary language attended full-day programs.

As the prevalence of full-day kindergarten programs has increased over the years there has been growing interest in the effect of full-day kindergarten on children's academic achievement. Past research generally finds that full-day kindergarten programs compare favorably to half-day programs in terms of children's academic achievement (see Fusaro 1997 for a meta analyses of these studies) and their development of social skills (Elicker and Mathur

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<sup>1</sup>Throughout this paper, White refers to White, non-Hispanic; Black refers to Black, non-Hispanic; and Other refers to Other, non-Hispanic (i.e., American Indian, Alaska Native, or multiracial).

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1997). Several studies have used data from the Early Childhood Longitudinal Study, Kindergarten Class of 1998-99 (ECLS-K) to examine the relationship between kindergarten program type and children's reading and mathematics achievement. Walston and West (2004) used data from this nationally representative sample of first-time public school kindergarten children and found that children in full-day classes made greater gains in reading and mathematics during the kindergarten year compared to those attending half-day classrooms, after accounting for other child and classroom characteristics. That study also examined teachers' reports about the instructional activities in their classrooms and found that public school children in full-day classes spend more time each day engaged in reading and mathematics lessons compared to those in half-day classes. It appears that the increased instructional time available to children in full-day programs is related to the acquisition of more skills and knowledge during the kindergarten year.

Another study with the ECLS-K data found that the reading and mathematics achievement gains from kindergarten through third grade (for children attending both public and private schools) was not higher for those who had attended a full-day compared to a half-day kindergarten program, suggesting that any advantage associated with a full-day program at the end of kindergarten may not persist three years later (Rathbun and West 2004). In light of this general finding, Rathbun and West (2004) pose the question; is full-day kindergarten associated with sustained advantage for certain groups of children – particularly for groups of children with various family risk factors or racial/ethnic backgrounds typically associated with lower academic achievement? This paper uses the ECLS-K data to investigate the relationship of kindergarten program type and the academic growth from kindergarten through third grade for public school children from these various backgrounds.

## **PURPOSE**

This paper extends the findings from Walston and West (2004), which suggest that public school kindergarten children make greater gains during the kindergarten year in full-day compared to half-day kindergarten classes. This study looks at the same sample of children (public school, first-time kindergartners) but tracks their growth in reading and mathematics through third grade. The aim of this paper is to investigate whether the apparent academic advantage public school kindergartners in full-day programs have over those in half-day programs persists beyond the kindergarten year for children in general and for groups of public school children from various sociodemographic backgrounds – especially for groups who tend to achieve lower levels of school success. Risk factors for low school performance identified in previous education research include: coming from a low-income family or single-parent household, having parents who did not complete high school, and having parents who speak a language other than English in the home (Croninger and Lee 2001; Pallas, Natriello and McDill 1989; Rathbun and West 2004; Zill and West 2001). Previous studies have found associations among these family background characteristics and poor educational outcomes, including low achievement scores, grade repetition, and dropping out of high school.

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## Data Source

The data for this paper come from the Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K) sponsored by the National Center for Education Statistics (NCES), within the U.S. Department of Education’s Institute of Education Sciences. The ECLS-K is following a nationally representative sample of kindergartners from the fall of 1998 and has followed them into fifth grade. The study collects information directly from the children and their families, teachers, and schools. The full ECLS-K base-year sample is composed of 22,782 children who attended 1,277 schools with kindergarten programs during the 1998–99 school year. The weighted school response rate for the kindergarten year was 74 percent. The child and parent completion rates in the kindergarten year were 92 percent and 89 percent, respectively. In the spring of 2002, 80 percent of the children and 77 percent of the parents who were eligible for the third-grade data collection participated in the study (Rathbun and West 2004). The ECLS-K sample was designed to represent the 3.9 million children attending 178,000 kindergarten classes in the U.S. in 1998-99. The findings in this paper are based on the 11,139 children in the ECLS-K sample who were in public school at each data collection point, entered kindergarten for the first time in 1998, and have complete data on the characteristics included in this paper.<sup>2</sup> Table 1 shows the percentage distribution for each of the characteristics used in the analyses (program type, home language, poverty status, mother’s education, and family type (single- or two-parent household), race/ethnicity, and sex). Each of these characteristics is defined in greater detail later in this paper (see Measures).

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<sup>2</sup>Estimates in this report are weighted by the ECLS-K longitudinal full-sample child weight, C1\_5FC0.

**Table 1. Percentage distribution of first-time public school kindergarten children by kindergarten program type and child characteristics: 1998–99**

Child characteristic	Sample size	Weighted percent (standard error)
Total	11,139	100
Kindergarten program type		
Full-day	5,249	54 (2.59)
Half-day	5,890	46 (2.59)
Sex		
Female	5,598	50 (0.43)
Male	5,541	50 (0.43)
Race/ethnicity		
White, non-Hispanic	6,637	60 (1.42)
Black, non-Hispanic	1,351	15 (0.85)
Hispanic	1,908	18 (1.05)
Asian/Pacific Islander	753	3 (0.28)
Other, non-Hispanic	490	4 (0.79)
Home language		
English	9,717	89 (0.69)
Non-English	1,422	11 (0.69)
Poverty status <sup>1</sup>		
At or above federal poverty threshold	9,154	80 (0.93)
Below federal poverty threshold	1,985	20 (0.93)
Mother's education		
Less than high school	1,333	14 (0.66)
High school or above	9,806	86 (0.66)
Family type		
Single-parent family	2,260	24 (0.81)
Two-parent family	8,879	76 (0.81)

<sup>1</sup>Poverty is a function of household size and household income. Based on 1998 Census information, a household of four with a total income below \$16,655 was considered to be below the federal poverty level.

NOTE: Sample size details may not sum to total due to missing data.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K), Longitudinal Kindergarten – Third Grade Public-Use data file, fall 1998, spring 1999, spring 2000, and spring 2002.

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## METHOD

Initial analyses of the relationships of kindergarten program type with reading and mathematics achievement during the kindergarten year are included to support the finding from previous research that children in full-day kindergarten learn more reading and mathematics skills during the kindergarten year compared to those in half-day programs (see table 2).<sup>3</sup> In these two initial analyses, spring kindergarten reading and mathematics scores are examined by child characteristics: fall kindergarten reading or mathematics scores, home language, poverty status, mother's education, and family type (single- or two-parent household), race/ethnicity, and sex. These child characteristics along with program type and their interactions with program type are included as factors in the model of spring kindergarten scores in order to describe the relationship of program type to learning during the kindergarten year for these groups of children.

The main analyses are intended to explore the longer-term relationship of kindergarten program type and reading and mathematics achievement (see table 3). Two-level hierarchical linear modeling (HLM) is used to describe the achievement growth of children with various background characteristics (home language, poverty status, mother's education, and family type, race/ethnicity, and sex, along with the type of program they attended in kindergarten and interactions between the child characteristics and program type. These analyses model the kindergartner's scores from four occasions (fall kindergarten, spring kindergarten, spring first grade and spring third grade) at level one and child-level variables at level two (i.e., kindergarten program type, the child characteristics, and the interactions). Child characteristics are included as predictors in the second-level equations for the intercept in order to describe how they are related to children's skills and knowledge at the beginning of the kindergarten year. Program type, the child characteristics, and their interactions with program type are included as predictors of the growth-rate parameters in order to describe the relationship of program type to learning from kindergarten entry to the end of third grade. Separate models are analyzed for reading and mathematics scores. This set of analyses investigates whether the differences associated with kindergarten program type found during the kindergarten year are sustained beyond the end of kindergarten and whether the effect<sup>4</sup> of full-day kindergarten might vary for different groups of children.

Effects noted in the text are tested for statistical significance to ensure that the differences are larger than might be expected due to sampling variation. All effects described are significant at the .05 alpha level. Due to the large sample size, many effects (no matter how substantively minor) may be statistically significant. Thus, effect sizes for comparisons are also included to provide a measure of the magnitude of group differences. Cohen's (1988) convention for interpreting effect sizes considers effect sizes of .20 as small, .50 as medium, and .80 as large.

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<sup>3</sup> The Walston and West (2004) study included fewer of the child characteristics presented here and some additional classroom characteristics at the class-level of the HLM analyses of children's reading and mathematics gain scores from fall to spring kindergarten.

<sup>4</sup> The term "effect" here and elsewhere in this paper is not intended to imply causation but is used in the context of regression analysis terminology.

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## Measures

The variables used in the analyses come from the ECLS-K Longitudinal Kindergarten–Third Grade public-use data file (NCES 2004–089). More detailed information on these measures and about the ECLS-K design can be found in the User's Manual for the ECLS-K Third Grade Public-Use Data Files and Electronic Code Book (NCES 2004-001).

### *Level-one variables*

*Children's reading and mathematics knowledge and skills.* The scores used in these analyses are from the reading and mathematics ECLS-K direct child cognitive assessments.<sup>5</sup> The ECLS-K battery used a two-stage assessment approach in which the first stage in each domain contained a routing test that determined the child's approximate skills. According to the child's performance on the routing test, the child is administered one of the skill level assessments in that domain (the second stage). This adaptive approach is used in all administrations of the assessments. The reading assessment includes basic literacy skills, vocabulary, and comprehension items. The mathematics assessment measures conceptual understanding of numbers, shapes, patterns, mathematical operations, and processes for problem solving. This paper examines the overall Item Response Theory (IRT) scaled scores for each subject area from the fall and spring of kindergarten (fall 1998 and spring 1999), the spring of first grade (spring 2000), and the spring of third grade (spring 2002).<sup>6</sup> (Reading variables: C1R2RSCL, C2R2RSCL, C4R2RSCL, C5R2RSCL; Mathematics variables: C1R2MSCL, C2R2MSCL, C4R2MSCL, C5R2MSCL).

*Elapsed time between assessments.* In most cases, the assessments were administered at each round over the course of about four to six weeks. This variable controls for the differences in the amount of time between assessments at each round. The date of assessment was recorded at each data collection period (e.g., in the kindergarten year, C1ASMTMM (month), C1ASMTDD (day), C1ASMTYY (year)). The elapsed time, in months, was calculated between the initial assessment (in fall kindergarten) and each later assessment (i.e., spring kindergarten, spring first grade, spring third grade). This value is zero for all children's fall kindergarten score and the elapsed time between each assessment and the initial assessment in fall of kindergarten was calculated to describe the amount of reading and mathematics gains children demonstrated *each month* since the fall kindergarten assessment.

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<sup>5</sup> Prior to administering the assessments in kindergarten and first grade, children's English proficiency was evaluated. Children whose home language was other than English (as determined by school records) were administered the Oral Language Development Scale (OLDS). Approximately 68 percent of Hispanic children and 78 percent of Asian/Pacific Islander children were assessed in English in the fall and spring of kindergarten and in the spring of first grade (Denton and West 2002). In the third-grade year, the OLDS was not administered and all children were assessed in English. In an earlier report (Denton and West 2002), analyses were conducted to explore how including children who initially could not take the battery in English but were tested by spring of first grade would impact achievement estimates. Significant reading *t*-score differences overall and by specific racial/ethnic group were not detected between the sample assessed in English at all timepoints and the total sample, including those who were able to be tested with the English assessment at a later time. Children who did not take the assessments in English in early rounds were not excluded from the analyses.

<sup>6</sup> This paper refers to data collected in the spring of 2002 as third-grade data and the sampled children as third-graders, although not all children in the sample used for this paper were enrolled in third grade. In the spring of 2002, about 89 percent of the sampled children were in third grade, 10 percent were in second grade, and about 1 percent were enrolled in other grades (e.g., first or fourth grade). All of the children had been enrolled in school for four years.

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***Level-two variables:***

All level-two variables are dummy coded; the group set equal to 0 is the reference group.

*Kindergarten program type:* Full-day kindergarten or half-day kindergarten program the child was enrolled in during their kindergarten year. (A2CLASS, or if this was missing, F2CLASS).

0 = Half-day; 1 = Full-day

*Family risk factors in the kindergarten year (four variables):* These analyses consider four family characteristics identified in previous research as potential risk factors for children's school achievement. Each of the risk factors used in the analyses come from interviews with parent in the kindergarten year. The four risk factors examined included:

1) Primary home language (WKLANGST)

0 = English; 1= Not English

2) Household poverty level<sup>7</sup> (WKPOV\_R)

0 = At or above the poverty threshold; 1 = Below the poverty threshold

3) Mother's education level high school (WKMOMED, collapsed)

0 = Mother received a high school diploma or GED; 1= Mother did not graduate high school or receive a GED

4) Household type(P2HFAMIL, collapsed)

0 = Lives in a two-parent household; 1 = Lives in a single-parent household (i.e., mother-only or father-only)

*Child's sex:* Male or female (GENDER)

0 = Female; 1 = Male

*Child's race/ethnicity:* White, non-Hispanic; Black, non-Hispanic; Hispanic, Asian/Pacific Islander (API); and Other, non-Hispanic (which includes American Indians, Alaska Natives, and non-Hispanic multiracial children) (RACE, collapsed). Separate dummy-

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<sup>7</sup>The federal poverty level status composite variable is derived from household income and the total number of household members. Federal poverty thresholds are used to define households below the poverty level. For instance, in 1998 if a household contained four members, and the household income was lower than \$16,655, then the household was considered to be in poverty.

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coded variables are entered in the models for Black, non-Hispanic; Hispanic; API; and Other, non-Hispanic, so that White, non-Hispanic is the reference group.

Black, non-Hispanic: 0 = Not Black, non Hispanic; 1 = Black, non Hispanic

Hispanic: 0 = Not Hispanic; 1 = Hispanic

API: 0 = Not API; 1= API

Other: 0=Not Other; 1 = Other

## **HLM models**

The structure of the two-level HLM models (where Y=reading scores or Y=mathematics scores) is defined below.

### ***Level-1***

At level 1, children's individual growth trajectories were modeled based on their assessment scores from multiple occasions (fall K, spring K, spring 1<sup>st</sup> and spring 3<sup>rd</sup>). The level 1 model is:  $Y = B0 + B1*(TIME) + R$

Y is the child's subject-area score at a given time point. The intercept, B0, is the child's initial (fall K) achievement score (i.e., at 0 months). B1 is the growth rate over the first 4 years of school, which represents the child's expected change in achievement each month. TIME is the elapsed time (i.e., number of months) since the initial (fall K) assessment. This model assumes that errors (R) are independent and normally distributed, with a common variance (Bryk and Raudenbush 1992).

### ***Level-2***

The level 2 model incorporates predictors of B0 (child's initial status) and B1 (growth parameters). Each of the child and family characteristics is included as a predictor in the level-two B0 equation for initial status (the level-1 intercept). G00 represents the intercept of this equation. G01 through G09 are the coefficients describing initial differences for each of the child and family characteristics. The growth rate parameter (B1) equation has these child and family characteristics, program type, and interaction terms. Interaction terms for kindergarten program type by each of the child characteristics are included in the growth parameter equation in level two to determine whether the relationship between growth and kindergarten program type is uniform across the levels of each child characteristic. G10 represents the intercept of this equation and G11 through G13 are the coefficients that describe growth rate differences associated with each of the terms in the model. The error term (U1) is assumed to be independent, normally distributed, with a common variance.

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$$B0 = G00 + G01*(MALE) + G02*(NON-ENG) + G03*(POVERTY) + G04*(MOM\_ED) + G05*(SNGL\_PAR) + G06*(BLACK) + G07*(HISPANIC) + G08*(API) + G09*(OTHER) + U0$$

$$B1 = G10 + G11*(MALE) + G12*(NON\_ENG) + G13*(POVERTY) + G14*(MOM\_ED) + G15*(SNGL\_PAR) + G16*(BLACK) + G17*(HISPANIC) + G18*(API) + G19*(OTHER) + G110*(HALFFULL) + G111*(POVFULL) + G112*(BLACFULL) + G113*(HISPFULL) + G114*(APIFULL) + G115*(OTHFULL) + G116*(LANGFULL) + G117*(FAMFULL) + G118*(MOMFULL) + G119*(MALEFULL) + U1$$

## Findings

Linear models of spring kindergarten reading and mathematics scores show full-day versus half-day differences in achievement that are consistent with those reported by Walston and West (2004). Compared to children in half-day programs, children in full-day kindergarten have higher scores in reading and in mathematics at the end of kindergarten after controlling for fall scores,<sup>8</sup> each of the four family risk factors, race/ethnicity, and sex (table 2). There are no significant interaction effects between any of the child characteristics and program type that would suggest that the relationship between full-day kindergarten and cognitive achievement is stronger for some groups of children compared to others.

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<sup>8</sup> The average fall kindergarten reading score (unadjusted for other factors in the model) is higher for children enrolled in a full-day program compared to those in a half-day program (38.2 vs. 36.8) (full-day standard error = 0.28; half-day standard error = 0.31; t-value = .034). Full-day and half-day kindergartners have fall scores in mathematics of 20.7 and 21.2, respectively (full-day standard error = 0.44; half-day standard error = 0.44).

**Table 2. Linear model for spring kindergarten reading and mathematics scores (with kindergarten program type, fall scores, and other child characteristics): 1998-99**

Fixed Effect	Reading Coefficient	s.e.	Mathematics Coefficient	s.e.
Intercept	-4.43*	1.422	-0.54	1.015
Fall score	1.09*	.019	1.06*	.015
Primary home language non-English	0.74	.575	-0.05	.372
Living below federal poverty threshold	-0.84	.441	-0.79*	.379
Mother's education less than high school	-1.17	.550	-0.85	.438
Single-parent household	-0.48	.333	0.05	.320
Black, non-Hispanic	-0.93	.562	-2.20*	.579
Hispanic	0.32	.456	-0.57	.410
Asian/Pacific Islander	0.36	.650	0.23	.558
Other, non-Hispanic	0.19	.720	-0.84	.597
Male	-0.83*	.228	-0.05	.276
Elapse	2.16*	.194	1.48*	.165
Full-day kindergarten	1.79*	.417	1.51*	.297
<i>Child characteristics by full-day kindergarten</i>				
Primary home language non-English x full-day	0.04	.897	-0.54	.714
Living below federal poverty threshold x full-day	0.73	.568	0.41	.445
Mother's education less than high school x full-day	-0.31	.656	-0.08	.641
Single-parent household x full-day	-0.23	.509	-0.97	.454
Black, non-Hispanic x full-day	-1.10	.616	0.43	.680
Hispanic x full-day	-0.11	.876	0.44	.555
Asian/Pacific Islander x full-day	0.24	.900	-0.22	.917
Other, non-Hispanic x full-day	-1.15	.865	-0.08	.891
Male x full-day	0.50	.391	0.35	.361

\* p<.05

<sup>1</sup>Poverty is a function of household size and household income. Based on 1998 Census information, a household of four with a total income below \$16,655 was considered to be below the federal poverty level.

NOTE: The "elapse" variable is included in these models to control for the amount of time between the fall and spring assessments.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 1998-99 (ECLS-K), Longitudinal Kindergarten - Third Grade Public-Use data file, fall 1998, spring 1999, spring 2000, and spring 2002.

Results for the HLM longitudinal analyses of reading and mathematics growth between kindergarten entry and the end of third grade are presented in table 3.

**Table 3. Linear model of growth from kindergarten to third grade for first-time public school kindergartners' reading and mathematics knowledge and skills (with child background factors and kindergarten program type): 1998–2002**

Effect	Reading Coefficient	s.e.	Mathematics Coefficient	s.e.
<b>Model for initial status (fall kindergarten)</b>				
Intercept	31.17*	.210	25.99*	.166
Primary home language non-English	-2.30*	.500	-1.53*	.392
Living below federal poverty threshold	-3.13*	.304	-2.49*	.262
Mother's education less than high school	-4.10*	.307	-3.47*	.286
Single-parent household	-2.09*	.292	-1.72*	.243
Black, non-Hispanic	-2.00*	.365	-4.29*	.276
Hispanic	-2.70*	.402	-3.67*	.319
Asian/Pacific Islander	3.92*	.694	0.15	.510
Other, non-Hispanic	-2.10*	.600	-2.86*	.473
Male	-1.74*	.245	-0.20	.200
<b>Model for growth rate (fall kindergarten to spring third grade)</b>				
Intercept	2.07*	.009	1.54*	.008
Primary home language non-English	0.06*	.247	0.00	.021
Living below federal poverty threshold	-0.12*	.022	-0.08*	.016
Mother's education less than high school	-0.17*	.024	-0.12*	.018
Single-parent household	-0.03	.018	0.00	.014
Black, non-Hispanic	-0.17*	.029	-0.18*	.023
Hispanic	-0.10*	.021	-0.08*	.017
Asian/Pacific Islander	-0.06*	.026	-0.01	.023
Other, non-Hispanic	-0.07*	.029	-0.02	.025
Male	-0.07*	.012	0.07*	.010
Full-day kindergarten	-0.04*	.014	-0.02	.011

**Table 3. Linear model of growth from kindergarten to third grade for first-time public school kindergartners' reading and mathematics knowledge and skills (with child background factors and kindergarten program type): 1998–2002 (continued)**

Effect	Reading Coefficient	s.e.	Mathematics Coefficient	s.e.
<i>Child characteristics by full-day kindergarten</i>				
Primary home language non-English x full-day	0.07*	.034	0.02	.029
Living below federal poverty threshold x full-day	-0.00	.028	-0.01	.021
Mother's education less than high school x full-day	0.01	.031	-0.01	.023
Single-parent household x full-day	-0.01	.024	-0.02	.019
Black, non-Hispanic x full-day	-0.04	.034	-0.01	.027
Hispanic x full-day	0.01	.030	0.06*	.023
Asian/Pacific Islander x full-day	-0.07	.036	-0.03	.032
Other, non-Hispanic x full-day	-0.15*	.043	-0.12*	.034
Male x full-day	0.02	.017	-0.01	.014

\*  $p < .05$ . <sup>1</sup>Poverty is a function of household size and household income. Based on 1998 Census information, a household of four with a total income below \$16,655 was considered to be below the federal poverty level. NOTE: Only children who were first-time kindergartners (non-repeaters) in 1998-99 were included in the sample. SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K), Longitudinal Kindergarten – Third Grade Public-Use data file, fall 1998, spring 1999, spring 2000, and spring 2002.

### ***Reading and mathematics achievement at entry to kindergarten***

Results from the reading and mathematics analyses indicate that many of the child-level characteristics are associated with children's achievement status at kindergarten entry after accounting for the other child characteristics in the model (table 3). All four family risk factors were negatively related to children's reading and mathematics scores in the fall of kindergarten. After accounting for other factors in the model, children from a home where English is not the primary language spoken scored about 2.3 points lower in reading compared to other children (effect size = .24)<sup>9</sup> and 1.5 points lower in mathematics (effect size = .17). Kindergartners in poverty scored 3.1 points lower in reading (effect size = .32) and 2.5 points lower in mathematics (effect size = .29) than those at or above the poverty threshold. Children whose mothers did not complete high school scored 4.1 points lower in reading (effect size = .43), and 3.5 point lower in mathematics (effect size = .40) than children whose mothers held at least a high school diploma. Children in single-parent households had reading scores that are 2.1 points lower (effect size = .22) and mathematics scores that were 1.7 points lower (effect size = .20) than those in two-parent homes. There were also initial score differences detected by race/ethnicity and sex. Black children scored 2.0 score points lower than White children in reading (effect size = .21) and 4.3 score points lower in mathematics (effect size = .49). Hispanic children start the year with scores that are 2.7 points lower than White children in reading (effect size = .28) and 3.7 points lower in mathematics (effect size = .43). Asian/Pacific Islanders have scores that are 3.9 point higher than White children in reading (effect size = .41). Children from other racial/ethnic backgrounds (i.e.,

<sup>9</sup> Effect sizes are calculated by dividing the absolute value of the coefficient by the corresponding standard deviation. The standard deviations for initial achievement are 9.6 points for reading and 8.7 points for mathematics. The standard deviations for achievement growth are 0.39 points/month in reading and 0.32 points/month in mathematics.

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American Indian, Alaska Native, or multiracial) start the year with reading scores that are 2.1 points lower (effect size= .22) and mathematics scores that are 2.9 points lower (effect size= .33) than White children. Males have reading scores that are 1.7 points lower than females (effect size =.18).

### ***Reading and mathematics achievement from kindergarten entry through third grade***

On average, children gained 107 score points in reading and 84 score points in mathematics from the fall of kindergarten to the spring of third grade. Two of the four family risk factors are negatively associated with public school children's reading and mathematics growth rates over the first four years of school. After taking into account the other factors in the model, reading score growth per month is .12 points lower for children in poverty (effect size =.31) and .17 lower for children whose mother has less than a high school education (effect size =.44). Mathematics score growth per month is .08 points lower for children in poverty (effect size =.25) and .17 lower for children whose mother has less than a high school education (effect size =.37). Additionally, Hispanic, Asian Pacific Islander, and "other" (i.e., American Indian, Alaska Native, or multiracial) children made slower growth in reading compared to White children, and Black and Hispanic children made slower growth in mathematics. Compared to females, males had greater growth in mathematics and slower growth in reading (table 3).

The reading score growth per month is .04 points lower (effect size =.10) for children who attended full-day kindergarten compared to those who attended half-day kindergarten after taking into account the other factors in the model. No difference was detected for the growth of mathematics scores. These findings suggest that children who attended public school full-day kindergarten classes did not maintain their advantage over the three years after kindergarten.

Interaction terms were examined to investigate whether attending a full-day kindergarten program has a uniform relationship with achievement growth for the groups of children represented in the model. Interestingly, there were some significant interactions that suggest that the relationship may not be the same for all groups of children (table 3). The relationship between kindergarten program type and reading achievement growth over time is not the same for children from a home where English is not the primary language<sup>10</sup> as it is for children from English speaking homes (B=.07). Although the main effect for children from non-English speaking homes is negative (B=-2.30), the positive interaction term for home language by kindergarten program type indicates that attending full-day kindergarten is associated with less of a growth rate difference between children from homes where English is the primary language and homes where it is not. To illustrate this interaction, figure 1 displays the actual average scores (unadjusted for other factors) at each time point for full-day and half-day kindergarteners by home language. The difference between those who attended full-day and half-day kindergarten that is seen at the end of kindergarten can still be detected at the end of third grade only for children whose family primarily speaks a language other than English.

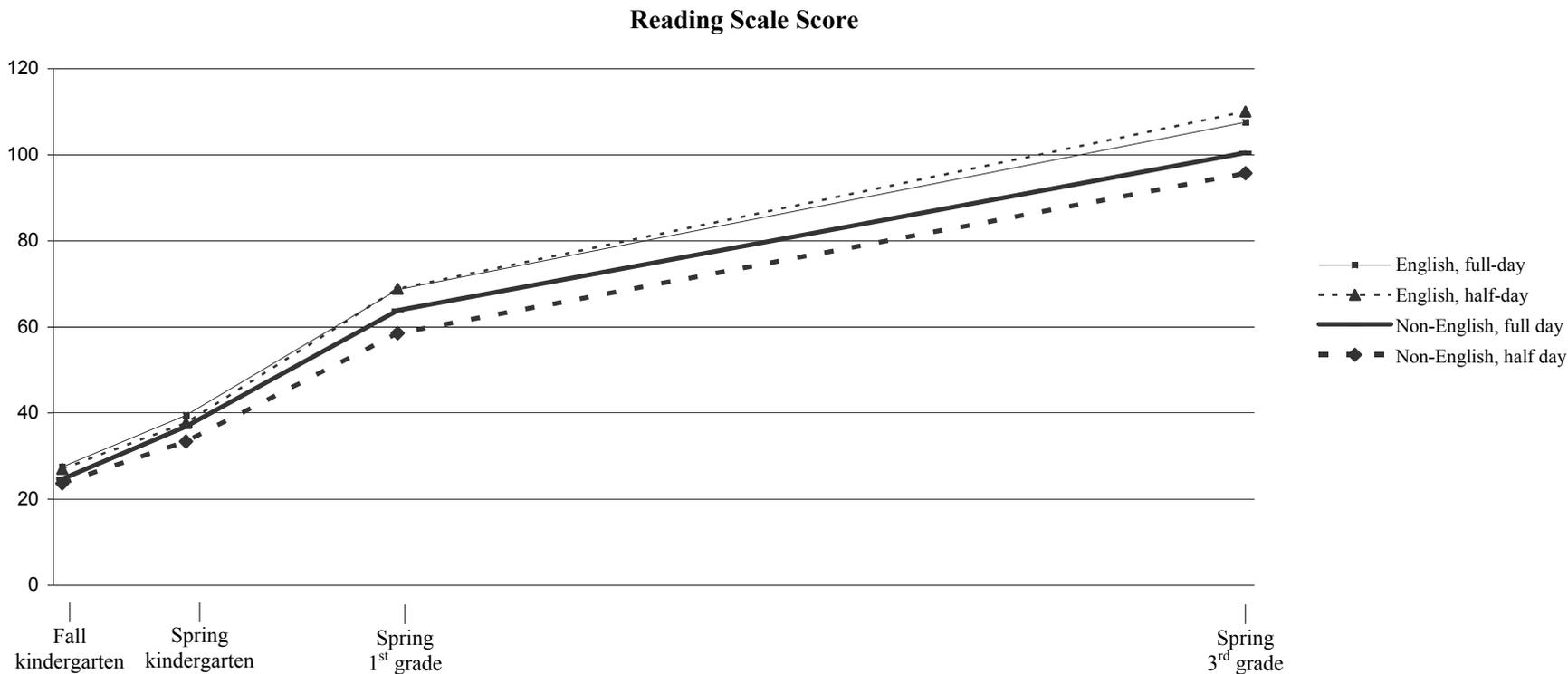
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<sup>10</sup> Ten percent of full-day kindergarten children and 14 percent of half-day kindergarten children come from a home where English is not the primary language spoken.

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Another small interaction effect with kindergarten program type is apparent for Hispanic children's mathematics growth from kindergarten through third grade. Although the main effect for Hispanic children is negative ( $B = -.08$ ), the positive interaction term for Hispanic by kindergarten program type indicates that attending full-day kindergarten is associated with less of a growth rate gap between Hispanic and White children. On the other hand, full-day kindergarten is associated with slower growth for children from the "other" race/ethnicity group which is comprised of American Indian, Alaska Native, and multiracial children (compared to White children) in reading and mathematics, when growth is measured through third grade and after accounting for other factors in the model.

**Figure 1. Reading scale scores from fall kindergarten to spring third grade (public school), by kindergarten program type and primary home language: 1998-2002**



NOTE: These estimate include children that were first-time kindergartners in public school in 1998-99 and remained in a public school until spring 2002.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K), Longitudinal Kindergarten – Third Grade Public-Use data file, fall 1998, spring 1999, spring 2000, and spring 2002.

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## DISCUSSION

Prior research with the ECLS-K data has suggested that public school children attending a full-day kindergarten program learn more in reading and mathematics during the year compared to children in a half-day program after accounting for other child and classroom factors (Walston and West 2004). Whether or not the apparent advantage associated with full-day kindergarten persists beyond the end of the kindergarten year is an important question for policy makers debating how best to use limited resources to provide young children the best opportunities for success in school. The large-scale, nationally representative longitudinal data available with the ECLS-K offers a good opportunity to investigate this question. The findings presented here support past studies that report greater academic gains during the kindergarten year for those attending a full-day program compared to a half-day program. However, the reading score differences between full-day and half-day kindergarten children that are apparent at the end of the kindergarten year seem to fade over time. There are some notable exceptions. The difference between those who attended full-day and half-day kindergarten is apparent at the end of third grade only for children whose family primarily speaks a language other than English at home. Further investigation into the home, classroom and school experiences of these children, which are available in the ECLS-K data, can further explore the correlates of school success for this group of children.

Full-day kindergarten is also associated with greater growth in mathematics when measured through third grade for Hispanic children as compared to White children after accounting for other child and family characteristics. It is unclear from these analyses what accounts for this finding but further analyses with the ECLS-K data could investigate to what extent, if any, this finding is related to other home, classroom or school characteristics. It is interesting to point out that while full-day kindergarten is often available in schools that serve large enrollments of Black and low-income families, language minority children and Hispanic children do not attend full-day kindergarten at a higher rate than others. In U.S. public schools, 79 percent of Black, 49 percent of White, and 46 percent of Hispanic children attended a full-day program; 62 percent of children in poverty, 51 percent of those not in poverty, 45 percent of language minority children and 55 percent of children from primarily English speaking homes attended a full-day program (Walston and West 2004).

The findings that show slower growth in reading and mathematics for the full-day kindergartners who are American Indian, Alaska Native, or multiracial, non-Hispanic children could also be explored further. It is unclear what other characteristics or school or home experiences might be unique about this diverse group (which makes up 4 percent of the first-time public school kindergarten children) that might account for this relationship. The ECLS-K does not include adequate numbers of American Indian or Alaska Native children to support separate analyses of these groups of children, but perhaps other data sources may.

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It is important to note that these analyses do not imply a causal relationship between kindergarten program type and children's reading and mathematics achievement. The analyses rely on survey data and other potentially important variables (e.g., preschool experiences, home environment, school resources) that may be related to children's achievement but are not represented in these analyses. The analyses in this paper are intended to provide a description of differences associated with full-day and half-day kindergarten and children's achievement over time and to stimulate others to further explore the differences and lack of differences found here.

This study provides a first step in using the ECLS-K data to examine the important question about the long-term relationship of full-day kindergarten and children's cognitive development. The breadth of child, teacher, and school-level data available with the ECLS-K data will continue to be used to investigate this relationship and other between children's achievement and child, classroom, and school factors.

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