



EDUCATION

- THE ARTS
- CHILD POLICY
- CIVIL JUSTICE
- EDUCATION
- ENERGY AND ENVIRONMENT
- HEALTH AND HEALTH CARE
- INTERNATIONAL AFFAIRS
- NATIONAL SECURITY
- POPULATION AND AGING
- PUBLIC SAFETY
- SCIENCE AND TECHNOLOGY
- SUBSTANCE ABUSE
- TERRORISM AND HOMELAND SECURITY
- TRANSPORTATION AND INFRASTRUCTURE
- WORKFORCE AND WORKPLACE

This PDF document was made available from www.rand.org as a public service of the RAND Corporation.

[Jump down to document](#) ▼

The RAND Corporation is a nonprofit research organization providing objective analysis and effective solutions that address the challenges facing the public and private sectors around the world.

Support RAND

[Browse Books & Publications](#)

[Make a charitable contribution](#)

For More Information

Visit RAND at www.rand.org

Explore [RAND Education](#)

View [document details](#)

Limited Electronic Distribution Rights

This document and trademark(s) contained herein are protected by law as indicated in a notice appearing later in this work. This electronic representation of RAND intellectual property is provided for non-commercial use only. Permission is required from RAND to reproduce, or reuse in another form, any of our research documents for commercial use.

This product is part of the RAND Corporation monograph series. RAND monographs present major research findings that address the challenges facing the public and private sectors. All RAND monographs undergo rigorous peer review to ensure high standards for research quality and objectivity.

School Readiness, Full-Day Kindergarten, and Student Achievement

An Empirical Investigation

Vi-Nhuan Le, Sheila Nataraj Kirby, Heather Barney,
Claude Messan Setodji, Daniel Gershwin

Supported by the Rockefeller Foundation and the Ford Foundation



RAND

EDUCATION

The research described in this report was conducted within RAND Education and was supported by the Rockefeller and Ford Foundations.

The RAND Corporation is a nonprofit research organization providing objective analysis and effective solutions that address the challenges facing the public and private sectors around the world. RAND's publications do not necessarily reflect the opinions of its research clients and sponsors.

RAND® is a registered trademark.

© Copyright 2006 RAND Corporation

All rights reserved. No part of this book may be reproduced in any form by any electronic or mechanical means (including photocopying, recording, or information storage and retrieval) without permission in writing from RAND.

Published 2006 by the RAND Corporation
1776 Main Street, P.O. Box 2138, Santa Monica, CA 90407-2138
1200 South Hayes Street, Arlington, VA 22202-5050
4570 Fifth Avenue, Suite 600, Pittsburgh, PA 15213-2665
RAND URL: <http://www.rand.org/>
To order RAND documents or to obtain additional information, contact
Distribution Services: Telephone: (310) 451-7002;
Fax: (310) 451-6915; Email: order@rand.org

Preface

Recent research has shown that the skills and knowledge that children have upon entering school is predictive of later achievement. As a result, there has been increased focus on school readiness of children entering kindergarten, where school readiness is broadly defined to include literacy and cognitive skills, and social, emotional, and physical development. Recognizing that children from disadvantaged backgrounds often lag behind their more advantaged peers with respect to cognitive and social-emotional skills, some policymakers advocate the provision of full-day kindergarten. Proponents of full-day kindergarten argue that the extended time in these programs can be used to increase students' readiness at first grade and beyond. However, critics point to the costs of implementing full-day kindergarten, and to uncertainty about the long-term benefits of full-day kindergarten.

This study uses data from the Early Childhood Longitudinal Study, Kindergarten Class of 1998-1999 (ECLS-K) to examine how children's skills and knowledge at kindergarten entry predict their achievement in later grades. It extends previous research by examining longer-term achievement outcomes, namely test scores at the end of fifth grade, and gives an indication of how the other nonacademic areas of school readiness (i.e., physical and socio-emotional development) may be related to test performance. The findings should help inform the debate about the merits of full-day kindergarten and should be of interest to educational researchers and education policymakers at the national, state, and local levels who are struggling with issues of school readiness and how to give all students an opportunity to learn to high standards.

This research was conducted within RAND Education, and was sponsored by the Rockefeller and Ford Foundations. The study reflects RAND Education's mission to bring accurate data and careful, objective analysis to the national debate on education policy.

The principal author of this work may be contacted by email at vi-nhuan_le@rand.org or by phone at 703-413-1100, ext. 7632. For more information on RAND Education, contact the Acting Director, Susan Bodilly. She can be reached by email at Susan_Bodilly@rand.org, by phone at 703-413-1100, ext. 5377. More information about RAND is available at www.rand.org.

Contents

Preface	iii
Figures	vii
Tables	ix
Summary	xi
Acknowledgments	xv
CHAPTER ONE	
Introduction	1
Literature Review	2
School Readiness and Student Achievement	3
Racial/Ethnic Gaps in School Readiness Skills	4
Development of Nonacademic School Readiness Skills	4
The Case for Full-Day Kindergarten	5
Effect of Full-Day Kindergarten on Student Achievement	6
Effects on Disadvantaged Students	7
Effects on School Readiness and Associated Nonacademic Outcomes	7
Purpose of This Report	8
Organization of This Report	8
CHAPTER TWO	
Data and Methodology	9
Multistage Sampling Design	9
Data Collection	10
Direct Assessment of Children	10
Parent Interviews	11
Teacher Surveys	12
School Administrator Surveys	12
Sample Size of Targeted Population	12
Measures Used in the Analysis	13
School Readiness Measures	13
School Program Characteristics	14
Classroom and School Context Factors	14
Child-Level Covariates	15

Analytic Approach	16
Weights.....	16
Multiple Imputation.....	16
Model Details	17
CHAPTER THREE	
Descriptive Statistics for the Variables Used in This Analysis	21
Academic Achievement.....	21
School Readiness Skills at Kindergarten Entry	22
Classroom and School Context	22
Racial/Ethnic Differences.....	25
Academic Achievement.....	25
Nonacademic School Readiness Skills at Kindergarten Entry	25
CHAPTER FOUR	
Estimation Results: School Program Characteristics, Student Achievement, and School	
Readiness Skills	31
Variance Decomposition Analysis.....	31
Mathematics Achievement from Kindergarten Through Fifth Grade.....	33
Reading Achievement from Kindergarten Through Fifth Grade	37
Relationships Between Kindergarten Program Factors and Nonacademic School	
Readiness Skills Through Fifth Grade.....	39
Sensitivity Analyses with Low-Income Students.....	43
Model Limitations	44
Summary of Results	44
CHAPTER FIVE	
Discussion and Policy Implications.....	47
APPENDIX	
A. Scale Items and Reliability Estimates	51
B. Descriptive Statistics of Scales for Waves 2–5	53
References	57

Figures

3.1.	Distribution of Mathematics Achievement by Race/Ethnicity, Fall Kindergarten to Spring 5th Grade	26
3.2.	Distribution of Reading Achievement by Race/Ethnicity, Fall Kindergarten to Spring 5th Grade	26
3.3.	Distribution of Teachers' Reports of Approaches to Learning by Race/Ethnicity	27
3.4.	Distribution of Teachers' Reports of Self-Control by Race/Ethnicity	27
3.5.	Distribution of Teachers' Reports of Interpersonal Skills by Race/Ethnicity	28
3.6.	Distribution of Teachers' Reports of Externalizing Behaviors by Race/Ethnicity	28
3.7.	Distribution of Teachers' Reports of Internalizing Behaviors by Race/Ethnicity	29
3.8.	Distribution of Fine Motor Skills by Race/Ethnicity	29
3.9.	Distribution of Gross Motor Skills by Race/Ethnicity	30
4.1.	Variance Decomposition for Mathematics Achievement	32
4.2.	Variance Decomposition for Reading Achievement	32
4.3.	Variance Decomposition for Approaches to Learning	33

Tables

2.1.	Description of Data Collection Instruments	11
2.2.	Sample Size for Participating Teachers and Schools	13
3.1.	Descriptive Statistics: Mathematics and Reading Test Scores	21
3.2.	Descriptive Statistics: School Readiness Skills at Kindergarten Entry	22
3.3.	Descriptive Statistics: Academic School Readiness Skills, Classroom and School Context, and Home Background Measures at Kindergarten Entry	23
3.4.	Percentage of Students or Schools with Selected Characteristics at Kindergarten Entry	24
3.5.	Characteristics of School Program Factors at Kindergarten Entry	25
4.1.	Coefficients for Mathematics Achievement Through Spring Fifth Grade	34
4.2.	Coefficients for Reading Achievement Through Spring Fifth Grade	37
4.3.	Coefficients for Nonacademic School Readiness Skills Through Fifth Grade	40
B.1.	Descriptive Statistics for Wave 2 (Spring Kindergarten)	53
B.2.	Descriptive Statistics for Wave 3 (Spring First Grade)	54
B.3.	Descriptive Statistics for Wave 4 (Spring Third Grade)	55
B.4.	Descriptive Statistics for Wave 5 (Spring Fifth Grade)	56

Summary

Background and Purpose

In recent years, there has been increased attention toward ensuring that children enter school “ready to learn.” While there is little consensus on the specific skills and knowledge that constitute school readiness, many educators, researchers, and policymakers adopt a broad perspective that extends beyond literacy and cognitive skills and includes social, emotional, and physical health. Despite the attention and focus on school readiness, recent research shows that large skill gaps exist even before children enter kindergarten. For example, on average, minority children come to kindergarten with lower literacy skills and poorer social development than do white students. This is an issue of serious concern for educators and policymakers because the skills and knowledge that children have upon entering school are predictive of later achievement.

In an attempt to address the differences in the school readiness of certain groups of children, some policymakers advocate the provision of full-day kindergarten. Proponents of full-day kindergarten argue that the extended time in these programs can be used to increase students’ readiness at first grade and beyond. They also point to studies that show academic benefits of full-day kindergarten participation through the end of first grade. However, critics point to the costs of implementing full-day kindergartens, and the uncertainty about the long-term benefits of full-day kindergarten.

This study uses data from the Early Childhood Longitudinal Study, Kindergarten Class of 1998–1999 (ECLS-K) to examine how children’s skills and knowledge at kindergarten entry predict their achievement in later grades. It extends previous research by examining longer-term achievement outcomes, namely test scores at the end of fifth grade, and gives an indication of how other nonacademic areas of school readiness (i.e., physical and socio-emotional development) may be related to test performance. This study addresses two research questions:

- What is the relationship between children’s school readiness skills at kindergarten entry and reading and mathematics achievement through the fifth grade?
- What kindergarten program factors predict the development of nonacademic school readiness skills? In particular, is attendance at a full-day program related to nonacademic school readiness?

Methods

We analyzed data from 7,897 students and their parents, teachers, and school leaders collected during five waves: fall of kindergarten and spring of kindergarten, first grade, third grade, and fifth grade. Children completed mathematics and reading assessments at each wave, as well as fine and gross motor skills' assessments at kindergarten entry. At each wave, their teachers provided information on teaching practices, experience, and class size. Teachers also provided information about children's attendance at full-day kindergarten program, and their nonacademic readiness skills along five dimensions: approaches to learning (i.e., disposition toward learning), self-control, interpersonal skills, and internalizing behaviors and externalizing behaviors (measured by a scale indicating acting-out behaviors such as getting angry, arguing, fighting, etc.) as students moved through school. Parents provided information about the child's home background, and school leaders provided information about school context variables, such as percent of minority students.

We conducted a longitudinal, cross-classified analysis in which students' outcomes over the five time points were modeled in relation to their school program characteristics, classroom and school context factors, school readiness skills at kindergarten entry, and other covariates. The model included both random and fixed effects for school- and student-level variables.

Findings

School Readiness and Reading and Mathematics Achievement

We found that both academic and nonacademic school readiness skills at entry to kindergarten were significantly related to eventual reading and mathematics achievement in fifth grade. Controlling for nonacademic readiness skills at kindergarten entry eliminated the black-white achievement gap in reading at the fifth grade, while attending a full-day kindergarten was unrelated to reading performance. Attendance in a full-day kindergarten program was not related to achievement in mathematics in fifth grade except when nonacademic school readiness factors were included in the model. When those factors were considered, full-day attendance was negatively related to math achievement. In other words, after controlling for nonacademic readiness at kindergarten, children who had attended a full-day program at kindergarten showed poorer mathematics performance in fifth grade than did children who had attended a part-day kindergarten program. This finding raises the possibility that earlier studies may have failed to find relationships between full-day kindergarten and outcomes because they omitted important information relating to nonacademic dimensions of readiness. Future studies should explore whether the inclusion of such variables changes interpretations about the effectiveness of full-day programs.

Kindergarten Program Factors and Nonacademic Readiness Skills

Attendance in a full-day kindergarten program was negatively associated with attitudes toward learning, self-control, and interpersonal skills, and was positively related toward internalizing (measured by a scale indicating presence of anxiety, loneliness, low self-esteem, and sadness)

and externalizing behaviors. With the exception of class size (the effect of which was counterintuitive), few kindergarten program features were related to nonacademic readiness skills. Instead, positive home background factors, such as higher income and higher parental involvement with the school, were associated with all five dimensions of nonacademic school readiness skills; higher income and more parental involvement were positively related to a child's attitudes toward learning, self-control, and interpersonal skills and negatively predictive of internalizing and externalizing actions.

Study Limitations

This study did not control for a number of variables. For example, this study did not attempt to address potential self-selection bias, where parents with certain characteristics are more likely to choose full-day kindergarten programs. The theoretical direction of the bias could reflect either positive or negative selection, although there is some evidence that suggests that lower-income parents are more likely to enroll their children in full-day programs. Regardless of the direction of the bias, future studies should consider statistical methods that control for self-selection.

A second limitation of our study concerns potential aggregation bias stemming from the school-level measures of kindergarten program characteristics. Due to computational limitations, we could not estimate a three-level model (i.e., students nested within teachers nested within schools), and instead we conducted a two-level model (i.e., children nested in schools). Additional research on whether teacher-level measures of kindergarten program characteristics would offer different interpretations is warranted.

Implications

Our analyses reinforce the findings of earlier studies that suggest that full-day kindergarten programs may not enhance achievement in the long term. Furthermore, our study raises the possibility that full-day kindergarten programs may actually be detrimental to mathematics performance and nonacademic readiness skills. However, these findings should be interpreted carefully because we have not accounted for potential self-selection bias or other nonobservable factors. It is possible that some of our findings are driven by unobserved characteristics.

Our results also suggest that investments in the development of nonacademic school readiness skills may not only raise overall achievement but may also narrow the achievement gap between minority and white students. Indeed, on average, white students enter kindergarten with better nonacademic skills than do blacks and Hispanics. Our findings indicate that racial/ethnic differences in achievement might be narrowed if we could enhance the nonacademic readiness skills of minority students, particularly black students, at an early age. Current full-day kindergarten programs do not affect nonacademic skills, but perhaps redesigned early education programs could improve nonacademic skills that ultimately translate into improved academic achievement.

Ultimately, the decision regarding where policymakers should direct funds needs to be guided by a cost-benefit analysis that compares investments in full-day kindergarten programs to investments in other potential interventions, such as those that promote nonacademic readi-

ness skills. While full-day kindergarten programs have been shown to have some initial positive effects on student achievement, it is unknown whether the apparent lack of enduring benefits merits the costs associated with their implementation. A program of research that involves a better understanding of how full-day programs and nonacademic skills may influence outcomes and the associated costs of each type of intervention would provide a strong foundation for future decisions about effective programs.

Acknowledgments

We are grateful to our sponsors, the Rockefeller and Ford Foundations, for their support and their patience with the project. We are grateful to several RAND colleagues who provided useful comments on an earlier draft of the report, including Sue Bodilly and Laura Hamilton. In particular, we owe special thanks to Richard Buddin and Jill Cannon, our reviewers, whose insightful and critical comments substantially improved the substance and clarity of this monograph. We appreciate their patience and their helpfulness as we went through several iterations of the report. All remaining errors are our own.

Introduction

In light of the trend toward high-stakes testing and other accountability demands, policymakers are focusing on the early childhood years as a crucial step in developing the competencies that form the basis of future academic success. In particular, there has been increased attention on ensuring that children enter school “ready to learn.” While there is little consensus on the specific skills and knowledge that constitute school readiness, many educators, researchers, and policymakers adopt a broad perspective that extends beyond literacy and cognitive skills. The standards put forth by the National Education Goals Panel, for example, define five dimensions of school readiness: (1) physical well-being and motor development; (2) social and emotional development; (3) approaches to learning (e.g., curiosity, persistence, and other dispositions towards learning); (4) language development; and (5) cognition and general knowledge (Kagan, Moore, and Bredekamp, 1995).

Despite the attention and focus on school readiness, recent research shows that large skill gaps exist even before children enter kindergarten. For example, minority children on average come to kindergarten with lower literacy skills and poorer social development than do white students (Stipek and Ryan, 1997; Zill, 1999). This is a serious concern because the skills and knowledge that children have upon entering school is predictive of later achievement (Alexander, Entwisle, and Dauber, 1993). Phillips, Crouse, and Ralph (1998) report that the achievement gap widens over time, and that half of the achievement gap between blacks and whites at the end of twelfth grade is attributable to achievement differences between students when they started school.

In an attempt to address the differences in the school readiness of certain groups of children, some policymakers advocate the provision of full-day kindergarten. Proponents of full-day kindergarten argue that these extended programs allow for greater individualization and self-directed activities (Clark and Kirk, 2000; Elicker and Mathur, 1997; Morrow et al., 1998) and can serve as a means of improving school readiness at first grade and beyond. However, critics point out that full-day programs require significant additional resources, in particular, additional teachers and classroom space, which must be redirected from other programs, and that the long-term benefits of full-day kindergarten are uncertain. In addition, some question the developmental ability of young children to focus and learn for extended periods of time (Lee et al., 2006; Plucker et al., 2004).

This study uses data from the Early Childhood Longitudinal Study, Kindergarten Class of 1998–1999 (ECLS-K) to examine how children’s skills and knowledge at kindergarten

entry predict their achievement in later grades. It extends previous research by examining longer-term achievement outcomes, namely test scores at the end of fifth grade, and how other areas of development beyond cognitive and literacy skills may be related to test performance. It also examines how school program factors are related to achievement and school readiness, focusing in particular on the nonacademic aspects of school readiness (i.e., physical, social, and emotional development). The ECLS-K is a longitudinal study of a nationally representative sample of 21,260 entering kindergarten students in 1998–1999; the grade 5 follow-up was recently released in May 2006. The study provides extensive information on the social, cognitive, and health outcomes of children at the beginning of kindergarten, as well as at several points during children's elementary school years. Parents, teachers, and school administrators were interviewed about community resources, and about family and school environments. Specifically, teachers were asked to rate the children's school readiness, and children were administered a psychomotor assessment to evaluate fine and gross motor skills at the time of entry into kindergarten.

Because of the richness and breadth of its data collection and its longitudinal nature, the ECLS-K is particularly well suited for addressing the two main research questions underlying this study:

1. What is the relationship between children's school readiness skills at kindergarten entry and reading and mathematics achievement through the fifth grade?
2. What kindergarten program factors predict the development of nonacademic school readiness skills? In particular, is attendance at a full-day program related to non-academic school readiness?

The remainder of this chapter presents a literature review of previous work on non-academic school readiness indicators and their relationship to student outcomes and the impact of full-day versus half-day kindergarten on student achievement and readiness skills.

Literature Review

This review begins with an attempt to expound on school readiness, with a focus on non-academic measures of school readiness. It then examines the literature on measures of school readiness and their association with student achievement. Because full-day kindergarten has been advanced as a way of bridging the wide gap that exists in the readiness to learn of some groups of children, we take a careful look at what previous studies have shown regarding the immediate and longer-run effects of full-day kindergarten on the cognitive and nonacademic skills of children.

School Readiness and Student Achievement

In this study, we adopt a broad definition of school readiness that encompasses both “readiness to learn” and “readiness for school.” According to the North Central Regional Educational Laboratory, readiness to learn “involves a level of development at which the child has the capacity to learn specific materials” and readiness for school “involves a specific set of cognitive, linguistic, social, and motor skills that enables a child to assimilate the school’s curriculum.”¹ That is, school readiness entails skills that allow children to participate in the school curriculum (May et al., 1994).

While the significance of early cognitive skills to school readiness is self-evident, it is also important to understand the role that physical and socio-emotional development has in preparing children for school. Young children learn through physical exploration of their environments (Cassidy and Shaver, 1999; Smith and Pederson, 1988), and lags in the development of age-appropriate gross and fine motor skills (e.g., being able to run and skip or hold a pencil) can hinder their learning opportunities (Poest et al., 1990; Brown, 1982; Seefeldt, 1980). Analogously, children who enter school with difficulties paying attention, controlling disruptive behaviors, or forming social relations with peers tend to be less engaged in the classroom, and exhibit more disciplinary problems (Arnold et al., 1999; McClelland, Morrison, and Holmes, 2000). The importance of nonacademic behaviors to school success may explain why a poll of public-school kindergarten teachers nationwide indicated that good physical health, sociability (e.g., taking turns and sharing), and enthusiasm for learning were more important readiness skills than were knowledge of letters and numbers (Heaviside and Farris, 1993). For example, only 10 percent of teachers indicated that entering kindergarten students should recognize the alphabet, whereas 76 percent indicated that students should be curious in their approach to new activities (Lewitt and Baker, 1995).

The relationship between early cognitive readiness and long-term achievement has been well established (Alexander, Entwisle, and Dauber, 1993; Phillips, Crouse, and Ralph, 1998), but less is known about the associations between the nonacademic dimensions of school readiness and longer-term outcomes. There is, however, evidence that physical development, social skills, and problem behaviors are predictive of academic achievement, at least in the short term. Agostin and Bain (1997) reported that cooperation and self-control measured at the end of kindergarten predicted retention status and reading, mathematics, and language achievement at the end of first grade. They also found that a measure of fine motor skills could be used to effectively discriminate among children who were retained, promoted, or needed to be placed in an intensive-assistance classroom. These findings were similar to those reported by McClelland, Morrison, and Holmes (2000), who found cooperation and self-control predicted variance in academic outcomes for kindergarten through second-grade students. Likewise, Ladd, Birch, and Buhs (1999) found that kindergartners’ class participation (e.g., following classroom rules and complying with the teachers’ requests) was associated with higher achievement at kindergarten; and Kwon (2005) reported socio-emotional competence to be a major protective factor moderating socio-demographic risk factors in kindergarten and first-grade students.

¹ See <http://www.ncrel.org/sdrs/areas/issues/students/earlyclde/ea700.htm>.

The exact means by which nonacademic readiness skills might affect academic outcomes has not been well researched, although a handful of studies suggest some potential pathways. Valeski and Stipek (2001), for example, propose and test a model whereby social competence is linked to the quality of teacher-child relationships that, in turn, help predict academic achievement. A pathway study by Normandeau (1998) confirmed another model whereby pro-social behaviors influenced academic achievement by means of cognitive self-control. Continuing to explicate these relationships seems to be a fruitful area for further research, although that is beyond the scope of this study.

Racial/Ethnic Gaps in School Readiness Skills

Researchers have hypothesized that some of the racial/ethnic gaps in achievement may stem from differences in the school readiness skills of minority students and whites upon kindergarten entry. Many studies have reported that black and Hispanic students, on average, demonstrate significantly lower cognitive skills at school entry than white students (Jencks and Phillips 1998). Lee and Burkam (2002) found that upon kindergarten entry, on average, whites scored 21 percent higher than blacks and 19 percent higher than Hispanics on a measure of mathematics achievement. Whites also scored better on reading assessments (Duncan and Magnuson, 2005) and on measures of vocabulary development (Brooks-Gunn et al., 2003) upon arrival at school.

Although racial/ethnic differences on nonacademic readiness skills have been less publicized, many studies report inequities in that area as well. Zill (1999) reports that one in six children has a difficult entry into school, including difficulty following directions and working independently. Minority children make up a disproportionate percentage of this group. Similarly, Chase-Lansdale et al. (1997) reported that whites were less likely than blacks to exhibit internalizing (e.g., loneliness or anxiety) or externalizing (e.g., acting out or impulsivity) behaviors upon school entry. In a survey of 3,500 kindergarten teachers nationwide, Rimm-Kaufman, Pianta, and Cox (2000) found that teachers rated Hispanic and black students as having more difficulty working in groups than did white students. They also found that teachers teaching in schools with a high proportion of minority students were much more likely to report substantial behavioral and transition-to-school problems than were teachers in schools with low proportions of minorities. Taken together, the findings paint a portrait of minority students who, on average, enter kindergarten at a disadvantage, not only in academics, but also on the nonacademic dimensions of school readiness.

Development of Nonacademic School Readiness Skills

A number of authors have suggested that family background and home environment are the dominant determinants of children's nonacademic skill development. Feinstein (2000) finds that, while nonacademic skills are not a proxy for family background and demographics, they seem to serve as a "channel" for them—accounting for nonacademic skills in a model of edu-

cational attainment often reduces the impact of family background variables. Furthermore, Feinstein finds that parental interest (or lack of it) is more important in explaining acquisition of nonacademic readiness skills than are schooling variables. Heckman, Stizrud, and Orzua (2006) find significant gaps in nonacademic skills for children at different levels of income as early as age four. These gaps largely disappear when controls for maternal education, maternal scores on the Armed Forces Qualification Test, and single versus two-parent households are introduced, indicating that early childhood home environment is a major contributor to non-academic readiness skills.

Research also indicates that experiences in settings outside the home can also play a significant part in the development of nonacademic readiness skills. Heckman et al. (2006) (see also Heckman, 2006) cites the Perry Preschool program as providing suggestive evidence of the potential that early interventions can have on nonacademic behaviors. The evaluation of the Perry Preschool program used an experimental random assignment design and featured long-term follow-up of the participants. While the Perry preschoolers did experience a short-term bump in IQ scores, both the control and treatment groups had equivalent IQ scores by the age of 10. The Perry Preschool children, however, were more likely to graduate on time from high school, less likely to be placed in special education, and less likely to engage in delinquent behavior. Heckman et al. argues that achievement effects cannot account for the full range of these effects because academic gains had diminished by age 10. Instead, they assert that the more persistent effects indicate the Perry Preschool program must operate through important but unmeasured nonacademic skills that the program helped to foster.

Overall, the research indicates that nonacademic skills in the early years of life appear to be important in predicting achievement and other academic outcomes (e.g., special services or graduation).

The Case for Full-Day Kindergarten

With an increasing number of children entering kindergarten without the cognitive, motivational, or social maturity necessary for school (Pianta, 2002; West, Denton, and Reaney, 2000), educators and policymakers are pushing for the implementation of full-day kindergarten programs. Full-day kindergarten is seen as a way to help level the playing field for disadvantaged children with much lower levels of school readiness and to reduce the chance that they will be retained in grade (also expressed in this monograph as grade retention) (National Association of Early Childhood Specialists in State Departments of Education, 2000). Advocates argue that half-day programs do not allow enough time to both prepare children for first grade and attain goals for kindergarten (Porch, 2002), and that the additional time available in full-day programs can be used to promote both achievement and development of academic and nonacademic readiness skills.

There is some support for the claim that full-day programs allow for more instructional time, although such increased time does not add up to a “double dosage.” Nationally representative survey data show full-day kindergarten programs are more likely than half-day programs to offer more than 60 minutes of reading instruction and more than 30 minutes

of math instruction daily, and to include reading aloud every day (Walston and West, 2004). This translates to full-day students receiving 30 percent more instructional time in reading and 46 percent more instructional time in math than half-day students. In total, full-day children spend approximately 15 minutes of additional daily instruction in each subject (Lee et al., 2006). Children in full-day programs, however, also spend more time in self-directed activities that purportedly are related to long-term learning—57 minutes on average compared with 32 minutes for students in half-day kindergarten (Walston and West, 2004).

Whether participation in a full-day program is associated with improved outcomes has been the focus of intense inquiry. Definitive conclusions, however, have been stymied by studies with small sample size, lack of statistical controls, potential self-selection bias, and other methodological weaknesses (Lee et al., 2006; Cryan et al., 1992; Ackerman et al., 2005; Plucker et al., 2004; Long Beach Unified School District, 2000). Additionally, most studies report on outcomes at the end of the kindergarten year or at the end of first grade. While such proximal differences may be important, some have argued that the longer-term effect of full-day kindergarten should be of more concern to policymakers in determining how to distribute scarce resources. Finally, there is no consistent definition of full-day kindergarten, and little research that explicates the nature, features, or structure of particular programs. As a result, generalizations about full-day versus half-day programs must be made with caution.

Effect of Full-Day Kindergarten on Student Achievement

The existing literature on the effects of full-day kindergarten on student achievement finds positive outcomes in the proximal years but little difference as children progress through school. Cryan et al. (1992) and Weiss and Offenber (2002) utilized longitudinal data on large samples of kindergarten students in their evaluations of full-day kindergarten programs. Cryan et al. (1992) analyzed data on 8,290 students in 27 Ohio school districts and found a positive relationship between participation in full-day kindergarten and school success through first grade, as measured by grade retention, special education placements, standardized test scores, and teacher rankings. Weiss and Offenber (2002) tracked 17,563 students in Philadelphia schools through fourth grade and concluded that full-day kindergarten students were less likely to be retained and had better attendance and higher standardized test scores. However, both studies examined the end-status of students rather than their growth, as neither accounted for initial achievement levels going into kindergarten or controlled for other covariates. Elicker and Mathur (1997) used random assignment in their study of 179 students in 12 full- and half-day kindergarten, and found that full-day students had higher kindergarten report card grades and were rated higher on first-grade readiness by parents and teachers.

The most recent research on the effects of full-day kindergarten has focused on analyses of data from the ECLS-K study of a nationally representative sample of more than 21,000 students who attended full-day and half-day kindergarten in 1998–1999. Kaplan (2002) found significantly greater linear growth through the end of first grade for full-day kindergarten students, after controlling for age and socioeconomic status. Lee et al. (2006) reported a significant positive effect of full-day kindergarten on student achievement at the end of kindergarten,

a finding supported by Walston and West (2004) and Walston, West, and Rathbun (2005). However, Rathbun and West (2004) and Walston, West, and Rathbun (2005) examined subsequent waves and concluded that these effects did not persist into third grade.

Cannon, Jacknowitz, and Painter's (2006) analysis supports both these findings; they noted a positive achievement effect of full-day kindergarten through the end of kindergarten, but also found that the effect was reduced by half at the end of first grade and eliminated by the end of third grade. The authors also report no significant relationship between full-day kindergarten attendance and grade retention through third grade. They attempted to control for potential selection bias by using fixed effects models and instrumental variables; the findings remained relatively robust across different models.

Effects on Disadvantaged Students

One issue of particular interest has been whether full-day kindergarten can help level the playing field for students from disadvantaged backgrounds (Clark and Kirk, 2000; Entwistle et al., 1987; Evansville-Vanderburgh School Corporation, 1988; Karweit, 1987; Morrow, Strickland, and Woo, 1998; Nieman and Gastright, 1981; Slaughter and Powers, 1983). Kaplan (2002) found that the effect of full-day kindergarten was greatest for children who demonstrated particularly slow reading development; among normal- and fast-developing readers, there was little difference between those who attended full- and half-day kindergarten. Walston, West, and Rathbun (2005) report stronger positive full-day kindergarten effects for students from non-English speaking households and for Hispanic students, although they did not find differential effects for poverty or for other racial/ethnic groups. Cannon, Jacknowitz, and Painter (2006) found effect sizes for poor children that were equivalent to or smaller than effect sizes for non-poor children, and conclude that economically disadvantaged students do not receive extra benefits from full-day kindergarten. Lee et al. (2006) also report no differential effects of full-day kindergarten by socioeconomic background, and highly inconsistent differential effects by race/ethnicity.

Effects on School Readiness and Associated Nonacademic Outcomes

As with student achievement, the literature is mixed with respect to the effect of full-day kindergarten on school readiness and nonacademic outcomes. Elicker and Mathur (1997) observed children in full-day and half-day kindergarten programs in one school for two years and reported that, compared with children in half-day programs, children in full-day programs (a) spent more time in self-directed activities and teacher-directed individual work; (b) scored higher on end-of-year kindergarten report cards; and (c) were ranked by teachers as being at higher levels of first-grade readiness. Children in full-day programs also displayed a higher level of engagement in their activities and more positive affects (emotional displays) than their peers in half-day programs, and this difference was particularly evident in the second year. A statewide longitudinal study reported that, along with higher school performance (at least

through first grade), children in full-day programs tended to be more involved and showed more originality and independent learning than did their counterparts in half-day kindergarten programs (Cryan et al., 1992). However, other studies have failed to find significant differences in social outcomes. For example, Hough and Bryde (1996) compared teacher ratings of over 500 kindergartners and found little difference between full-day and half-day attendees in terms of focus on tasks, cooperative work and play, or showing respect for rules. Similar results were reported by West, Denton, and Reaney (2001), who used ECLS-K data to examine skills such as accepting peer ideas, making friends, and comforting others.

Purpose of This Report

The evidence reviewed above suggests that early competencies lay the foundation for future academic success. However, in a recent national poll, nearly 50 percent of kindergarten teachers indicated that a significant proportion of entering kindergartners were ill-prepared for school (Mason-Dixon Polling and Research, 2004). Given this, understanding the conditions and experiences of children as they enter school is critical to improving children's outcomes in subsequent years. This report helps fill some of the information gap by examining how school readiness and attendance in full-day kindergarten contribute to later outcomes, and by exploring the features of kindergarten programs that can help to promote school readiness in later grades.

Organization of This Report

The report is organized into several chapters. The second chapter presents a brief overview of the ECLS-K database; describes the measures of school readiness skills, program characteristics, and home background used in our study; and provides details of the analytic methods we used to investigate the associations among mathematics and reading achievement, programmatic factors, and readiness skills. Chapter Three presents the descriptive statistics of the measures used in this study. Chapter Four presents the results of the models used to examine the relationship (a) between school readiness skills at kindergarten entry and achievement; and (b) between type of kindergarten program and readiness skills. Chapter Five presents conclusions and policy implications. Appendixes A and B provide supporting tables for the analyses.

Data and Methodology

This study analyzes data from the Early Childhood Longitudinal Study, Kindergarten Class of 1998–1999 (ECLS-K) to address the two research questions noted in Chapter One:

1. What is the relationship between children’s school readiness skills at kindergarten entry and reading and mathematics achievement through the fifth grade?
2. What kindergarten program factors predict the development of nonacademic school readiness skills? In particular, is attendance at a full-day program related to nonacademic school readiness?

The ECLS-K is a longitudinal study of a nationally representative sample of 21,260 entering kindergarten students in 1998–1999. The study provides extensive information on the social, cognitive, and health outcomes of children at the beginning of kindergarten, as well as at several points during children’s elementary school years. The study also collects information from students’ parents, teachers, and school administrators about community resources and family and school environments.

This chapter describes the methodology used to analyze the ECLS-K database. It starts with an overview of the ECLS-K study, focusing on its sampling design, data collection procedures, and sample size for our targeted population. It then provides information about the derivation of the measures used in this study, focusing in particular on the measures of school readiness. It concludes with the analytic procedures used to investigate the associations among mathematics and reading achievement, programmatic factors, and school readiness.

Multistage Sampling Design

The ECLS-K study, sponsored by the National Center for Education Statistics (NCES), consists of a comprehensive set of data collected from multiple sources at the beginning of kindergarten in order to better understand what skills and knowledge children bring to kindergarten, and to determine what explains differences among children in their level of skills and knowledge as they progress through school. To date, the study has collected information through the end of fifth grade. Our analysis examined data from the public-use version of the ECLS-K K–5 Longitudinal Electronic Files and Codebook (NCES, 2006).

The sampling plan called for a multistage stratified design in which there were three primary sampling units. The first sampling unit was geographic region, where data from the national census was used to construct the frame in which counties (or group of counties) were selected. Regions with larger populations and larger concentrations of Asian/Pacific Islanders (API) were selected with greater probability. It was necessary to oversample API children in order to obtain accurate estimates for this subpopulation.

The second sampling unit represented the selection of public and private schools. For public schools, schools were ranked by size, and then divided into three groups of roughly equal aggregate size. Within each of these three groups, schools were sorted by proportion of APIs to facilitate oversampling of these children. Private schools were grouped by affiliation (religious or nonsectarian), then sorted by size. Both public and private schools were chosen with probability of selection proportional to total size.

The third sampling unit entailed the selection of students. Within each school, two sampling strata were generated, one for API students and one for the general student population. The target sample for each school was typically 24 children, with API children selected at 2.5 times the rate of non-API children. After the sampling of students, study coordinators notified teachers, school administrators, and parents to obtain consent for teacher and administrator surveys, parent interviews, and child assessment. More information about the sampling design can be found in the ECLS-K Base Year Public-Use Data Files and Electronic Codebook (NCES, 2001).

Data Collection

Nationally, representative information was collected from the full sample of children, parents, teachers, and administrators during five waves of data collection: fall of kindergarten, spring of kindergarten, first grade, third grade, and fifth grade.¹ Information about children's development, early learning experiences, and learning contexts were collected through a variety of instruments. Table 2.1 provides a sample of topics collected from the broader range of information assessed. More details about each instrument are described in the following sections.

Direct Assessment of Children

Upon entry into kindergarten, children completed a psychomotor assessment to evaluate fine and gross motor skills. Fine motor skills require the coordination of small muscle movements, whereas gross motor skills require the coordination of large muscle movements. To assess fine motor skills, children were asked to draw pictures, copy shapes onto paper, and use building blocks to replicate models. Children demonstrated their gross motor skills through such tasks as skipping, walking backwards, and standing or hopping on one foot (see NCES, 2001 for more information). Measures of children's psychomotor skills were obtained only during the initial wave of data collection (i.e., fall kindergarten).

¹ Data collection on 30 percent of the sample was conducted during the fall of first grade.

Table 2.1
Description of Data Collection Instruments

Data Collection Instrument	Provides information About:
Direct assessment of children	Cognitive outcomes, including language and literacy and mathematical thinking Psychomotor abilities, including fine motor and gross motor skills
Parent interviews	Family demographics Parental involvement Childcare arrangements Child's extracurricular activities
Teacher survey	Teaching experience Teaching practices Class size Availability of activity centers Child's academic and nonacademic readiness skills Classroom readiness skills
School administrator survey	School-level demographics Type of kindergarten

Children's cognitive outcomes were assessed at every wave of data collection. Children were assessed in mathematics, reading, and general knowledge during kindergarten and first grade, and in mathematics, reading, and science during third and fifth grades. The same set of achievement tests were used in kindergarten and first grade, but the tests were changed to reflect appropriate grade-level content in later years.

In kindergarten and first grade, children were administered a screening test to ensure they had sufficient understanding of English to respond to the full battery of cognitive tests. This practice was discontinued in later waves because nearly all children demonstrated sufficient English proficiency. During the kindergarten and first grade assessments, children received a routing test to determine the subsequent test form they should take. In mathematics and reading, there were three forms, reflecting low, medium, and high difficulty levels. Children received one of the three test forms with the difficulty level reflecting their performance on the routing test.

Item Response Theory (IRT) was used to create a scale score for each of the achievement tests. IRT makes it possible to compare performance on forms of different difficulty levels and facilitates a longitudinal scale score across grades. The scores reflect children's achievement gains as they progress through school.

Parent Interviews

Parents were interviewed at each stage of the data collection. They were asked to provide information about family income, their involvement with the school, previous childcare arrangements, and their child's engagement in extracurricular activities. They also indicated whether the child had learning problems or had received therapy services prior to entering kindergarten. In addition, parents indicated whether the age at which their child entered kindergarten was earlier, later, or the same as the age established by school guidelines for kindergarten enrollment.

Teacher Surveys

Information about children's outcomes was also obtained through teacher surveys. Teachers were asked to report on targeted children's numerical and literacy skills, as well as on their non-academic readiness skills, such as sociability and problem behaviors. Teachers also reported on children's full-day kindergarten attendance. In addition to reporting on child outcomes, teachers provided information about their teaching experience, class size, and teaching practices. Information about children's outcomes and school program features was collected during all five waves. Teachers also reported about classroom context factors, including the availability of activity centers (such as reading areas) and the school readiness of the class as a whole. This latter information was obtained only during kindergarten.

From kindergarten through third grade, the survey did not collect separate teacher information for mathematics and reading because one teacher was typically responsible for teaching both subjects. However, fifth grade mathematics and reading may be taught by different teachers (as within departmentalized middle schools) so the fifth-grade data collection efforts obtained separate teacher information about mathematics and reading.

School Administrator Surveys

School administrators were asked to indicate the type of kindergarten program they offered (e.g., public versus private). They also completed surveys about school-level demographics, including the percentage of minority students in the school and percentage of students who were eligible for free or reduced-price lunches. This information was used to understand the learning contexts of students.

Sample Size of Targeted Population

The targeted population for our study was first-time kindergartners in 1998–1999 whose English language proficiency was sufficient to take the full battery of cognitive tests. We also limited the study to children who did not switch from a full-time kindergarten program to a part-time program (or vice versa) and who had parent interview data present for all five waves of data collection (and were consequently assigned a non-zero weight). This resulted in an unweighted sample of 7,897 children, who represented approximately 3,622,024 children nationwide. White children constituted the majority of the population, followed by Hispanics, blacks, Asian/Pacific Islanders, and “other race” students. “Other race” consisted of students who were Native American, Alaskan native, or of multiple races.

Table 2.2 shows the sample size for participating teachers and schools across the five waves. Between 2,500 and 3,500 teachers responded to the surveys, and between 900 and 1,500 schools participated.

Table 2.2
Sample Size for Participating Teachers and Schools

Survey Respondents	Wave 1 (Fall K)	Wave 2 (Spring K)	Wave 3 (Spring 1st)	Wave 4 (Spring 3rd)	Wave 5 (Spring 5th)
Teachers	2,449	2,447	3,086	3,428	3,495 (reading) 3,484 (mathematics)
Schools	896	941	1,199	1,530	1,517

NOTE: K = kindergarten; 1st, 3rd, and 5th = grades 1, 3, and 5, respectively.

Measures Used in the Analysis

School Readiness Measures

Teachers' evaluations of children's numerical and literacy skills served as indicators of their cognitive readiness for school. These measures, which we labeled Numerical Skills and Literacy Skills, represented teachers' assessments as to whether the children were proficient in these areas. Children were evaluated on a five-point scale, where 1 = "not yet proficient," 3 = "in progress," and 5 = "proficient."

The other dimensions of school readiness encompass the social, emotional, and physical development of children. These scales, obtained from the ECLS-K database, include the following (NCES, 2001, pp. 2–16):

- The *Approaches to Learning Scale* measures behaviors that affect the ease with which children can benefit from the learning environment. It includes six items that rate the child's attentiveness, task persistence, eagerness to learn, learning independence, flexibility, and organization.
- The *Self-Control Scale* has four items that indicate the child's ability to control behavior by respecting the property rights of others, controlling temper, accepting peer ideas for group activities, and responding appropriately to pressure from peers.
- The five *Interpersonal Skills* items rate the child's skill in forming and maintaining friendships; getting along with people who are different; comforting or helping other children; expressing feelings, ideas, and opinions in positive ways; and showing sensitivity to the feelings of others
- *Externalizing Problem Behaviors* includes acting-out behaviors. Five items on this scale rate the frequency with which a child argues, fights, gets angry, acts impulsively, and disturbs ongoing activities.
- The *Internalizing Problem Behavior Scale* asks about the apparent presence of anxiety, loneliness, low self-esteem, and sadness. This scale is made up of four items.

Each of these nonacademic readiness dimensions was rated on a four-point metric, where higher scores denote that children possess more of those skills or traits. For example, a score of 4 on the Externalizing Problem Behaviors scale indicates that the child tends to act out, whereas a score of 1 indicates that the child rarely acts impulsively.

School Program Characteristics

We also included several variables relating to teaching practices, class size, teaching experience, and adequacy of facilities. We chose these school program factors because they have been shown to be related to student achievement (see e.g., Stipek et al. [1995] for teaching practices; Ferguson [1991] for class size; and Greenwald, Hedges, and Laine [1996] for teaching experience). We focused on the following teaching practice variables:

- *Child-Selected* assesses the number of hours per day during which children were allowed to select their own instructional activities.
- *Whole-Class* consists of teachers' reports of the hours per day that teacher-directed instruction takes place in a whole-class setting.
- *Individual Activities* measures the number of hours per day of teacher-directed individual activities.
- *Small-Group* measures the number of hours per day teachers report spending in teacher-directed small-group instruction.

These variables were originally on a five-point scale, where 1 represented "no time," 3 represented "about one hour," and 5 represented "three hours or more." We converted these variables from fixed categories to hours per day, using the heading descriptors as a guide. For instance, a teacher response of "5" for a particular instructional practice was converted to three hours.

In addition, we included the following program characteristics:

- *Class Size* represents the number of students in the class.
- *Experience at Grade* indicates the total number of years teachers taught at the grade level in question.
- *Activity Centers* indicates the number of interest areas or activity centers (e.g., art area or reading area with books) available in the kindergarten.

Class Size and Experience at Grade were continuously scored variables for which the teacher's response represents the score on that measure. Values on the Activity Center scale ranged from 0 to 11.

Classroom and School Context Factors

We also constructed other classroom- and school-level demographic variables to provide a context for children's learning experiences. At kindergarten, teachers indicated the proportion of students in the class who could recognize letters, read words, and read sentences. In addition, they rated the general behavior of the class. We used these variables as aggregate measures of peers' school readiness behaviors and included them in the models to capture potential peer effects.

In addition, we included other school-level variables, such as the proportion of the student population who were minorities or eligible for free- or reduced-price lunches. At kindergarten, we measured whether the school was a public or private school, and whether it was a regular

type of kindergarten.² We also obtained information about school urbanicity (i.e., suburban, rural, or city) as well as the geographic region from which the schools were drawn (i.e., Northeast, West, South, and Midwest). It is important to include information about geographic location because there is tremendous regional variability in the provision of full-day kindergarten. According to Ackerman, Barnett, and Robin (2005), only nine states currently require districts to offer a full-day program, and eight of these nine states are in the South, where 80 percent of public schools provide full-day kindergarten. Only a third of schools in the West and Northeast provide full-day programs, and about 57 percent of schools in the Midwest do so (Ackerman, Barnett, and Robin, 2005).

Child-Level Covariates

Although school readiness measures and school program factors are the key independent variables in our study, we were also interested in how child-level factors, particularly home background variables, relate to the development of nonacademic school readiness skills. We included several variables that were likely to be correlated with children's mathematics and reading achievement.

- *Extracurricular Activities* is a five-item scale that assesses the number of out-of-school activities the student participated in. These include activities such as dance, music, or clubs.
- *Parent Involvement* is a six-item scale measuring parents' involvement with their child's school. Items asked about whether the parent attended school events, such as open houses or parent-teacher conferences.
- *Income* is a measure of the family's annual income.
- *Full Day* assesses whether the child attended a part- or full-time kindergarten program. Because 6 percent of kindergartens have both full-day and part-time programs, we consider full-day attendance to be a child-level characteristic. Additionally, we did not make a distinction between morning and afternoon part-time programs because preliminary analyses showed no differences between the two program types.
- *Center Care* is a measure of whether the child received care from a center or school-based preschool program prior to entering kindergarten.
- *Early Entry and Delayed Entry* are measures of whether the age at which the child entered kindergarten was earlier or later than the school guidelines for kindergarten enrollment, respectively.
- *Disability* indicates whether the child was diagnosed with a learning disability or had received therapy services for a disability prior to entering kindergarten.

The creation of the Parental Involvement and Extracurricular Activities scales posed a challenge because of the longitudinal nature of the study. Extracurricular activities or parental

² A regular kindergarten is a one-year program intended to serve five-year-old children. Two-year programs, programs with multiple grades or those that are ungraded, and transitional programs (i.e., intended for children who are not ready for first grade) are excluded from the regular kindergarten designation.

behaviors that are developmentally appropriate at kindergarten (e.g., reading to the child) may not be considered developmentally appropriate by fifth grade. In creating these scales, we chose items that were relevant across the different grade levels.

We considered scales relating to extracurricular activities, parental involvement, and income as home background factors, and the remainder of the child-level variables as demographic variables. All of the child demographic variables were dichotomously scored—that is, a score of 1 denoted the presence or existence of the construct measured by that variable, and a score of 0 indicated an absence of that construct. Income was initially on a 13-point categorical scale, but we converted the variable from fixed categories to yearly wages using the heading descriptors as a guide. (This process is analogous to the conversion process for the teaching practice variables.) Items that make up the extracurricular activities and parental involvement scales are provided in Appendix A.

Analytic Approach

Weights

While the sampling design allows for a nationally representative sample for targeted populations, the complexity of the design also calls for the use of weights in analysis. Weights are needed to account for stratification, oversampling of API students, and nonresponse at both the school and child level. Weights are also necessary to draw inferences about the prevalence or distributions of certain characteristics within the national population. Thus, both the descriptive statistics for the child-level variables and the analysis use weights.³

Multiple Imputation

Approximately 63 percent of the sample had test scores, demographic records, and teacher- and school-level information across the five waves of data collection. However, limiting the analysis to complete records does not capitalize on important information contained in partially complete records. Furthermore, there can be systematic differences between individuals with complete data and individuals with incomplete data. Indeed, there is evidence that the patterns of missing data are not random, as students who have non-missing test score data perform significantly better on the observed achievement scores than do students who have missing test scores on two or more waves. Thus, we decided to use a multiple imputation technique to account for missing data, in which each missing value was replaced with a random sample of plausible values.

For time-invariant child-level variables (e.g., gender), the imputation occurred at the level of the student. For time-varying variables (e.g., parental involvement), we imputed at the level of student by year, using all observed data in a multivariate normal model as a basis for predicting missing values. Analogous imputation processes were conducted for missing school-

³ This is the C1_6FP0 weight for interested readers familiar with the ECLS data. The C1_6FP0 weight is used for longitudinal analysis of the full sample of children up to fifth grade, and is defined to be non-zero for children with parent information at each wave.

level variables. Dichotomous variables were treated as continuous in the imputation process, and then rounded back to dichotomous variables for analysis. We imputed 10 sets of plausible values, and then synthesized the results in a manner that accounted for the uncertainty due to the missing information (see Schafer, 1997).

Although data was collected during fall and spring of kindergarten, some variables were measured only during the second wave (i.e., spring of kindergarten). For these variables (i.e., parental involvement, extracurricular activities, income, percent minority students, and percent of students eligible for free- or reduced-price lunches), we did not impute missing values, but instead used values collected during spring of kindergarten. That is, we assumed that there would be little change in responses between fall and spring on these particular variables.

Model Details

Because many students change schools over time as they progress from kindergarten to fifth grade, traditional HLM methods designed for nested data structures are not appropriate. Instead, we conducted a longitudinal, cross-classified analysis in which students' outcomes over the five time points were modeled in relation to their kindergarten program characteristics, classroom and school context factors, school readiness skills at kindergarten entry, and other covariates. For the i^{th} student in the j^{th} school at time point t , we define X_{ijt} as the time-varying student-level predictor variables (e.g., home background factors), W_{ij} as the time-invariant student-level predictors (e.g., gender), Z_j as the student's school-level predictor (e.g., percent minority), and Y_{ijt} as the outcome of interest (i.e., student's mathematics achievement, reading achievement, or score on each of the five dimensions of nonacademic school readiness). We include both random and fixed effects for school- and student-level variables in our models.⁴ We fit models of the form:

$$Y_{ijt} = \alpha_{ij} + \delta X_{ijt} + \varepsilon_{ijt} \quad (1)$$

$$\alpha_{ij} = \mu_j + \lambda W_{ij} + \zeta_{ij} \quad (2)$$

$$\mu_j = \theta + \gamma Z_j + \omega_j \quad (3)$$

where ε_{ijt} , ζ_{ij} , and ω_j are random errors assumed to be normally distributed with mean θ and different standard deviations. Equation (1) estimates, for each i^{th} student, the relationship between the time-varying student-level predictors and the outcome of interest. The effect of the time-varying student-level predictors, indicated by the parameter δ , is assumed to be the same

⁴ In preliminary models, the variance components of several random variables were estimated to be zero. We subsequently declared these variables as fixed instead of random (see Searle, Casella, and McCulloch, 1992, for estimation of mixed models when variance components are zero or non-positive).

across all students. However, the average outcome score, represented by the intercept α_{ij} of the i^{th} student in the j^{th} school, is allowed to vary across students. The random error ε_{ijt} describes the variability within student outcomes across waves. Equation (2) models the intercept α_{ij} as a function of the time-invariant student-level predictors W_{ij} . The parameter λ estimates the effects of the time-invariant student-level predictors, and is assumed to be constant from one school to the next. The term ζ_{ij} describes the variability of children's outcomes within the same school.

Because of the hierarchical structure of the data, we will also assume that the average student-level intercept α_{ij} differs from one school to another. The parameter μ_j indicated in Equation (3), captures this school-level variability, and is assumed to be correlated with the school-level variables Z_{ij} . In Equation (3), the parameter γ quantifies the effects of the school-level variables on the outcome measure, Y_{ijt} ,⁵ and θ estimates the overall average outcome. The random errors ζ_{ij} and ω_i account for the variability between students and between schools, respectively.

We conducted two separate models to address the research questions, with the difference in the models arising in how we treated school program factors. To address the first research question (i.e., the relationships between student achievement and school readiness skills), it was necessary to treat school program factors (i.e., teaching practice, class size, and experience) as time varying. This is because student achievement is likely to be influenced by both past as well as contemporaneous school program characteristics. In contrast, the second research question concerning the relationships between school readiness skills and kindergarten program factors necessitates that the kindergarten program factors be treated as time invariant.

Another challenge in addressing the second research question related to the creation of a measure of kindergarten program factors. Because data were collected twice during kindergarten, we needed to aggregate data across the two waves in order to create an overall measure of kindergarten program. However, if teachers' responses were vastly different across the two waves, then aggregation could be masking important variation. To explore the consistency of teachers' responses across the two waves of data collection, we examined correlations among responses. The correlation coefficients for responses across the first two waves ranged from .55 to .76; given these moderate-to-high correlations, we felt justified in our decision to average responses across waves.

We then explored a measure of program factors that aggregated across teacher responses within the same schools. Again, this can potentially obscure important variation because teachers within the same school can have different teaching practices, class size, and experience. To understand the extent to which teachers within the same schools provide similar responses, we examined the intraclass correlations. This was done separately for part-day and full-day teachers at kindergarten. Although there are no definitive guidelines on how a large intraclass correlation should be before one can conclude that teachers are providing homogenous responses, we used a criterion of .18 because Singer (1998) suggests that this figure represents a "fair bit of

⁵ Time and age at assessment were highly correlated ($r = .96$). Thus, we used age at assessment as a proxy for time in the models.

clustering” (p. 338). For the following, we present results obtained during kindergarten entry, but note that intraclass correlations for other waves were generally comparable.

Class size was very consistent across classrooms ($r = .85$ for full-day and $r = .76$ for part-day), whereas teaching experience was less so ($r = .10$ for both full-day and part-day teachers). There was also a fair amount of clustering of teaching practices within schools, with the intraclass correlations ranging from $.25$ to $.31$ for full-day teachers, and $.27$ to $.28$ for part-day teachers. These intraclass correlations suggest that teachers in the same schools provide moderately similar responses, and that school-level composites can be reasonably created. Thus we created school-level composites for the teaching practice, class size, and teaching experience variables. For the 6 percent of kindergarten schools that offered both full-day and part-day programs, we created two school-level measures of instruction corresponding to the type of kindergarten program.

Descriptive Statistics for the Variables Used in This Analysis

This chapter presents the descriptive statistics for the measures used in our study: mathematics and reading achievement; school readiness skills, focusing in particular on the nonacademic skills that emphasize social, emotional, and physical development; and school program factors, school context variables, and home background measures. We also discuss racial/ethnic differences in test scores and nonacademic school readiness skills.

Academic Achievement

Table 3.1 presents the means and standard deviations for the mathematics and reading test scores for the five waves: fall kindergarten, spring kindergarten, spring first grade, spring third grade, spring fifth grade. There is a systematic increase in students' performance as they pro-

Table 3.1
Descriptive Statistics: Mathematics and Reading Test Scores

Scale scores	Mean	Standard Deviation	Minimum	Maximum
Mathematics				
Fall kindergarten (Wave 1)	22.59	8.70	7.49	86.54
Spring kindergarten (Wave 2)	32.86	11.41	8.73	104.18
Spring 1st grade (Wave 3)	57.39	16.39	10.92	120.50
Spring 3rd grade (Wave 4)	91.61	21.37	33.19	146.59
Spring 5th grade (Wave 5)	112.76	21.44	47.00	150.94
Reading				
Fall kindergarten (Wave 1)	28.71	9.76	14.85	124.28
Spring kindergarten (Wave 2)	40.29	13.48	16.25	138.49
Spring 1st grade (Wave 3)	71.33	22.34	19.25	163.12
Spring 3rd grade (Wave 4)	117.23	25.53	45.71	178.92
Spring 5th grade (Wave 5)	138.29	23.15	59.87	181.22

gress through the grades. Students show an average increase of approximately 90 points from beginning of kindergarten to end of fifth grade in mathematics, and an average gain of nearly 110 points in reading.

School Readiness Skills at Kindergarten Entry

The descriptive statistics for the variables used in the analysis for the continuous measures of academic and nonacademic readiness skills are shown in Table 3.2. In terms of numerical and literacy skills upon entering school, teachers rated the average child as beginning to acquire proficiency. Children entered kindergarten with relatively high levels of attitudes toward learning, self-control, and interpersonal skills. They scored an average of approximately 3 (out of a maximum score of 4) on these dimensions. Similarly, children tended to start school with few internalizing and externalizing problems. Children also tended to demonstrate a reasonably high level of fine and gross motor skills, and scored relatively better on the assessment of gross motor skill than on the assessment of fine motor skills.

Classroom and School Context

Table 3.3 presents some descriptive statistics for the classroom and school context. Approximately 50 percent of children could recognize letters, but few could read words (10 percent), and even fewer could read sentences (3 percent). Teachers rated classroom behavior as average, meaning that children tended to misbehave occasionally.

With respect to school context factors, approximately 9 percent of the children were eligible for reduced-price lunches, and another 36 percent were eligible for free lunches. Minority students comprised, on average, 40 percent of a school population. For the home background variables, the average family income was approximately \$56,000, and the average child was

Table 3.2
Descriptive Statistics: School Readiness Skills at Kindergarten Entry

Scale	Mean	Standard Deviation	Minimum	Maximum
Academic school readiness				
Numerical skills	2.55	.81	1.00	5.00
Literacy skills	2.51	.73	1.00	4.93
Nonacademic school readiness				
Approaches to learning	3.00	.67	1.00	4.00
Self-control	3.10	.62	1.00	4.00
Interpersonal skills	2.99	.63	1.00	4.00
Externalizing problem behaviors	1.61	.64	1.00	4.00
Internalizing problem behavior	1.52	.51	1.00	4.00
Fine motor skills	5.77	2.04	.00	9.00
Gross motor skills	6.33	1.87	.00	8.00

Table 3.3
Descriptive Statistics: Academic School Readiness Skills, Classroom and School Context, and Home Background Measures at Kindergarten Entry

Scale	Mean	Standard Deviation	Minimum	Maximum
Classroom context				
Percent recognizing letters	48.90	25.85	.00	100
Percent reading words	10.38	11.64	.00	94.73
Percent reading sentences	3.38	5.92	.00	57.04
Class behavior	3.46	.59	1.00	5.00
School context factors				
Percent minority ^a	40.37	31.14	.00	100
Percent reduced-price lunch ^a	8.51	6.49	.00	32.50
Percent free lunch ^a	35.95	28.57	.00	100
Home background/student characteristics				
Income ^a	\$55,935	\$37,290	\$0.00	\$150,000
Age at assessment (months)	68.30	4.11	54.00	79.00
Extracurricular activities ^a	1.03	1.01	.00	5.00
Parent involvement ^a	3.97	1.49	.00	6.00

^a Indicates information was collected during spring kindergarten.

NOTE: Includes imputed values.

assessed when he or she was a little more than 5 years old. Children tended not to participate in extracurricular activities during kindergarten, and parents were moderately involved with the schools.

Table 3.4 presents descriptive statistics for the dichotomous variables—the percentages of schools or students with the selected characteristics. Nearly 95 percent of kindergarten programs were classified as a regular type. Geographically, kindergarten programs are most frequently located in cities and in the South. Approximately half the students were enrolled in a full-day kindergarten program and 78 percent received care in a center prior to entering kindergarten. Additionally, few children were classified with a learning disability, and few children started kindergarten earlier or later than the school guidelines for enrollment.

Table 3.4
Percentage of Students or Schools with Selected
Characteristics at Kindergarten Entry

Characteristics	Percentage
School context factors	
Regular kindergarten type	94
Public	78
West	25
South	31
Northeast	19
Midwest	25
Urban	37
Rural	21
Central city	42
Student characteristics	
Disability	2
Attending a full-day kindergarten	53
Center care	78
Delayed entry	7
Early entry	1

NOTE: Includes imputed values.

Table 3.5 provides the school program factors, delineated by full-day and part-day kindergarten program. As noted by Lee et al. (2006), instructional activities occur more often in full-day programs, but they do not represent a “double dosage.” The patterns of instructional practices were the same across full-day and part-day programs. In both types of programs, child-selected and teacher-directed individual activities were practiced less than one hour per day while small group activities and whole class instruction took place more than one hour per day. The average kindergarten class size was about 20 students, and teachers had on average 8 to 9 years of teaching experience at kindergarten. Additionally, most kindergartens had numerous activity centers (e.g., reading area, sand boxes, etc.), with an average score of 9 (out of a maximum score of 11).

Table 3.5
Characteristics of School Program Factors at Kindergarten Entry

Scale	Full-Day Kindergarten				Part-Day Kindergarten			
	Mean	Std.	Min.	Max.	Mean	Std.	Min.	Max.
Child-selected	.98	.42	.00	3.00	.74	.34	.00	2.00
Whole class	1.91	.66	.50	3.00	1.40	.55	.50	3.00
Individual activities	.77	.35	.00	3.00	.58	.256	.00	2.17
Small group	1.22	.53	.25	3.00	.96	.45	.00	3.00
Class size	20.61	4.43	9.50	30.00	19.66	4.20	9.50	30.00
Experience at grade	8.26	4.91	1.00	30.00	9.02	5.50	1.00	30.00
Activity centers	9.16	1.58	1.00	11.00	9.19	1.49	3.00	11.00

NOTE: Includes imputed values.

We now turn to an examination of racial/ethnic differences in test score performance and in school readiness.

Racial/Ethnic Differences

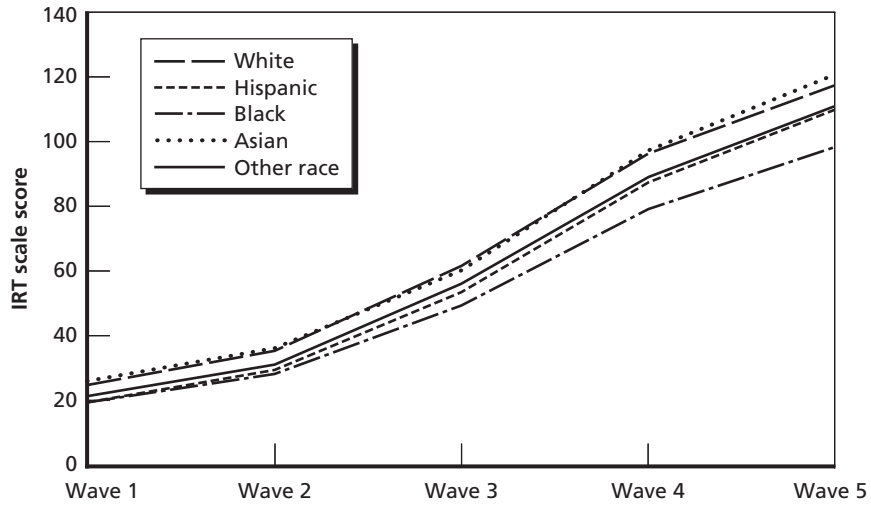
Academic Achievement

Figures 3.1 and 3.2 provide the mathematics and reading distributions for the different ethnic groups, respectively. On average, white and Asian students enter kindergarten with the highest scores in both subjects, whereas Hispanic and black students demonstrate the lowest achievement scores. The achievement gaps in mathematics and reading become more pronounced over time, with white and Asian students scoring approximately three-fourths of a standard deviation higher than Hispanics and nearly one standard deviation higher than blacks by the end of fifth grade. The finding that achievement differences between minorities and whites upon kindergarten entry increases in later years has been well documented in the literature (Coley, 2002; Rouse, Brooks-Gunn, and McLanahan, 2005; West, Denton, and Reaney, 2001).

Nonacademic School Readiness Skills at Kindergarten Entry

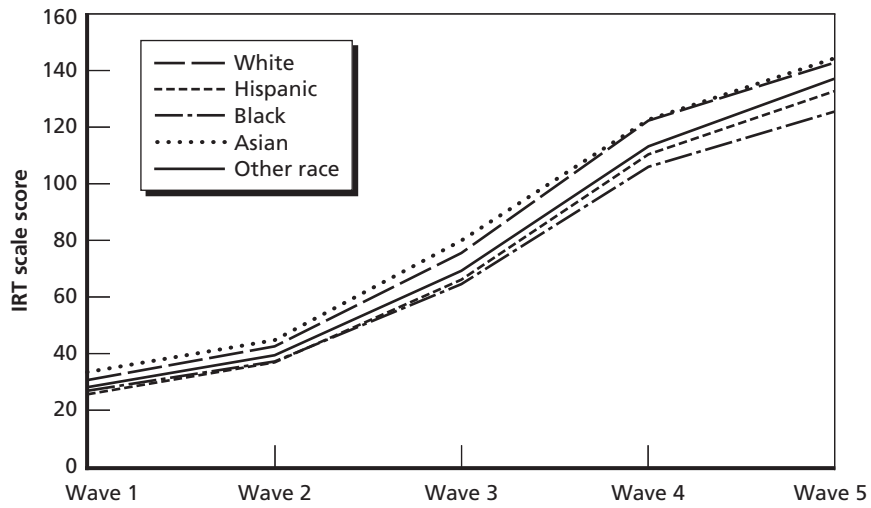
Figures 3.3 through 3.7 provide the distribution for the nonacademic socio-emotional indicators of school readiness skills at kindergarten entry, as reported by teachers. (Descriptive statistics for the other waves are presented in Appendix B.) Figures 3.8 and 3.9 present the distributions for children's performance on standardized assessments of fine motor and gross motor skills, respectively.

Figure 3.1
Distribution of Mathematics Achievement by Race/Ethnicity, Fall Kindergarten to Spring 5th Grade



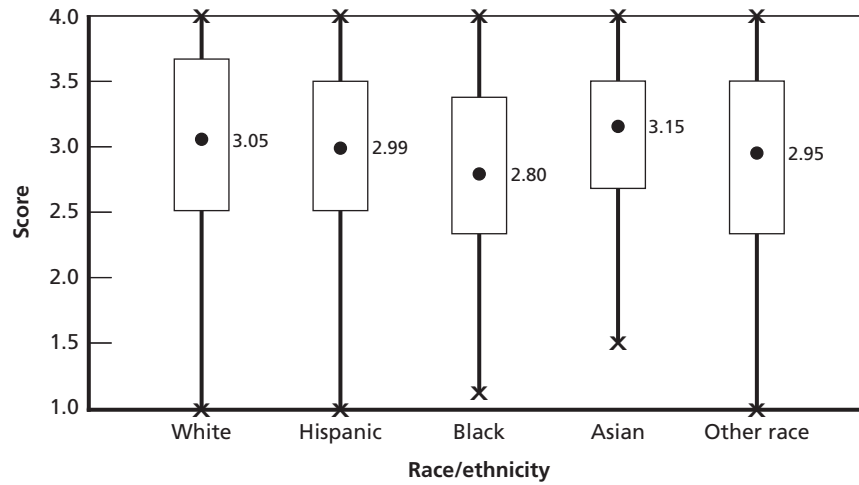
RAND MG558-3.1

Figure 3.2
Distribution of Reading Achievement by Race/Ethnicity, Fall Kindergarten to Spring 5th Grade



RAND MG558-3.2

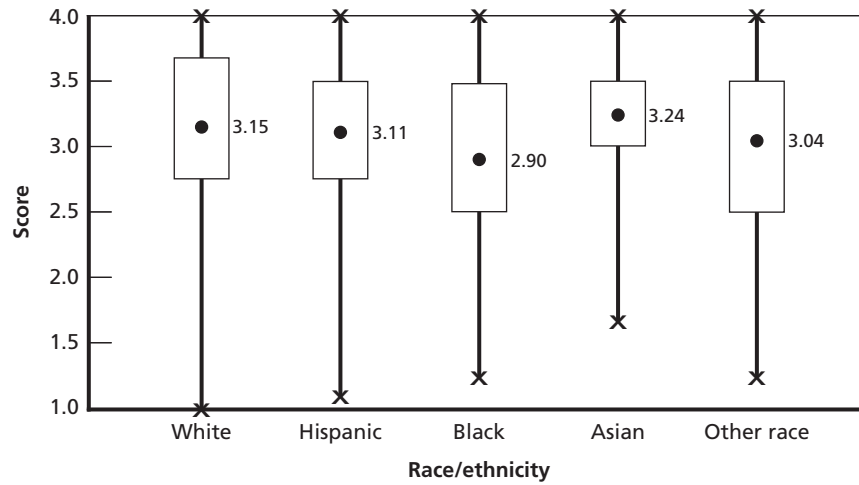
Figure 3.3
Distribution of Teachers' Reports of Approaches to Learning by Race/Ethnicity



NOTE: Box-and-whisker plot shows mean score (dot), 25th to 75th percentile range (rectangle or box), and minimum and maximum points (X).

RAND MG558-3.3

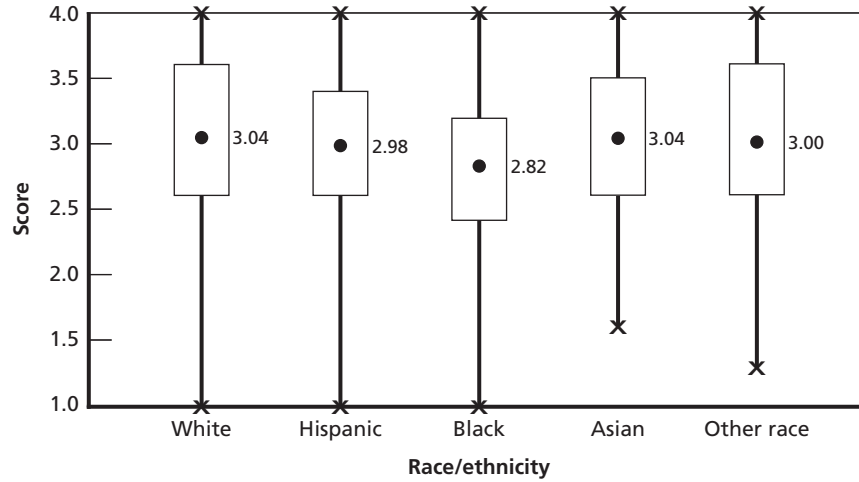
Figure 3.4
Distribution of Teachers' Reports of Self-Control by Race/Ethnicity



NOTE: Box-and-whisker plot shows mean score (dot), 25th to 75th percentile range (rectangle or box), and minimum and maximum points (X).

RAND MG558-3.4

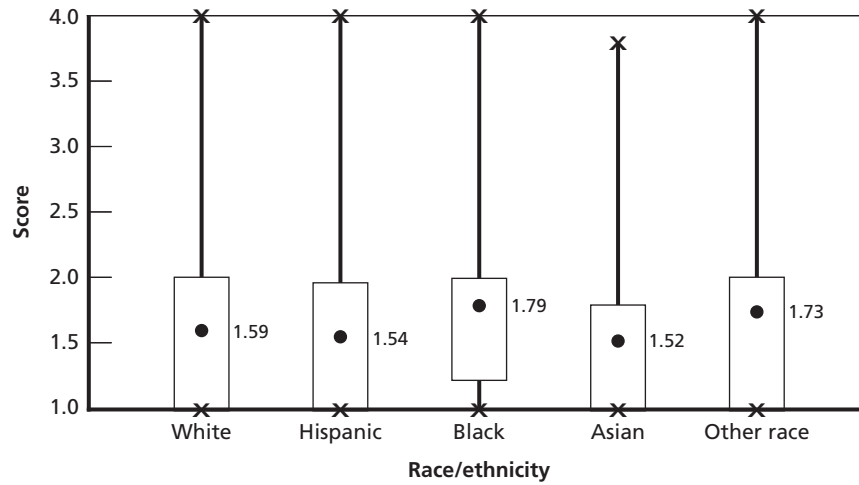
Figure 3.5
Distribution of Teachers' Reports of Interpersonal Skills by Race/Ethnicity



NOTE: Box-and-whisker plot shows mean score (dot), 25th to 75th percentile range (rectangle or box), and minimum and maximum points (X).

RAND MG558-3.5

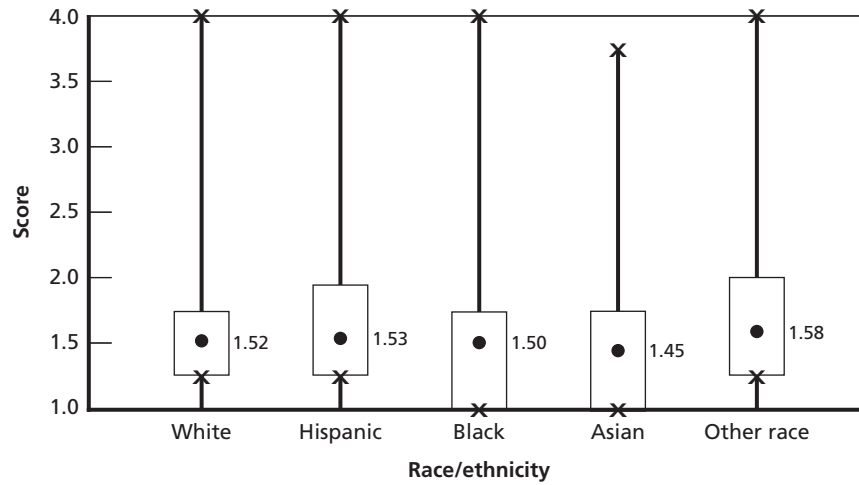
Figure 3.6
Distribution of Teachers' Reports of Externalizing Behaviors by Race/Ethnicity



NOTE: Box-and-whisker plot shows mean score (dot), 25th to 75th percentile range (rectangle or box), and minimum and maximum points (X).

RAND MG558-3.6

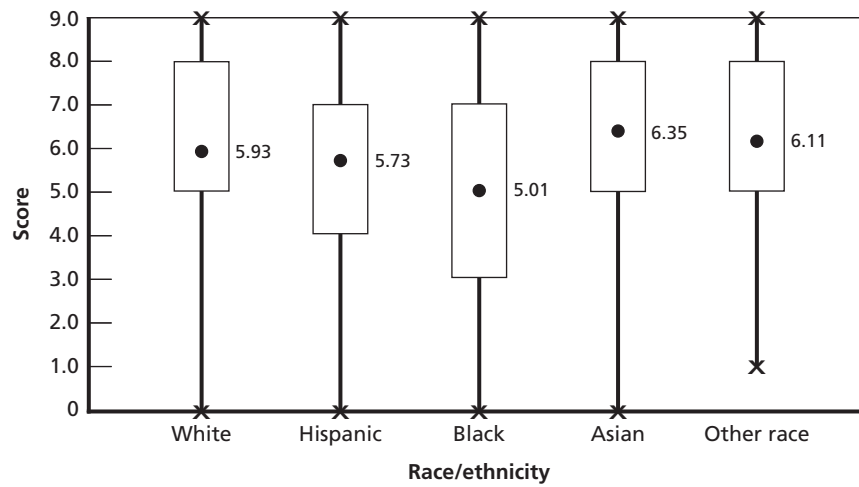
Figure 3.7
Distribution of Teachers' Reports of Internalizing Behaviors by Race/Ethnicity



NOTE: Box-and-whisker plot shows mean score (dot), 25th to 75th percentile range (rectangle or box), and minimum and maximum points (X).

RAND MG558-3.7

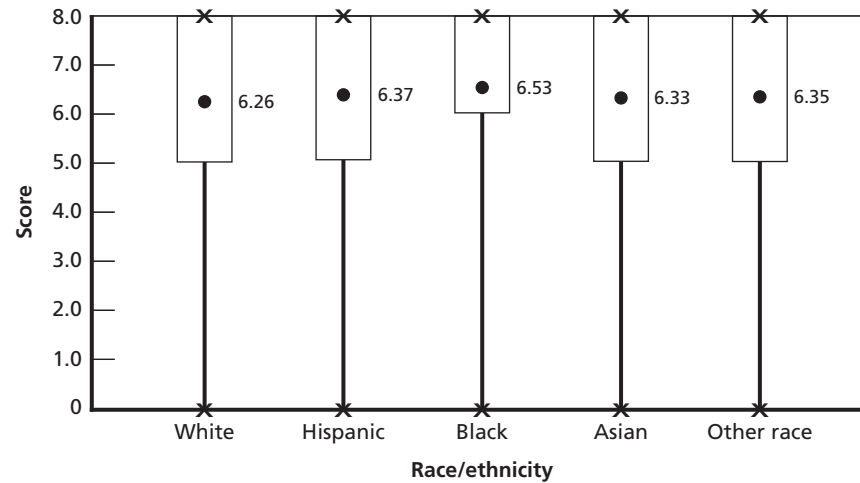
Figure 3.8
Distribution of Fine Motor Skills by Race/Ethnicity



NOTE: Box-and-whisker plot shows mean score (dot), 25th to 75th percentile range (rectangle or box), and minimum and maximum points (X).

RAND MG558-3.8

Figure 3.9.
Distribution of Gross Motor Skills by Race/Ethnicity



NOTE: Box-and-whisker plot shows mean score (dot), 25th to 75th percentile range (rectangle or box), and minimum and maximum points (X).

RAND MG558-3.9

An examination of the distributions for socio-emotional readiness skills also shows racial/ethnic differences between groups, although variation is much larger within groups than between groups (see Figures 3.3 through 3.9).¹ Teachers evaluated white and Asian students as having, on average, the highest levels of socio-emotional readiness skills upon kindergarten entry. On average, whites and Asians received the highest scores on dispositions toward learning, self-control, and interpersonal skills. Asians were also more likely to exhibit low incidences of internalizing behaviors (measured by a scale indicating presence of anxiety, loneliness, low self-esteem, and sadness) and externalizing behaviors (measured by a scale indicating acting-out behaviors such as getting angry, arguing, fighting, etc.). Teachers rated black students as having, on average, the poorest interpersonal skills, attitudes toward learning, and self-control. On average, black students also rated most poorly on externalizing behaviors. That blacks were less likely to be socially and emotionally prepared than whites for school is consistent with other studies (Chase-Lansdale et al., 1997).

With respect to fine motor skills, on average, Asians and other race students performed best, and blacks performed poorest. On tests of gross motor skills, blacks tended to perform best, and white students tended to perform poorest. However, it is important to note that students of all ethnic groups tended to perform well on gross motor skills, with the average score being 6.33 (out of a maximum score of 8).

¹ Statistical tests (either t-tests or ANOVA, where applicable) indicated that average racial/ethnic differences were significant at the .01 level.

Estimation Results: School Program Characteristics, Student Achievement, and School Readiness Skills

This chapter presents the estimation results from our cross-classified models of student achievement and school readiness skills, and school readiness skills and kindergarten program factors. In particular, we focus on nonacademic readiness skills that incorporate dimensions of physical, social, and emotional development. We also examine associations of outcomes with attendance in a full-day program.

Variance Decomposition Analysis

To investigate the relationships among school program factors, achievement from kindergarten through fifth grade, and nonacademic school readiness skills, we examined how much of the differences in student achievement and nonacademic school readiness scores could possibly be associated with differences among school program features. Mathematically, we can separate and compare the differences (“variation”) in student scores within a given school and the differences (variation) in scores between different schools. The latter provides an upper bound on the size of any overall effects that might be due to school program characteristics (e.g., teaching practices, class size, and teacher experience). Figures 4.1–4.2 provide the variance decomposition analysis for mathematics and reading achievement in which variation is broken down into within-school, between-school, and within-child between-wave variation. Because teachers’ reports across the dimensions of nonacademic readiness skills were very similar, we show only the variance decomposition analysis for teachers’ reports of approaches to learning in Figure 4.3.

Figure 4.1
Variance Decomposition for Mathematics Achievement

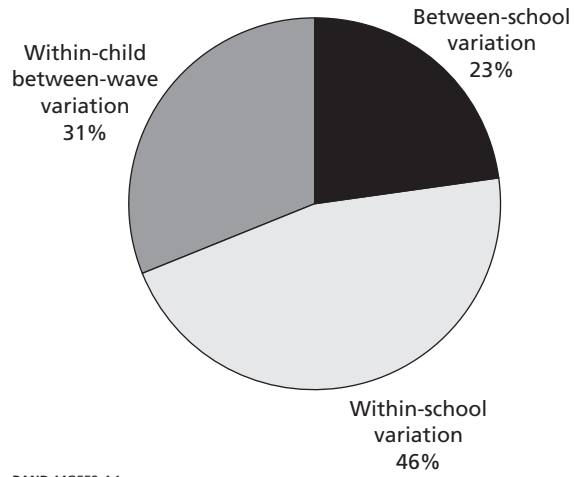


Figure 4.2.
Variance Decomposition for Reading Achievement

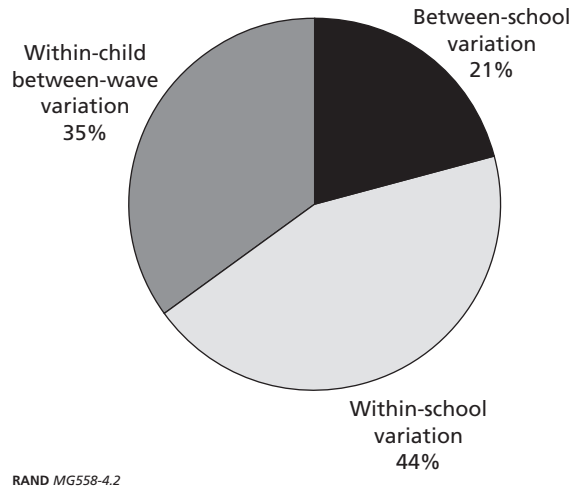
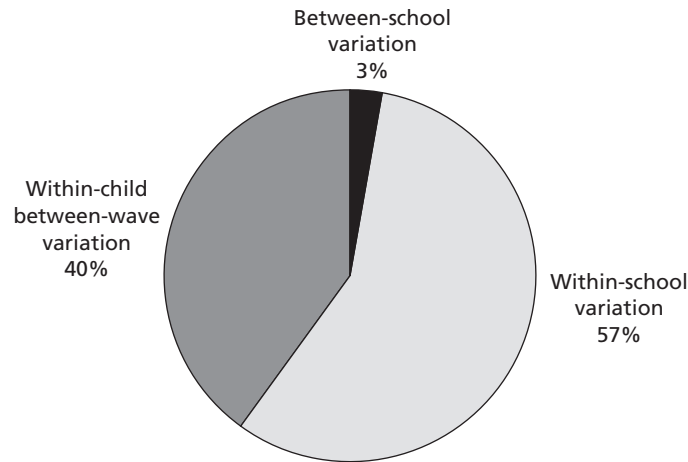


Figure 4.3
Variance Decomposition for Approaches to Learning



RAND MG558-4.3

Across the three figures, it is clear that most of the variation in test score is attributable to within-school variation (indicated by the light gray shading) and between-wave variation (indicated by the dark gray shading). That leaves a moderate proportion that is attributable to between-school variation (indicated by the black areas) for achievement scores, and a very small proportion for the nonacademic school readiness skills. In fact, the within-school variation is 19 times as large as the between-school variation for the nonacademic school readiness skills. These findings suggest that kindergarten program characteristics cannot explain more than a small fraction of the variance in the nonacademic school readiness skills.

Mathematics Achievement from Kindergarten Through Fifth Grade

Table 4.1 provides the regression coefficients for the mathematics achievement model from kindergarten through fifth grade. Here we model the achievement trajectory as a function of time-varying school program factors as well as time-varying school context factors and home background variables. The table provides two sets of results, one in which nonacademic school readiness skills are included in the models, and one in which the nonacademic indicators are excluded. This allows us to explore whether nonacademic school readiness skills affect interpretations.

Table 4.1.
Coefficients for Mathematics Achievement Through Spring Fifth Grade

Scale	Estimate	Std. Error	Estimate	Std. Error
Intercept	-170.522	3.462 **	-162.585	3.045 **
School program characteristics				
Child-selected	-0.463	0.350	-0.211	0.337
Whole class	1.583	0.148 **	1.715	0.176 **
Individual activities	0.679	0.305 *	0.716	0.300 *
Small group	0.886	0.144 **	0.938	0.145 **
Class size	0.084	0.024 **	0.101	0.023 **
Experience at grade	-0.079	0.015 **	-0.061	0.025 *
Activity centers	0.369	0.142 **	0.304	0.199
Classroom context factors				
Percent recognizing letters	0.020	0.010	0.020	0.013
Percent reading words	-0.007	0.028	-0.020	0.034
Percent reading sentences	0.084	0.054	0.092	0.059
Class behavior	0.649	0.413	0.571	0.477
School context factors				
Regular kindergarten	-0.121	0.988	0.395	1.209
Public	-2.278	0.563 **	-2.899	0.650 **
West	-0.479	0.597	-0.526	0.735
Northeast	-0.687	0.591	-1.358	0.771
Midwest	-2.263	0.586 **	-2.309	0.822 *
City	-0.015	0.470	-0.600	0.539
Rural	-2.141	0.558 **	-3.016	0.669 **
Percent minority	0.012	0.007	0.014	0.008
Percent reduced-price lunch	0.014	0.034	0.010	0.023
Percent free lunch	-0.025	0.006 **	-0.029	0.005 **
School readiness at kindergarten entry				
Approaches to learning	3.891	0.353 **		
Self-control	-1.090	0.422 *		
Interpersonal	-1.281	0.403 **		
Externalizing behaviors	-1.257	0.322 **		
Internalizing behaviors	-0.992	0.289 **		
Fine motor skills	1.432	0.079 **		
Gross motor skills	0.011	0.087		
Numerical skills	3.814	0.242 **	6.093	0.280 **
Home background				
Income	0.000	0.000 **	0.000	0.000 **
Parental involvement	0.153	0.065 *	0.158	0.062 *
Extracurricular activities	0.558	0.079 **	0.592	0.083 **

Table 4.1 (cont.)

Scale	Estimate	Std. Error		Estimate	Std. Error	
Student characteristics						
Age at assessment	2.968	0.031	**	2.913	0.029	**
Age at assessment squared	-0.008	0.000	**	-0.008	0.000	**
Disability	-2.142	1.402	*	-3.252	1.082	*
Hispanic	-3.028	0.452	**	-2.792	0.505	**
Asian	1.876	0.783	*	2.805	0.984	*
Black	-6.599	0.583	**	-7.939	0.641	**
Other Race	-3.182	0.781	**	-2.974	0.918	**
Male	3.523	0.270	**	2.312	0.253	**
Center care	-0.221	0.401		-0.162	0.506	
Delayed entry	-7.274	0.492	**	-6.709	0.518	**
Early entry	4.261	1.153	**	3.120	1.267	*
Full day	-0.885	0.437	*	-0.553	0.486	

NOTE: * indicates significance at .05; ** indicates significance at .01.

The regression coefficient for the independent variable is the difference in IRT scale score for a one-unit change in the independent variable.¹ For a dichotomous independent variable such as race, the coefficient represents the average mean difference between minorities and whites, holding all other variables constant. For example, a regression coefficient of -6.60 for black students indicates that black students score, on average, about 6.60 IRT scale points lower than white students, all else being equal. Similarly, the regression coefficient for the continuous independent variables represents the predicted difference in IRT scale score given a one-unit change in the independent variable. For instance, in the case of the approaches to learning indicator, a one-point difference on this scale represents a difference of approximately 3.89 IRT scale points.

Because our major interest in this study relates to the racial/ethnic gaps, nonacademic school readiness skills, full-day kindergarten participation, and school program factors, we view all other variables as covariates and limit our discussion to the variables of interest. As expected, numerical skills at kindergarten entry is a strong predictor of mathematics achievement. However, nonacademic school readiness skills are also important, as nonacademic school readiness skills explain approximately 16 percent of the between-child variation in mathemat-

¹ We present unstandardized regression coefficients, but the standardized regression coefficients can be computed by multiplying the unstandardized coefficient by the ratio of the standard deviation of the independent variable to the standard deviation of the dependent variable (Gardner, 2001).

ics.² With the exception of gross motor skills, all the included indicators of nonacademic school readiness were statistically significant, although not necessarily in the anticipated direction. Having higher numerical skills, more developed fine motor skills, and better attitudes toward learning were associated with higher mathematics scores. Conversely, more internalizing and externalizing behavioral problems were negatively associated with mathematics achievement. Unexpectedly, having better interpersonal skills and self-control at kindergarten entry were also negatively predictive of mathematics performance. At this point, we can only speculate on some of the reasons why this finding arises (e.g., kindergarten teachers may not have accurately assessed children on these two dimensions). However, it merits further investigation and replication.

The inclusion of nonacademic readiness skills does not appreciably change the coefficients associated with the different racial/ethnic groups. Racial/ethnic differences in mathematics achievement are evident, regardless of whether we control for nonacademic readiness skills. Results indicate that, on average, whites trail Asians in mathematics, but outperform blacks, Hispanics, and other-race students.

Variables that were significant in the analyses that controlled for nonacademic readiness skills remained significant in the analyses that excluded these indicators. However, there were two notable exceptions. The number of activity centers available in kindergarten was positively predictive of mathematics achievement when nonacademic readiness skills were included in the model, but was not significant when the nonacademic readiness variables were excluded. More noteworthy, attendance in a full-day kindergarten program was not significant in models that excluded nonacademic school readiness factors but was significant when these sets of variables were included. In other words, children who were enrolled in a full-day program at kindergarten showed poorer mathematics performance than did children enrolled in a part-day program. This finding raises the possibility that earlier studies may have failed to find relationships between full-day kindergarten and outcomes because they omitted important information relating to nonacademic dimensions of readiness. Future studies should explore whether the inclusion of such variables changes interpretations about the effectiveness of full-day programs.

With respect to school program factors, virtually all the teaching practices were significant. Instruction that emphasized whole-class and small-group teaching, as well as teacher-initiated individual activities, was positively related to mathematics achievement. Surprisingly, larger class size was also positively related to mathematics test scores, whereas teachers' teaching experience at the grade they were assigned was negatively related to mathematics performance. These latter findings are counterintuitive and merit more research, but may reflect purposive assignment practices to place more challenging students in smaller classrooms or with more qualified teachers.

² Following the methods in Singer (1998), this figure was obtained by examining the reduction in the residual term with and without the inclusion of nonacademic school readiness skills in the models.

Reading Achievement from Kindergarten Through Fifth Grade

Analogous results for reading achievement from kindergarten through fifth grade are presented in Table 4.2. As with mathematics, these models treat school program characteristics as time-varying. Both literacy skills and nonacademic readiness skills were related to reading performance. Collectively, the nonacademic readiness skills explained 6 percent of the between-child variation in reading scores, less than what was observed in mathematics. Interpersonal skills, internalizing and externalizing behaviors, and gross motor skills were negatively related

Table 4.2
Coefficients for Reading Achievement Through Spring Fifth Grade

Scale	Estimate	Std. Error		Estimate	Std. Error	
Intercept	-194.970	6.128	**	-199.198	3.738	**
School program characteristics						
Child-selected	-0.963	0.290	**	-0.935	0.305	**
Whole class	3.479	0.201	**	3.818	0.218	**
Individual activities	1.457	0.275	**	1.525	0.267	**
Small group	1.526	0.358	**	1.535	0.299	**
Class size	-0.019	0.028		-0.008	0.028	
Experience at grade	-0.040	0.025		-0.009	0.038	
Activity centers	0.275	0.232		0.325	0.222	
Classroom context factors						
Percent recognizing letters	0.040	0.017	*	0.058	0.015	**
Percent reading words	-0.106	0.040	**	-0.141	0.040	**
Percent reading sentences	0.256	0.070	**	0.325	0.074	**
Class behavior	0.622	0.603		0.792	0.592	
School context factors						
Regular kindergarten	-1.593	1.626		-2.124	2.101	
Public	-5.505	0.936	**	-5.611	0.926	**
West	2.237	0.974	*	1.771	1.140	
Northeast	1.057	0.981		0.426	1.050	
Midwest	-2.331	0.881	**	-3.169	0.918	**
City	-0.870	0.711		-1.611	0.745	*
Rural	-1.855	0.968		-3.831	1.010	**
Percent minority	0.007	0.011		-0.003	0.015	
Percent reduced-price lunch	-0.213	0.090	*	-0.133	0.107	
Percent free lunch	-0.024	0.014		-0.021	0.007	**
School readiness at kindergarten entry						
Approaches to learning	0.356	0.429				
Self-control	0.180	0.542				
Interpersonal	-1.480	0.456	**			

Table 4.2 (cont.)

Scale	Estimate	Std. Error		Estimate	Std. Error	
Externalizing behaviors	-1.510	0.376	**			
Internalizing behaviors	-0.225	0.346				
Fine motor skills	0.213	0.095	*			
Gross Motor skills	-0.344	0.099	**			
Literacy skills	7.754	0.328	**	7.917	0.257	**
Home background						
Income	0.000	0.000	**	0.000	0.000	**
Parental involvement	0.093	0.074		0.120	0.060	*
Extracurricular activities	0.508	0.103	**	0.449	0.083	**
Student characteristics						
Age at assessment	3.732	0.047	**	3.633	0.034	**
Age at assessment squared		0.000	**	-0.010	0.000	**
Disability	-2.448	1.142	*	-0.204	0.681	
Hispanic	-1.098	0.592		-1.434	0.678	
Asian	4.777	0.807	**	5.031	0.793	**
Black	-1.047	0.770		-1.587	0.673	*
Other Race	-0.748	0.873		-0.623	0.890	
Male	-1.222	0.322	**	-1.224	0.311	**
Center care	0.046	0.431		-0.044	0.411	
Delayed entry	-11.241	0.652	**	-11.219	0.680	**
Early entry	5.069	1.371	**	4.835	1.324	**
Full day	-0.803	0.669		-0.757	0.722	

NOTE: * indicates significance at .05; ** indicates significance at .01.

to reading performance, whereas fine motor skills were positively predictive of reading scores. Again, it is unclear why gross motor skills and interpersonal skills would be negatively related to reading achievement, but the finding deserves additional scrutiny.

Unlike in mathematics, the inclusion or exclusion of the nonacademic readiness skills in the models changed the significance of a number of variables, particularly those relating to parental involvement, disability status, and school context variables. Most notably, controlling for nonacademic readiness indicators changed interpretations about the black-white average reading achievement differences. There were significant differences, on average, between black and white students when nonacademic readiness skills were excluded from the model, but these differences were not significant once the nonacademic variables were included. This suggests that part of the differences in the black-white reading achievement gap is attributable to differences in their nonacademic readiness skills upon kindergarten entry. Hispanic reading scores are not significantly different from those of white students in either specification.

With respect to school program factors, class size, teaching experience, and attendance in a full-day program were not significant. However, all of the teaching practice variables were significant, with whole-class instruction, teacher-directed individual activities, and

small-group teaching showing positive relationships with reading scores, and child-selected activities showing negative associations with reading performance. It is possible that the latter finding is related to the developmental appropriateness of this practice. Namely, as students progressed through the years, there was a systematic decrease in the number of hours that teachers engaged in this practice. It may be the case that allowing children to choose their own instructional activities is an effective practice in kindergarten but becomes less effective as children grow older. Indeed, preliminary cross-sectional analyses suggest that this practice is positively signed with kindergarten achievement, but negatively signed with achievement at older grades. Additional research about the potentially differential effectiveness of teaching practices at different grade levels would shed more light on this finding.

Relationships Between Kindergarten Program Factors and Nonacademic School Readiness Skills Through Fifth Grade

The importance of nonacademic readiness skills to reading and mathematics achievement raises the question of what factors may promote nonacademic readiness skills. In the following models, we examine the features of kindergarten programs that may influence the development of nonacademic readiness skills. We focus on kindergarten program characteristics because developing various types of competencies early on has been shown to have enduring academic benefits (Belsky and MacKinnon, 1994).

We could not model the trajectory of fine or gross motor skills because these skills were measured only at kindergarten entry. Thus, we focus our attention on the five dimensions of nonacademic school readiness skills as reported by teachers. Although the general forms of the following regression models are similar to the ones presented in Tables 4.1 and 4.2, there are two notable exceptions. First, our focus on kindergarten program factors led us to average data across the first two waves in order to obtain a composite of kindergarten program characteristics. Second, we treated this composite of kindergarten program characteristics as time-invariant rather than time-varying. Other variables in the models (such as those relating to time-varying school context and home background variables) remained the same.

Because of our interest in understanding the kindergarten program characteristics and home background factors that are related to the development of nonacademic school readiness skills, much of our discussion focuses on those variables. As shown in Table 4.3, attendance in a full-day kindergarten program was negatively associated with the development of nonacademic school readiness skills. Namely, children who participated in full-day kindergarten demonstrated poorer dispositions toward learning, self-control, and interpersonal skills, and greater tendency to engage in externalizing and internalizing behaviors. This replicates the findings of Hildebrand (2001), who reported that children in part-day programs demonstrated better classroom behaviors that facilitate learning than did children in full-day programs. Another explanation is that we have not fully accounted for the great variability in the quality of the full-day programs in our data.

Consistent with the findings of the variance decomposition analysis, few of the kindergarten program factors were related to nonacademic school readiness skills. Of the kindergarten

Table 4.3
Coefficients for Nonacademic School Readiness Skills Through Fifth Grade

Scale	Approaches to Learning		Self-Control			Interpersonal Skills			Externalizing Behaviors		Internalizing Behaviors	
	Est.	Std. Err.	Est.	Std. Err.		Est.	Std. Err.		Est.	Std. Err.	Est.	Std. Err.
Intercept	2.216	0.097 **	2.473	0.092 **		2.036	0.096 **		1.402	0.089 **	1.332	0.081 **
Kindergarten program characteristics												
Child-Selected	-0.017	0.019	-0.024	0.018		-0.019	0.019		0.040	0.018 *	0.008	0.016
Whole-Class	0.010	0.012	0.017	0.012		0.013	0.012		-0.001	0.011	-0.009	0.010
Individual Activities	-0.032	0.025	-0.050	0.023 *		-0.018	0.024		0.057	0.023 *	0.023	0.020
Small-Group	0.012	0.015	0.016	0.014		0.022	0.015		-0.007	0.014	-0.020	0.012
Class Size	0.004	0.002 *	0.005	0.002 **		0.005	0.002 **		-0.007	0.002 **	-0.002	0.001
Experience at grade	0.002	0.001	0.000	0.001		0.000	0.001		-0.001	0.001	-0.002	0.001
Activity Centers	-0.010	0.004 *	0.001	0.004		-0.001	0.004		-0.001	0.004	0.009	0.004 *
Classroom Context Factors												
Percent recognize letters	0.000	0.000	0.000	0.000		0.000	0.000		0.000	0.000	0.000	0.000
Percent read words	0.000	0.001	0.001	0.001		0.000	0.001		0.000	0.001	0.001	0.001
Percent read sentences	-0.002	0.001	0.000	0.001		-0.001	0.001		-0.001	0.001	-0.001	0.001
Class behavior	0.022	0.011 *	0.056	0.010 **		0.045	0.011 **		-0.073	0.010 **	-0.004	0.009
School Context Factors												
Regular kindergarten	-0.023	0.029	0.014	0.027		-0.007	0.028		-0.003	0.027	0.016	0.023
Public	0.035	0.018	0.039	0.017 *		0.028	0.017		-0.023	0.016	-0.012	0.015
West	-0.029	0.019	-0.058	0.018 **		-0.069	0.018 **		0.072	0.017 **	0.022	0.015
Northeast	-0.022	0.018	-0.003	0.017		-0.022	0.018		-0.028	0.017	0.033	0.015 *

Table 4.3 (cont.)

Scale	Approaches to Learning		Self-Control			Interpersonal Skills			Externalizing Behaviors		Internalizing Behaviors		
	Est.	Std. Err.	Est.	Std. Err.		Est.	Std. Err.		Est.	Std. Err.	Est.	Std. Err.	
Midwest	-0.043	0.017 *	-0.050	0.016	**	-0.086	0.016	**	0.029	0.015	0.038	0.014	**
City	0.007	0.014	0.000	0.013		0.032	0.013	*	0.005	0.013	-0.023	0.011	*
Rural	-0.020	0.017	-0.019	0.016		-0.005	0.016		0.027	0.015	-0.043	0.014	**
Percent minority	0.000	0.000	0.000	0.000		0.000	0.000		-0.001	0.000 *	0.000	0.000	
Percent reduced-price lunch	0.002	0.001 **	0.002	0.001	**	0.004	0.001	**	-0.002	0.001 **	0.000	0.001	
Percent free lunch	0.000	0.000	-0.001	0.000	**	-0.001	0.000	**	0.000	0.000 **	0.000	0.000	
School Readiness													
Literacy skills	0.274	0.012 **	0.078	0.012	**	0.146	0.012	**	-0.049	0.012 **	-0.124	0.010	**
Numerical skills	0.070	0.011 **	0.049	0.010	**	0.041	0.010	**	-0.012	0.011	-0.009	0.008	
Home Background													
Income	0.000	0.000 **	0.000	0.000	**	0.000	0.000	**	-0.000	0.000 **	-0.000	0.000	**
Parental involvement	0.013	0.002 **	0.013	0.002	**	0.022	0.002	**	-0.007	0.002 **	-0.009	0.002	**
Extracurricular activities	0.007	0.003 *	0.000	0.003		0.001	0.003		-0.001	0.003	-0.014	0.003	**

NOTE: * indicates significance at .05; ** indicates significance at .01.

Table 4.3. (cont.)

Scale	Approaches to Learning		Self-Control		Interpersonal Skills		Externalizing Behaviors		Internalizing Behaviors	
	Est.	Std. Err.	Est.	Std. Err.	Est.	Std. Err.	Est.	Std. Err.	Est.	Std. Err.
Student Characteristics										
Age at assessment	0.001	0.001	0.003	0.001 **	0.008	0.001 **	0.012	0.001 **	0.011	0.001 **
Age at assessment squared	0.000	0.000	0.000	0.000 *	0.000	0.000 **	0.000	0.000 **	0.000	0.000 **
Disability	0.011	0.010	0.034	0.009 **	0.029	0.009 **	-0.025	0.010 *	0.012	0.008
Hispanic	0.048	0.016 **	0.016	0.015	0.026	0.015	-0.006	0.016	-0.071	0.013 **
Asian	0.164	0.025 **	0.113	0.023 **	0.076	0.024 **	-0.109	0.024 **	-0.096	0.020 **
Black	-0.167	0.019 **	-0.182	0.018 **	-0.158	0.018 **	0.204	0.019 **	-0.030	0.015 *
Other Race	-0.018	0.026	-0.024	0.024	-0.017	0.024	0.044	0.025	0.030	0.020
Male	-0.251	0.010 **	-0.186	0.009 **	-0.214	0.009 **	0.232	0.010 **	0.021	0.008 **
Center care	-0.072	0.012 **	-0.078	0.011 **	-0.069	0.011 **	0.102	0.012 **	0.024	0.009 *
Delayed entry	0.040	0.019 *	-0.012	0.018	-0.010	0.018	-0.008	0.019	0.006	0.015
Early entry	-0.063	0.041	-0.068	0.039	-0.027	0.039	0.097	0.041 *	-0.011	0.032
Full day	-0.045	0.017 **	-0.061	0.016 **	-0.053	0.016 **	0.047	0.015 **	0.040	0.013 **

NOTE: * indicates significance at .05; ** indicates significance at .01.

program characteristics, only class size was consistently associated with nonacademic readiness skills. Larger class size was positively associated with attitudes toward learning, self-control, and interpersonal skills, but negatively related to problematic externalizing behaviors. The mechanism by which larger classes may promote the development of these skills is unknown, but perhaps the opportunity to interact with a greater number of peers is key. Students whose teachers engaged in more teacher-directed activities at kindergarten demonstrated less self-control and greater problematic externalizing behaviors. Again, this finding may arise because of the developmental appropriateness of this practice. Many developmental psychologists advocate a more child-initiated teaching approach for this age group (Marcon, 1992) because this type of instruction appears to promote cognitive outcomes as well as children's confidence in their own abilities (Stipek et al., 1995). However, in our study, we found child-initiated activities to be unrelated to most nonacademic readiness skills and, in fact, positively related to problematic externalizing behaviors. Additional studies that examine the effects of teacher-directed activities and child-selected activities on a range of outcomes would contribute to our understanding of the types of instructional practices that enhance children's development.

Some of our findings bear out earlier studies that indicate that nonacademic skills may be promoted not only within the school, but also within the home and other non-school settings. Children who participated in more extracurricular activities demonstrated higher motivation toward learning and lower levels of internalizing behaviors. Additionally, children from higher-income families and whose parents show more involvement with the schools demonstrate more positive dispositions toward learning, better self-control, better interpersonal skills, and fewer internalizing and externalizing behaviors. This finding is in line with the results of Brooks-Gunn and Markman (2005), who found that children from higher-income and more involved families demonstrated superior school-readiness skills.

Finally, we observed significant racial/ethnic differences in the nonacademic school readiness skills. On average, Asians demonstrated superior performance to whites on all five dimensions of nonacademic readiness skills. In contrast, blacks were more likely to demonstrate poorer readiness skills than whites. The exception was internalizing behaviors, where blacks tended to demonstrate fewer instances of such problem behaviors than whites. With the exception of disposition toward learning and internalizing behaviors, where Hispanics were more likely to exhibit better outcomes, Hispanics and whites on average showed similar levels of nonacademic school readiness skills. While there are likely to be multiple sources underlying these racial/ethnic differences, previous studies point to differences in resources within the home environments (Duncan and Magnuson, 2005) and variations in parenting styles (Brooks-Gunn and Markman, 2005).

Sensitivity Analyses with Low-Income Students

In light of research that suggests full-day kindergarten participation may be particularly effective for low-income students, we conducted additional sensitivity analysis to examine whether

full-day kindergarten programs had stronger benefits among the poorest students. We reran our models, limiting the analysis to students whose initial family income was below the 25th percentile (or approximately \$22,000). There was no evidence that full-day kindergarten participation enhanced mathematics and reading achievement for these students, as full-day kindergarten participation remained negatively signed with test scores. Likewise, the relationships between full-day kindergarten attendance and nonacademic school readiness skills remained the same for the low-income students as was observed for the general population. Taken together, the results do not provide evidence of differential effects for poorer students.

Model Limitations

This study has attempted to address the methodological concerns noted in Chapter One, regarding small sample sizes, lack of statistical controls, and short-term effects. However, there are a number of variables this study did not control for. For example, this study did not attempt to address potential self-selection bias whereby parents with certain characteristics are more likely to choose full-day kindergarten programs, given the choice.³ As noted by Cannon, Jacknowitz, and Painter (2006), the theoretical direction of the bias could reflect either positive or negative selection, although there is some evidence that suggests that lower-income parents are more likely to enroll their children in full-day programs (Walston and West, 2004). Regardless of the direction of the bias, future studies should consider statistical methods that control for self-selection.

A second limitation of our study concerns potential aggregation bias stemming from the school-level measures of kindergarten program factors. Although the intraclass correlations provide suggestive evidence that teachers within the same school tended to give similar responses with respect to program characteristics, it is also important to acknowledge variation in responses, especially with respect to teaching experience. Due to computational limitations, we could not conduct a three-level model (i.e., students nested within teachers nested within schools), and instead conducted a two-level model (i.e., children nested in schools). Additional research on whether teacher-level measures of kindergarten program characteristics would offer different interpretations is warranted.

Summary of Results

The analyses were designed to address two research questions, one about the relationship between school readiness and student achievement and the other between kindergarten program factors and nonacademic school readiness skills. Variance decomposition analysis indicated that most of the variation in achievement outcomes and nonacademic school readiness

³ It is unclear the extent to which self-selection bias affects results. If the child's assigned school does not offer a choice between full- and part-day kindergarten programs, then the selection problem may not be relevant for this group of students.

skills was attributable to between-wave and within-school variation, leaving a small to moderate proportion that could be attributed to between-school variation. Approximately 20 percent of the variation in achievement outcomes and 3 percent of the variation in nonacademic school readiness skills could be attributed to between-school factors. The regression analyses confirmed the results of the variance decomposition analyses, since school program factors, especially those relating to teaching practices, were generally related to both mathematics and reading achievement but were unrelated to nonacademic school readiness skills.

Nonacademic school readiness skills explained 16 percent of the between-child variation in mathematics scores and 6 percent of the between-child variation in reading scores. In some cases, the inclusion or exclusion of the nonacademic readiness skills in the regression models changed interpretations. In mathematics, attendance in a full-day kindergarten program was not significant in models that excluded nonacademic school readiness factors, but it was negatively predictive of achievement in models that controlled for nonacademic readiness skills. This raises the possibility that earlier studies may have failed to find relationships between full-day kindergarten and outcomes because they omitted important information relating to nonacademic dimensions of readiness.

On average, black-white achievement differences in reading were evident in models that excluded nonacademic readiness skills, but were eliminated once we controlled for nonacademic readiness skills. This suggests that some of the achievement gap in this area was attributable to the fact that blacks and whites had different levels of nonacademic readiness skills upon kindergarten entry.

With the exception of class size, few of the kindergarten program factors were predictive of nonacademic readiness skills. Attendance in a full-day kindergarten program was negatively associated with the development of nonacademic school readiness skills. Children who participated in a full-day kindergarten program demonstrated poorer dispositions toward learning, lower self-control, and poorer interpersonal skills than children in part-day programs. Children in full-day programs also showed a greater tendency to engage in externalizing and internalizing behaviors than children in part-day programs.

Home background variables proved to be predictive of nonacademic school readiness skills. Children whose parents were more involved with schools and those who came from higher-income families demonstrated better attitudes toward learning, more self-control, and better social skills. They also were less likely to exhibit problem behaviors. Engagement in extracurricular activities was also positively predictive of motivation for learning and negatively related to internalizing behavior problems. Taken together, these findings support the hypothesis that family resources are associated with nonacademic readiness skills.

Discussion and Policy Implications

Providing early learning and educational experiences is an overarching goal of social and educational policy in our country today (Committee for Economic Development, 2002). Our study suggests that policy initiatives that focus on the development of nonacademic school readiness skills at kindergarten entry may prove promising, as nonacademic school readiness skills at entry were significantly associated with mathematics and reading achievement from kindergarten through the fifth grade. Investment in the development of nonacademic school readiness skills may not only raise overall achievement but may also narrow the achievement gap between minority and white students. Indeed, on average, white students enter kindergarten with better fine motor skills than blacks or Hispanics, and are ranked higher on self-control, interpersonal skills, and approaches to learning than blacks. Our results showed that the black-white achievement gap in reading disappeared with the inclusion of nonacademic readiness skills in the regression model, which suggests that racial/ethnic differences in achievement might be narrowed if we could enhance the nonacademic readiness skills of minority students, particularly black students.

From a policy standpoint, however, promoting nonacademic readiness skills in institutional settings may prove difficult. Of the kindergarten programmatic factors, only larger class size was found to be consistently related to nonacademic readiness skills, which seems counterintuitive. Other programmatic factors were not significant or showed inconsistent and unanticipated patterns with nonacademic school readiness skills. Instead, nonacademic readiness skills were more consistently associated with home background factors, such as parental involvement, income, and extracurricular activities. This suggests that interventions that aim to improve family circumstances, including programs designed to enhance parenting, may be one way of improving children's academic success (Raver and Knitzer, 2002).

More research is needed to understand the mechanism by which nonacademic readiness skills are related to student achievement. It is unclear whether nonacademic readiness skills are an antecedent for learning, or whether such skills are an indirect marker for learning opportunities. For example, having better nonacademic readiness skills (e.g., motivation toward learning) may directly facilitate learning and test performance. It may also be the case that individuals with better nonacademic readiness skills engage in more activities that provide greater opportunities to learn. A better understanding of how nonacademic skills relate to the improvement of achievement can help policymakers design more effective intervention programs.

Although little is known about how to directly improve nonacademic readiness skills, many policymakers have advocated full-day kindergartens as a means of ensuring the readiness of children to learn as they enter first grade. The literature, however, has provided mixed findings with respect to the effect of full-day kindergarten on school readiness and nonacademic outcomes, and the results of our study raise the possibility that full-day kindergarten programs may actually be detrimental to the development of nonacademic readiness skills. Students who participated in full-day kindergarten were less likely to exhibit good self-control, interpersonal skills, and dispositions toward learning, and they were more likely to engage in problematic internalizing and externalizing behaviors. However, these findings should be interpreted carefully because we have not accounted for potential self-selection bias and may not have fully accounted for the quality of the full-day program, so it is possible that some of our findings are driven by unobserved characteristics.

Full-day kindergartens have also proven popular because a spate of early studies showed promising effects on the cognitive development of children in full-day kindergarten compared with those attending half-day kindergarten (see Ackerman, Barnett, and Robin, 2005 for a useful summary). However, later studies have shown that the effects largely disappear by first grade and, as Cannon, Jackowitz, and Painter (2006) and Rathbun and West (2004) showed, are eliminated by third grade. Our analyses that examined student achievement through the fifth grade reinforce the notion that full-day program may not enhance achievement and may actually be associated with poorer mathematics performance.

The decision of whether states and school districts should continue to push for full-day kindergarten requirement or direct funds to other avenues hinges on additional factors that are currently under-researched. For example, there is some evidence that the initial academic advantages held by students in full-day programs erode if the curriculum in the upper grades is not changed to reflect the progress made during kindergarten (Van Fleet, 2002). This suggests that participation in full-day programs would have more enduring benefits if curricula could be coordinated across grades (see for example, Bogard and Takanishi, 2005). However, little is currently known about the curricula in full-time programs and how they differ from those used in part-time programs.

Another area of research that would provide insight into the merits of a full-day kindergarten program involves identifying groups of children who may benefit most from full-day participation. Because full-day programs are more likely to serve low-income or at-risk children, there may be differential effects on children of the most disadvantaged backgrounds. Walston, West, and Rathbun (2005), for example, find that students from non-English-speaking households continue to show positive effects through the third grade. While our study found no evidence that children from low-income families showed any additional benefits from participation in full-day programs, we did not explore differential effects on the full range of at-risk children.

There appears to be growing evidence that attendance in full-day kindergarten programs is not associated with long-term academic benefits. However, it may be possible to redesign early education programs so that nonacademic skills are improved, which may translate into improved academic achievement. This would require additional research, especially with respect to the mechanisms by which full-day kindergartens affect student outcomes.

Ultimately, the decision of where policymakers should direct funds needs to be guided by a cost-benefit analysis that compares investments in full-day kindergarten programs with investments in other potential types of interventions, such as those that promote nonacademic readiness skills. While full-day kindergarten programs may have some initial positive effects on student achievement, it is unknown whether the lack of enduring benefits and the potentially negative impact on nonacademic skills merit the costs associated with their implementation. A program of research that involves a better understanding of how full-day programs and nonacademic skills influence outcomes and the associated costs of each type of intervention would provide a strong foundation for future decisions about effective programs.

Scale Items and Reliability Estimates

Extracurricular Activities

Outside of school hours, has your child ever participated in:

- Dance lessons
- Organized athletic activities, like basketball, soccer, baseball, or gymnastics
- Organized clubs or recreational programs, like scouts
- Music lessons, for example piano, instrumental music, or singing lessons
- Art classes or lessons, for example, painting, drawing, sculpting.

Reliability coefficients (in order) for waves 2, 3, 4, and 5: .42, .45, .36, .34.

Parent Involvement

Since the beginning of the school year, have you or the other adults in your household...

- Attended an open house or back-to-school night
- Attended a meeting of a PTA, PTO, or Parent-Teacher Student Organization
- Attended a school or class event, such as a play, sports event, or science fair
- Participated in fundraising for child's school
- Gone to a regularly-scheduled parent-teacher conference with your child's teacher or meeting with your child's teacher
- Volunteered at the school or served on a committee.

Reliability coefficients (in order) for waves 2, 3, 4, and 5: .42, .45, .34, .31.

Descriptive Statistics of Scales for Waves 2–5

Table B.1
Descriptive Statistics for Wave 2 (Spring Kindergarten)

Scale	Mean	Std.	Min.	Max.
Nonacademic school readiness				
Approaches to learning	3.10	.69	1.00	4.00
Self-control	3.17	.64	1.00	4.00
Interpersonal skills	3.12	.64	1.00	4.00
Externalizing problem behaviors	1.68	.66	1.00	4.00
Internalizing problem behavior	1.57	.51	1.00	4.00
School program characteristics				
Child-selected	.89	.45	.00	3.00
Whole class	1.58	.65	.00	3.00
Individual activities	.73	.37	.00	3.00
Small group	1.13	.54	.00	3.00
Class size	20.74	4.30	9.50	34.00
Experience at grade	8.65	5.49	.00	30.00
School context factors				
Percent minority	40.37	31.14	.00	100
Percent reduced-price lunch	8.51	6.49	.00	32.50
Percent free lunch	35.95	28.57	.00	100
Home background/student characteristics				
Income	\$48,604	\$35,667	\$0.00	\$150,000
Age at assessment (months)	68.14	4.05	54.00	79.00
Extracurricular activities	.91	.99	.00	5.00
Parent involvement	3.66	1.56	.00	6.00

NOTE: Includes imputed values.

Table B.2
Descriptive Statistics for Wave 3 (Spring First Grade)

Scale	Mean	Std.	Min.	Max.
Nonacademic school readiness				
Approaches to learning	3.02	.70	1.00	4.00
Self-control	3.17	.62	1.00	4.00
Interpersonal skills	3.09	.65	1.00	4.00
Externalizing problem behaviors	1.67	.64	1.00	4.00
Internalizing problem behavior	1.60	.52	1.00	4.00
School program characteristics				
Child-selected	.73	.36	.00	3.00
Whole class	2.14	.63	.00	3.00
Individual activities	.92	.45	.00	3.00
Small group	1.41	.58	.00	3.00
Class size	20.59	4.06	9.50	35.00
Experience at grade	5.27	3.86	.00	24.09
School context factors				
Percent minority	40.65	30.93	.00	100
Percent reduced-price lunch	8.25	5.46	.00	27.28
Percent free lunch	34.57	28.30	.00	100
Home background/student characteristics				
Income	\$53,187	\$44,503	\$5,000	\$200,000
Age at assessment (months)	86.60	4.03	72.00	96.00
Extracurricular activities	1.25	1.13	.00	6.00
Parent involvement	4.02	1.53	.00	5.00

NOTE: Includes imputed values.

Table B.3
Descriptive Statistics for Wave 4 (Spring Third Grade)

Scale	Mean	Std.	Min.	Max.
Nonacademic school readiness				
Approaches to Learning	2.99	.69	1.00	4.00
Self-Control	3.16	.62	1.00	4.00
Interpersonal skills	3.05	.65	1.00	4.00
Externalizing problem behaviors	1.74	.61	1.00	4.00
Internalizing problem behavior	1.66	.52	1.00	4.00
School program characteristics				
Child-selected	.60	.30	.00	3.00
Whole class	2.13	.66	.00	3.00
Individual activities	.86	.50	.00	3.00
Small group	1.15	.53	.00	3.00
Class size	21.00	3.94	9.50	35.85
Experience at grade	7.42	5.38	.00	29.00
School context factors				
Percent minority	42.54	31.01	.00	100
Percent reduced-price lunch	3.01	1.03	.00	7.10
Percent free lunch	36.45	27.94	.00	100
Home background/student characteristics				
Income	\$56,449	\$45,597	\$5,000	\$200,000
Age at assessment (months)	110.63	4.19	102.50	118.50
Extracurricular activities	1.32	1.10	.00	5.00
Parent involvement	4.13	1.47	.00	6.00

NOTE: Includes imputed values.

Table B.4
Descriptive Statistics for Wave 5 (Spring Fifth Grade)

Scale	Mean	Std.	Min.	Max.
Nonacademic school readiness				
Approaches to learning	3.03	.69	1.00	4.00
Self-control	3.21	.61	1.00	4.00
Interpersonal skills	3.05	.65	1.00	4.00
Externalizing problem behaviors	1.68	.59	1.00	4.00
Internalizing problem behavior	1.67	.55	1.00	4.00
School program characteristics (mathematics)				
Child-selected	.29	.23	.00	1.75
Whole class	.87	.53	.00	3.00
Individual activities	.54	.33	.00	3.00
Small group	.56	.32	.00	3.00
Class size	22.87	5.07	9.50	36.00
Experience at grade	7.26	5.01	.00	29.05
School program characteristics (reading)				
Child-selected	.43	.25	.00	2.00
Whole class	1.06	.65	.00	3.00
Individual activities	.62	.38	.00	3.00
Small group	.69	.42	.00	3.00
Class size	22.45	5.33	9.50	36.00
Experience at grade	7.32	5.21	.00	29.53
School context factors				
Percent minority	44.29	30.81	.00	100
Percent reduced-price lunch	3.01	.99	.00	6.49
Percent free lunch	38.31	27.80	.00	100
Home background/student characteristics				
Income	\$59,782	\$48,493	\$5,000	\$200,000
Age at assessment (months)	134.40	4.93	118.00	155.00
Extracurricular activities	1.41	1.08	.00	5.00
Parent involvement	3.99	1.50	.00	6.00

NOTE: Includes imputed values.

References

- Ackerman, D. J., Barnett, W. S., and Robin, K. B. (2005). *Making the Most of Kindergarten: Present Trends and Future Issues in the Provision of Full-Day Programs*. National Institute for Early Education Research (NIEER). Online at <http://nieer.org/resources/policyreports/report4.pdf> (as of July 15, 2006).
- Agostin, T. M., and Bain, S. K. (1997). "Predicting Early School Success with Developmental and Social Skill Screeners." *Psychology in the Schools* 34: 219–228.
- Alexander, K. L., Entwisle, D. R., and Dauber, S. L. (1993). "First-Grade Classroom Behavior: Its Short and Long-Term Consequences for School Performance." *Child Development*, 64: 801–814.
- Arnold, D. H., Ortiz, C., Curry, J. C., Stowe, R. M., Goldstein, N. E., Fisher, P. H., Zeljo, A., and Yershova, K. (1999). "Promoting Academic Success and Preventing Disruptive Behavior Disorders Through Community Partnership." *Journal of Community Psychology* 27(5): 589–598.
- Belsky, J., and MacKinnon, C. (1994). "Transition to School: Developmental Trajectories and School Experiences." *Early Education and Development*, 5(2): 106–119.
- Bogard, K., and Takanishi, R. (2005). "PK-3: An Aligned and Coordinated Approach to Education for Children 3 to 8 Years Old." *Social Policy Report* 19 (3).
- Brooks-Gunn, J., and Markman, L. B. (2005). "The Contribution of Parenting to Ethnic and Racial Gaps in School Readiness." *Future of Children* 1: 139–168.
- Brooks-Gunn, J., Klebanov, P. K., Smith, J., Duncan, G. J., and Lee, K. (2003). "The Black-White Test Score Gap in Young Children: Contributions of Test and Family Characteristics." *Applied Developmental Science* 7: 239–252.
- Brown, R. (1982). "Exercise and Mental Health in the Pediatric Population." *Clinics in Sports Medicine* 1: 515–527.
- Cannon, J. S., Jacknowitz, A., and Painter, G. (2006). "Is Full Better than Half? Examining the Longitudinal Effects of Full-day Kindergarten Attendance." *Journal of Policy Analysis and Management* 25 (2): 299–321.
- Cassidy, J., and Shaver, P. R. (1999). *Handbook of Attachment: Theory, Research, and Clinical Applications*. New York: Guilford Press.
- Chase-Lansdale, P. L., Gordon, R. A., Brooks-Gunn, J., and Klebanov, P. K. (1997). "Neighborhood and Family Influences on the Intellectual and Behavioral Competence of Preschool and Early-School-Age Children." In Brooks-Gunn, J., Duncan, G., and Aber, J. L. (eds.) *Neighborhood Poverty: Context and Consequences for Children*, Vol. I, 119–145. New York: Russell Sage Press.

- Clark, P., and Kirk, E. (2000). "All-Day Kindergarten." *Childhood Education* 76(4): 228–231.
- Coley, R. J. (2002). *An Uneven Start: Indicators of Inequality in School Readiness*. Princeton, N.J.: Educational Testing Service Policy Center. Online at www.ets.org/research/dload/Unevenstart.pdf (as of August 3, 2006).
- Committee for Economic Development (2002). *Preschool for All: Investing in a Productive and Just Society*. New York, NY: Author.
- Cryan, J. R., Sheehan, R., Wiechel, J., and Bandy-Hadden, I. G. (1992). "Success Outcomes of Full-Day Kindergarten: More Positive Behavior and Increased Achievement in the Years After." *Early Childhood Research Quarterly* 7: 187–203.
- Dunacan, G. J., and Magnuson, K. A. (2005). "Can Family Socioeconomic Resources Account for Racial and Ethnic Test Score Gaps?" *Future Child* 15(1): 35–54.
- Elicker, J., and Mathur, S. (1997). "What Do They Do All Day? Comprehensive Evaluation of a Full-Day Kindergarten." *Early Childhood Research Quarterly*, 12(4): 459–80.
- Entwistle, D., Alexander, K. L., Cadigan, D., and Pallas, A. M. (1987). "Kindergarten Experience: Cognitive Effects of Socialization?" *American Educational Research Journal* 24: 337–364.
- Evansville-Vanderburgh School Corporation (1988). "A Longitudinal Study of the Consequences of Full School Day Kindergarten: Kindergarten Through Grade Eight." Unpublished manuscript. Evansville, IN: Evansville-Vanderburgh School Corporation.
- Feinstein, L. (2000). "The Relative Economic Importance of Academic, Psychological and Behavioral Attributes Developed in Childhood." Centre for Economic Performance. Discussion Paper No. 443.
- Ferguson, R. F. (1991). "Paying for Public Education: New Evidence on How and Why Money Matters." *Harvard Journal on Legislation* 28 (2): 465–498.
- Gardner, R. C. (2001). *Psychological Statistics Using SPSS for Windows*. New York: McGraw-Hill.
- Greenwald, R., Hedges, L. V., and Laine, R. D. (1996). "The Effect of School Resources on Student Achievement." *Review of Educational Research* 66 (3): 361–396.
- Heckman, J. J. (2006). "Investing in Disadvantaged Youth and Children Is an Economically Efficient Policy." Paper presented at the Committee for Economic Development/The Pew Charitable Trusts/PNC Financial Services Group Forum on Building the Economic Case for Investments in Preschool, New York, January 10, 2006.
- Heckman, J. J., Stixrud, J., and Urzua, S. (2006). "The Effects of Cognitive and Noncognitive Abilities on Labor Market Outcomes and Social Behaviors." Cambridge, MA: National Bureau of Economic Research. Working Paper 12,006.
- Heavside, S., and Farris, E. (1993). *Public School Kindergarten Teachers' Views of Children's Readiness for Schools*. NCEs Report Number 93-410. Department of Education, National Center for Education Statistics.
- Hildebrand, C. (2001). "Effects of All-Day and Half-Day Kindergarten Programming on Reading, Writing, Math, and Classroom Social Behaviors." *Phi Delta Kappa International* 31 (December): 7–10.

- Hough, D., and Bryde, S. (1996). "The Effects of Full-Day Kindergarten on Student Achievement and Affect." Paper presented at the Annual Meeting of the American Educational Research Association, New York.
- Jencks, C., and Philips, M. (1998). "America's Next Achievement Test: Closing the Black-White Achievement Gap." *The American Prospect* (40): 44–53.
- Kagan, S. L., Moore, E., and Bredekamp, S. (eds.). (1995). *Reconsidering Children's Early Learning and Development: Toward Shared Beliefs and Vocabulary*. Washington, DC: National Education Goals Panel.
- Kaplan, D. (2002). "Methodological Advances in the Analysis of Individual Growth With Relevance to Education Policy." *Peabody Journal of Education* 77(4): 189–215.
- Karweit, N. (1987). "Full or Half-Day Kindergarten: Does it Matter?" Baltimore, MD: Center for Research on Elementary and Middle Schools.
- Kwon, Y. A. (2005). "Protective Mechanisms that Moderate Academic Risk Levels in Young Children: HLM Applications with the Early Childhood Longitudinal Study (ECLS-K) Kindergarten–First Grade Data Set." *Dissertation Abstracts International Section A: Humanities and Social Sciences* 66(1-A): 87.
- Ladd, G. W., Birch, S. H., and Buhs, E. S. (1999). "Children's Social and Scholastic Lives in Kindergarten: Related Spheres of Influence?" *Child Development* 70 (6): 373–400.
- Lee, V. E. and Burkam, D. T. (2002). *Inequality at the Starting Gate: Social Background: Differences in Achievement as Children Begin School*. Washington, D.C.: Economic Policy Institute. Online at http://www.epinet.org/books/starting_gate.html (as of August 22, 2006).
- Lee, V. E., Burkam, D. T., Ready, D. D., Honigman, J., and Meisels, S. J. (2006). "Full-Day Versus Half-Day Kindergarten: In Which Program Do Children Learn More?" *American Journal of Education* 112: 163–208.
- Lewit, E. M. and Baker, L. S. (1995). "School Readiness." *The Future of Children* 5(2): 128–39.
- Long Beach Unified School District Office of Research, Planning and Evaluation. (2000). "Research Summary: Full Day Academic Kindergarten." Long Beach, Calif.: Long Beach Unified School District.
- Marcon, R. A. (1992). "Differential Effects of Three Preschool Models on Inner-City 4-Year-Olds." *Early Childhood Research Quarterly* 7(4): 517–530.
- Mason-Dixon Polling and Research. (2004). *Fight Crime: Invest in Kids—A National Survey of Kindergarten Teachers on the Preparedness of Our Nation's Youngest Students*. Washington, D.C. Online at www.fightcrime.org/releases.php?id=101 (as of August 15, 2006).
- May, D. C., Kundert, D. K., Nikoloff, O., Welch, E., Garrett, M., and Brent, D. (1994). "School Readiness: An Obstacle to Intervention and Inclusion." *Journal of Early Intervention* 18: 290–301.
- McClelland, M. M., Morrison, F. J., and Holmes, D. L. (2000). "Children at Risk for Early Academic Problems: The Role of Learning-Related Social Skills." *Early Childhood Research Quarterly* 15(3): 307–329.
- Morrow, L. M., Strickland, D. S., and Woo, D. G. (1998). *Literacy Instruction in Half- and Whole-Day Kindergarten: Research to Practice*. Newark, Del.: International Reading Association.

- National Association of Early Childhood Specialists in State Departments of Education (2000). "Still Unacceptable Trends in Kindergarten Entry and Placement." Position statement developed by National Association of Early Childhood Specialists in State Departments of Education. Baton Rouge, La: Author.
- National Center for Education Statistics. (2001). *ECLS-K Base Year Public-Use Data Files and Electronic Codebook*. (NCES Report No. 2001029rev.). U.S. Department of Education. Washington, DC: U.S. Government Printing Office. Online at <http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2001029rev>. (as of July 31, 2006).
- National Center for Education Statistics. (2006). *ECLS-K K-5 Longitudinal Electronic Files and Codebook*. (NCES Report No. 2006032_2). U.S. Department of Education. Washington, DC: U.S. Government Printing Office. Online at http://nces.ed.gov/pubs2006/2006032_2.pdf. (as of July 31, 2006).
- Nieman, R. H., and Gastright, J. F. (1981). "The Long-Term Effects of Title I Preschool and All-Day Kindergarten." *Phi Delta Kappan* 63: 184–185.
- Normandeau, S. (1998). "Preschool Behavior and First-Grade School Achievement: The Medial Role of Cognitive Self-Control." *Journal of Educational Psychology* 90(1): 111–121.
- Phillips, M., J. Crouse, and J. Ralph. (1998). "Does the Black-White Test Score Gap Widen After Children Enter School?" In *The Black-White Test Score Gap*, Jencks, C., and Phillips, M., eds. (pp. 229–272), Washington D.C.: Brookings Institution Press.
- Pianta, R.C. (2002). *School Readiness: A Focus on Children, Families, Communities, and School*. Arlington, Va: Educational Research Service.
- Plucker, J. A., Eaton, J. J., Rapp, K. E., Lim, W., Nowak, J., Hansen, J. A., and Bartleson, A. (2004). *The Effects of Full Day Versus Half-Day Kindergarten: Review and Analysis of National and Indiana Data*. Indianapolis, Ind.: Center for Evaluation and Education Policy.
- Poest C. A., Williams J. R., Witt D. D., and Atwood M.L. (1990). "Challenge Me to Move: Large Muscle Development in Young Children." *Young Children* 45: 4–10.
- Porch, S. (2002). *Full-Day Kindergarten*. Arlington, Va: Educational Research Service.
- Rathburn, A. and West, J. (2004). *From Kindergarten Through Third Grade: Children's Beginning School Experiences*. Washington, D.C.: National Center for Education Statistics.
- Raver, C. C., and Knitzer, J. (2002). "Ready to Enter: What Research Tells Policymakers About Strategies to Promote Social and Emotional School Readiness Among Three- and Four-Year-Old Children" Policy Paper No. 3. New York: National Center for Children in Poverty.
- Rimm-Kaufman, S. E., Pianta, R. C., and Cox, M. J. (2000). "Teachers' Judgments of Problems in the Transition to Kindergarten." *Early Childhood Research Quarterly* 15: 147–66.
- Rouse, C. E., Brooks-Gunn, J., and McLanahan, S. (2005). "Introducing the Issue." *Future of Children* 1, 5–14.
- Schafer, J. L. (1997). *Analysis of Incomplete Multivariate Data*. New York: Chapman and Hall.
- Searle, S. R., Casella, G., and McCulloch, C. E. (1992). *Variance Components*. New York: John Wiley.

- Seefeldt, V. (1980). "Physical Fitness Guidelines for Preschool Children." In *Proceedings of the National Conference on Physical Fitness and Sports for All* (pp. 5–19). Washington, D. C.: President's Council on Physical Fitness and Sports.
- Singer, J. (1998). "Using SAS PROC MIXED to Fit Multilevel Models, Hierarchical Models, and Individual Growth Models." *Journal of Education and Behavioral Statistics* 24 (4): 323-355.
- Slaughter, H. B., and Powers, S. (1983). "Effect of Increased, Allocated and Engaged Instructional Time on the Achievement of High-Risk Kindergarten Students: An Evaluation of the Chapter I Extended Time Kindergarten Project." Tucson, Az.: Tucson Unified School District.
- Smith, P., and Pederson, D. (1988). "Maternal Sensitivity and Patterns of Infant-Mother Attachment." *Child Development* 59: 1097–1101.
- Stipek, D., Feiler, R., Daniels, D., and Millburn, S. (1995). "Effects of Different Instructional Approaches on Young Children's Achievement and Motivation." *Child Development* 66(1): 209–223.
- Stipek, D. J., and Ryan, R. H. (1997). "Economically Disadvantaged Preschoolers: Ready to Learn But Further to Go." *Developmental Psychology* 33: 711–723.
- Valeski, T. N., and Stipek, D. J. (2001). "Young Children's Feelings About School." *Child Development* 72(4): 1198–1213.
- Van Fleet, W. (2002). *All-Day Kindergarten Report*. Muncie, Ind.: Muncie Public Schools, Office of the Director of Elementary Instruction.
- Walston, J., and West, J. (2004). *Full-Day and Half-Day Kindergarten in the United States: Findings from the Early Childhood Longitudinal Study, Kindergarten Class of 1998–1999*. Washington, DC: National Center for Education Statistics.
- Walston, J., West, J., and Rathbun, A. H. (2005). "Do the Greater Academic Gains Made by Full-Day Kindergarten Children Persist Through Third Grade?" Paper presented at the Annual Meeting of the American Educational Research Association, Montreal.
- Weiss, A. and Offenberg, R. M. (2002). *Enhancing Urban Children's Early Success in School: The Power of Full-Day Kindergarten*. Philadelphia, Penna.: Philadelphia Public Schools Office of Research and Evaluation.
- West, J., Denton, K., and Reaney, L. M. (2001). *The Kindergarten Year: Findings from the Early Childhood Longitudinal Study, Kindergarten Class of 1998–99*. Washington, D.C.: National Center for Education Statistics. Online at www.nces.ed.gov/pubs2001/2001023.pdf. (as of July 31, 2006).
- Zill, N. (1999). "Promoting Educational Equity and Excellence in Kindergarten." In Pianta, R. C., and Cox, M., eds. *The Transition to Kindergarten* (pp. 67–105), Baltimore, Md.: Brookes Publishing Co.