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Academic Content, Student Learning, and the Persistence of Preschool Effects

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Little research has examined the relationship between academic content coverage in kindergarten and student achievement. Using nationally representative data, we examine the association between reading and mathematics content coverage in kindergarten and student learning, both overall and for students who attended preschool, Head Start, or participated in other child care prior to kindergarten entry. We find that all children benefit from exposure to advanced content in reading and mathematics and that students do not benefit from basic content coverage. Interestingly, this is true regardless of whether they attended preschool, began kindergarten with more advanced skills, or are from families with low income. Policy implications are discussed.

KEYWORDS: academic content, student achievement, kindergarten, preschool

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Whether the kindergarten year should be devoted to academic or social development has been the subject of much debate. Recent evidence documents a striking increase in the academic nature and content of kindergarten. Comparing nationally representative samples of kindergarten teachers drawn in 1998 and 2006, Bassok and Rorem (2013) find that the number of kindergarten teachers who expect to teach their students to read grew from approximately one-third to two-thirds. Teachers also reported increasing the number of minutes spent on reading and language arts by 25% during that time. Other research documents that achievement gains made in kindergarten in math and reading are predictive of student outcomes through eighth grade (Claessens, Duncan, & Engel, 2009).

Relatedly, a large literature has documented the short-term advantages of formal early childhood programs such as preschool. On average, children who attend formal preschool or center-based child care programs have higher achievement test scores at kindergarten entry than their counterparts who do not (Magnuson, Meyers, Ruhm, & Waldfogel, 2004; Magnuson, Ruhm, & Waldfogel, 2007). However, this skill advantage often fades (Barnett, 1995; Deming, 2009; Preschool Curriculum Evaluation Research Consortium, 2008), with effects disappearing as early as the end of kindergarten (U.S. Department of Health and Human Services, 2010).

Despite the discourse around preschool program fadeout, little research has focused on why the short-term test score gains from these programs tend to disappear in elementary school or how to sustain the gains acquired in preschool. Children's elementary school experiences should be one avenue through which the academic benefits of preschool can be sustained. Indeed, among the few studies aimed at understanding the persistence of preschool effects, most have focused on characteristics of children's subsequent school and classroom environments (Currie & Thomas, 2000; Magnuson et al., 2007; Sarama, Clements, Wolfe, & Spitler, 2012).

Thus, we know that kindergarten has become more academic in nature in recent years (Bassok & Rorem, 2013) and that kindergarten learning gains are important (Claessens et al., 2009). However, while a substantial body of research documents the effects of full-day kindergarten (Cannon, Jacknowitz, & Painter, 2006; DeCicca, 2007; Lee, Burkam, Honigman, & Meisels, 2006) and reduced class size (Angrist & Lavy, 1999; Finn & Achilles, 1990; Nye, Hedges, & Konstantopoulos, 2000) for increasing student learning during kindergarten, we know relatively little about the effects of content coverage during the kindergarten year.

Despite the relative lack of evidence on the effects of content coverage in kindergarten, recent educational policy changes, such as the adoption of the Common Core State Standards (CCSS), place a large emphasis on academic content beginning in kindergarten. The CCSS are a set of grade-specific content recommendations in mathematics and reading that the vast majority of states have adopted and begun to implement (Common

Core Standards Initiative, 2012). The basic premise behind this effort is that exposing students to rigorous content can serve to improve their academic performance.

We add to the body of research and inform educational policy by examining the association between academic content coverage in kindergarten classrooms and student learning. Using the Early Childhood Longitudinal Study–Kindergarten Cohort (ECLS-K), a nationally representative sample of kindergarteners, we investigate the reading and math content children are exposed to during kindergarten and how this relates to changes in children's reading and mathematics achievement across the kindergarten year. In addition to examining the overall effects of kindergarten content coverage, we examine whether advantages acquired from preschool program participation persist with exposure to more advanced, as opposed to more basic, academic content in reading and mathematics.

In the analyses that follow, specific mathematics and reading content is considered to be basic or advanced depending on whether the majority of children had mastered that content at kindergarten entry. If over half of children entering kindergarten have mastered a particular content area, we define it as basic. Content that most children have not yet mastered is defined as advanced. We pay particular attention to children from economically disadvantaged families, as they have been found to benefit most from attending preschool (Magnuson et al., 2004), by examining how content exposure relates to their cross-kindergarten achievement gains.

Contextual Influences

A myriad of school and classroom contextual factors are associated with student learning in elementary school, including school quality (e.g., Bryk, Sebring, Allensworth, Easton, & Luppescu, 2010), class size (e.g., Nye et al., 2000), and teacher pedagogical practices and content coverage (e.g., Crosnoe, Benner, & Davis-Kean, 2012). Using a variety of measures of school quality, studies have shown a positive association between quality and student achievement (Bryk et al., 2010; Rivkin, Hanushek, & Kain, 2005). Similarly, a wealth of experimental and non-experimental studies have found an association between smaller class sizes in the early grades and increases in student achievement in both reading and math (Angrist & Lavy, 1999; Finn & Achilles, 1990; Nye et al., 2000). In terms of content and instruction, Rittle-Johnson and Alibali (1999) found that both conceptual and procedural instruction were important for student learning in mathematics, and Gamoran (2001) found exposure to advanced content to be a particularly important predictor of student learning in mathematics at the high school level.

Several studies have used the ECLS-K to examine the effects of reading and mathematics instructional practices and content in the earliest years of school (Bodovski & Farkas, 2007; Byrnes & Wasik, 2009; Engel, Claessens, & Finch, 2013; Guarino, Hamilton, Lockwood, Rathbun, & Hausken, 2006; Xue & Meisels, 2004). Gaurino et al. (2006) found that traditional instructional practices and exposure to content including computation, measurement and advanced topics, and numbers and operations were all positively associated with kindergarten math gains. Exposure to basic mathematics content such as counting to 10 and identifying basic geometric shapes has been shown to be associated with reduced math achievement gains in kindergarten (Bodovski & Farkas, 2007; Engel et al., 2013), except among those students who had not mastered these basic skills at kindergarten entry (Engel et al., 2013). Further, exposure to more advanced content in kindergarten such as single-digit addition and subtraction was associated with increased gains (Engel et al., 2013). Focusing on reading instruction and content, Xue and Meisels (2004) found that students benefited from both phonics and integrated language arts instruction in kindergarten. However, students with low fall kindergarten reading achievement gained less from integrated language arts instruction, the measure of more advanced reading content.

Both education and developmental theory posit that academic content is an important determinant of student learning. Exposing children to content beyond their current skills but still within their range of abilities can promote development (Vygotsky, 1978). Further, content is an aspect of children's early classroom contexts that is important for child development (Bronfenbrenner & Morris, 1998, 2007). A child who attended an early childhood education program and enters kindergarten with higher levels of academic skills may build on this knowledge base with additional reading and mathematics instruction, receive reinforcement from the teacher, or be placed in a higher ability group. Conversely, the same child's growth might be constrained if he or she receives instruction that is below his or her ability level. Indeed, evidence suggests that exposing students to very basic content in mathematics might impede learning for most students (Engel et al., 2013). The current study focuses on the role of kindergarten academic content in promoting student achievement. We explore academic content exposure as a potential avenue for promoting academic skills for all children as well as for maintaining the benefits of preschool program attendance.

Early Childhood Education

Early childhood education programs have recently garnered additional attention as a result of their prominence in President Obama's 2013 State of the Union address. Both experimental and correlational studies of formal early childhood programs, including preschool,[1] have linked participation to early academic skill advantages (Abbott-Shim, Lambert, & McCarty, 2003; Camilli, Vargas, Ryan, & Barnett, 2010; Magnuson et al., 2004; Puma et al., 2005). The academic benefits from early childhood education and care have been found to be larger among children from economically disadvantaged backgrounds (Magnuson et al., 2004). Further, high-quality model early childhood interventions like the HighScope Perry Preschool program and the Abecedarian Project, which targeted children from low-income households and children with cognitive disadvantages, have been shown to improve children's cognitive skills in the short term (Barnett, 1995; Campbell, Ramey, Pungello, Sparling, & Miller-Johnson, 2002; Gorey, 2001).

Although children experience an initial boost in academic skills from preschool attendance, this advantage dissipates relatively quickly in elementary school (Barnett, 1995; McKey et al., 1985; Preschool Curriculum Evaluation Research Consortium, 2008) and has been the subject of much debate in research and policy (Ludwig & Phillips, 2008). This fadeout has been documented among Head Start participants as well (Currie & Thomas, 1995; Deming, 2009; U.S. Department of Health and Human Services, 2010). Even in model early childhood intervention programs, which have lasting positive impacts on participants' earnings and behavioral outcomes into adulthood (Belfield, Nores, Barnett, & Schweinhart, 2006), academic skill gains generally disappear during the first years of school (Currie, 2001). This lack of persistence is a pressing concern, particularly given the focus on early childhood programs as a means of improving the academic outcomes of children from disadvantaged backgrounds.

Subsequent Contextual Influences on Preschool Effects

Given that school and classroom contextual factors influence student learning, one approach to understanding the persistence of the preschool advantage has been to examine the effects of children's subsequent classroom and school contexts (Abelson, 1974). Focusing on Head Start, both Currie and Thomas (2000) and Lee and Loeb (1995) found that school quality, measured as school-level student achievement (Currie & Thomas, 2000) or a combination of academics and safety (Lee & Loeb, 1995), helped to explain some of the fadeout of Head Start effects, particularly for African American children (Currie & Thomas, 2000). In terms of preschool gains more generally, using the ECLS-K, Magnuson et al. (2007) found that students who did not attend preschool but then experienced smaller class sizes and more time on reading instruction caught up to their preschool counterparts in reading achievement. Children who attended preschool did not accrue similar benefits from smaller class sizes or more time on reading. Focusing on both content and pedagogy, Crosnoe and colleagues (2012) found that children from families with low incomes who did not attend preschool benefited more from phonics instruction in reading than their peers who did, particularly in schools serving large numbers of children from low-income backgrounds. Taken together, these studies suggest that students' subsequent school and classroom experiences play a direct role in determining whether the benefits of early childhood education programs are sustained.

Both theory and research suggest that subsequent contexts matter for sustaining the gains children acquire in early childhood programs. Early elementary school classroom contexts are important for both children who attended preschool and their peers who did not attend. We focus on one aspect of these classroom contexts, the reading and mathematics content covered in kindergarten. Specifically, we examine the association between content coverage and student learning and whether exposure to particular content is associated with the persistence of preschool effects.

The Present Study

Using the ECLS-K, we investigate the relationship between kindergarten academic content and student learning. We address three main research questions:

Research Question 1: What is the association between exposure to basic content in reading and mathematics during kindergarten and children's kindergarten achievement gains?

Research Question 2: What is the association between exposure to advanced content in reading and mathematics and achievement gains?

Research Question 3: Are there differential effects of exposure to basic or advanced reading and mathematics content for children who attended preschool, children who attended Head Start, and those children who were not in center-based child care or preschool settings?

The content to which children are exposed should be related to their learning in kindergarten. Thus, we anticipate that the content taught in kindergarten classrooms will influence student achievement gains in both reading and mathematics. Based on prior research on mathematics content (Engel et al., 2013), we expect that many children will not benefit from exposure to basic content. In contrast, we expect that all children have the potential to benefit from exposure to advanced academic content in kindergarten.

Further, we posit that content exposure might affect children differentially depending on whether or not they attended preschool. Based on both research (Engel et al., 2013) and theory (Vygotsky, 1978), we expect that all children may benefit from exposure to advanced content, including those children who stand to benefit from basic content that they may not have mastered prior to school entry. Specifically, we expect that children who attended preschool will benefit from exposure to content that provides continuity—building on the skills they gained from participation. Exposure to basic content for these children can be thought of as a discontinuity in content exposure in that most of these students will have already learned this basic content in preschool.

In contrast, we expect that children who did not attend preschool will likely benefit from kindergarten content that compensates for their not having experienced formal schooling prior to kindergarten entry. Thus, we hypothesize that exposure to basic content in reading and mathematics is likely to benefit children who enter kindergarten without having experienced formal early childhood education.

Our investigation provides new information about the effects of content exposure in kindergarten in general, how this relationship might vary depending on children's school entry skills, and evidence regarding the extent to which content coverage can contribute to the maintenance of preschool advantages. Further, examining whether there are differential effects of exposure to the same content among children who did not attend preschool can inform education policy and practice regarding the extent to which content differentiation is an important means for pursuing positive outcomes for all students.

Data

The data used in this study come from the ECLS-K, a nationally representative sample of children who entered kindergarten in the 1998–1999 school year. The data set provides extensive information on children's academic skills at school entry and throughout elementary and middle school. The ECLS-K contains detailed information about children and their families, teachers, classrooms, and schools. When weighted, the ECLS-K is representative of all U.S. kindergarteners from the 1998–1999 school year.[2] The ECLS-K sampling design included multiple children in most sampled classrooms, averaging six students per class. We used data from the fall and spring of kindergarten for this analysis. While the ECLS-K follows students through eighth grade, we focus on the kindergarten year in order to understand the role of kindergarten contexts in the persistence of preschool effects. We focus on kindergarten for two reasons. First, it is the first school experience following preschool, and second, research on kindergarten mathematics has found that kindergarten teachers spend more time on basic content during this year although most children have mastered that content (Engel et al., 2013).

The weighted analytic sample used in this study is 15,892 students from the original sample of 21,409. Excluding students from the sample if they were missing achievement test scores for the spring of kindergarten resulted in our dropping 2,489 observations. An additional 939 observations were dropped for students who could not be matched with a kindergarten teacher, resulting in a sample size of 17,981, which dropped to 15,892 when weighted. Students who attrited were more disadvantaged, on average, than those who remained in the analytic sample. For instance, students who left the study had lower achievement test scores at the start of kindergarten and mothers with lower levels of education than those who remained. These differences are consistent with prior research.

We followed von Hippel's (2007) recommendation, multiply imputing independent but not dependent variables. We used a host of auxiliary variables describing children's behaviors and home environments in our imputation models (Allison, 2009) including the dependent variables (von Hippel, 2007). Multiple imputation was conducted using the MI command in Stata 12.0 (Statacorp, 2011), which is based on multivariate normal regression and follows the NORM method outlined in Schafer (1997). Thirty imputed data sets were generated in order to maintain a less than 5% falloff in statistical power (Graham, Olchowski, & Gilreath, 2007; McCartney, Bub, & Burchinal, 2006).

Measures

Student Achievement

Children were given direct assessments in language and literacy (reading) and mathematics at the fall and spring of kindergarten. The assessments were designed using Item Response Theory (IRT) to allow for the examination of growth over time (Tourangeau, Nord, Sorongon, Najarian, & Hausken, 2009). The ECLS-K provides proficiency scores for nine levels of math achievement and 10 levels of reading achievement. We utilize information about the skills tested in these proficiency areas in kindergarten to construct measures of kindergarten content coverage (described in the following). The ECLS-K math assessment measured children's conceptual and procedural knowledge and problem-solving skills, and scores range in reliability from .91 to .93 for the kindergarten year. The reading test measured children's basic skills, vocabulary, and comprehension, and the reliability of the IRT scores ranges from .92 to .95 for the kindergarten year (Tourangeau et al., 2009). We use the spring of kindergarten test scores as our outcome of interest, and we control for fall of kindergarten test scores.

For math achievement, the average fall of kindergarten test score for the full sample was 26. The ECLS-K provides proficiency probability scores ranging from 0 to 1 for each of the test proficiency levels in both reading and math. The average score on the most basic math proficiency level (counting, number, and shape) was .94, while the average score on the most advanced level on which children scored (addition and subtraction) was .04. For reading, the average score in the fall of kindergarten on the full test was 35, and the average score on the most basic proficiency level was .66 (letter identification) compared with .01 on the most advanced (words in context).

Kindergarten Reading and Mathematics Content

In the spring of kindergarten, teachers were surveyed about classroom activities and content. We use teacher reports of how often they taught particular reading and mathematics skills and content to create reading and math content measures for each classroom. We constructed these measures to align as closely as possible with the most basic and most advanced reading and mathematics proficiency areas measured by the ECLS-K achievement tests in the fall of kindergarten. Appendix A in the online journal provides means and standard deviations for all of the items related to teaching reading and mathematics that were included on the spring teacher survey. Because our goal was to construct content measures that align as closely as possible with the achievement test proficiency areas, we use a subset of these items—specifically, those that we were able to match to the content tested on the ECLS-K reading and mathematics tests in the fall of kindergarten—to create our measures. We construct the measures this way in order to investigate the relationship between student skills, as measured by the ECLS-K achievement tests, and content exposure.

We consulted with content specialists to create measures that aligned as closely as possible with the content tested on the ECLS-K achievement tests. In consultation with two reading specialists, we identified the items that captured the content and skills most directly related to the ECLS-K proficiency levels tested in kindergarten. Similarly, for math, we consulted with a math educator to create our basic and advanced measures of mathematics content. We excluded items that did not align with the proficiency areas that at least 1% of students had mastered in the fall of kindergarten.

We created four measures of kindergarten academic content—basic mathematics, advanced mathematics, basic reading, and advanced reading. We categorized proficiency levels as basic or advanced based on the proportion of children who had mastered each proficiency level at kindergarten entry. Mastery of proficiency levels was calculated using the mean of the proficiency probability variables as outlined in the ECLS-K user manual (Tourangeau et al., 2009). If 50% or more of the full sample had mastered the proficiency level (e.g., math proficiency Level 1), we consider the teacher-reported content items associated with that level to be basic. Conversely, if fewer than 50% of the full student sample had mastered a proficiency level (e.g., math proficiency Level 3), the teacher-reported content items associated with that level are considered advanced. Teachers reported on how often they taught particular content using a 6-point Likert scale that included the following categories: *never, once a month or less, two or three times a month, once or twice a week, three or four times a week*, or *daily.* Using the averages for each category, we rescaled responses to individual items to indicate the number of days per month a teacher reported teaching that content, with possible responses of 0 (never), 1 (once a month or less), 2.5 (two or three times a month), 6 (once or twice a week), 14 (3 or 4 times a week), or 20 (daily) days per month.

The Basic Math content measure (α =.80) combines the content domains corresponding to ECLS-K mathematics proficiency Levels 1 and 2 (Tourangeau et al., 2009). It contains nine items including counting out loud, recognizing and naming geometric shapes, and ordering objects. Tables 1 and 2 list these items for math and reading, respectively, which are a subset of the population of items shown in Appendix A in the online journal. We did not include items that might be considered basic math but were not aligned with proficiency Levels 1 or 2. For example, writing numbers 1 through 10, although a basic skill, is not included in the measure of basic mathematics because writing numbers is not tested on the ECLS-K math test. The measure is the average of teachers' responses to the nine items. As shown in Table 1, teachers reported an average of nearly 10 days per month on basic mathematics content.

The Advanced Math content measure (α = .72) was constructed using eight items including place value, reading two-digit numbers, and adding single-digit numbers. The measure corresponds to ECLS-K mathematics proficiency Levels 3 and 4 (Tourangeau et al., 2009). Again, although teachers reported on a larger set of items related to mathematics content, we included only the items that correspond to proficiency Levels 3 or 4. As shown in Table 1, on average, teachers reported teaching advanced mathematics content about 6 days per month.

The Basic Reading content measure aligns with reading proficiency Level 1, letter recognition. The measure (α = .60) includes four items: alphabet and letter recognition, working on names of letters, practicing writing the letters, and writing one's own name. On average, teachers reported teaching this content 18 days per month. The Advanced Reading content measure (α = .57) corresponds with reading proficiency Levels 2 through 5 and was created from nine items including matching letters to sounds, common prepositions, and using context cues for comprehension. As shown in Table 2, on average, teachers reported over 11 days per month on advanced reading content. As with the Basic and Advanced Math content measures, we only include items in the measures if they align with the content reported in the ECLS-K manual as having been included in specific proficiency levels.

Early Childhood Education

In the fall of kindergarten, parents were surveyed about their child's nonparental child care experiences prior to kindergarten entry. Parents were asked if their child attended center-based child care/preschool or Head Start in the year before kindergarten. We code all center-based child care participation as "preschool" for two reasons. First, the vast majority of parents, when asked what type of child care program their child attended, reported that it was preschool or prekindergarten. Second, this coding of preschool is consistent with the extant literature using these data to examine preschool effects (Crosnoe et al., 2012; Magnuson et al., 2004, 2007). Using parental responses, we created two mutually exclusive indicators of primary early childhood program participation: one for Head Start and one for

Table 1

Descriptive Statistics and Items for Teacher-Reported Mathematics Content Measures

Content Measures	Individual Items From Spring Kindergarten Teacher Survey	Mean Days/ Month (*SD*)	ECLS-K Achievement Test Proficiency Levels[a]
Basic Math		9.79 (4.75)	Level 1: Identifying some one-digit numerals, recognizing geometric shapes, and one-to-one counting up to 10 objects
α = .80		Median =9.44	
	Count out loud	18.03	
	Work with geometric manipulatives	9.68	
	Correspondence between number and quantity	14.33	
	Recognizing and naming geometric shapes	8.66	Level 2: Reading all one-digit numerals, counting beyond 10, recognizing a sequence of patterns, and using nonstandard units of length to compare objects
	Using measuring instruments	3.71	
	Identify relative quantity	9.88	
	Sort into subgroups	7.42	
	Ordering objects	6.69	
	Making/copying patterns	9.69	
Advanced Math		6.46 (4.78)	
α = .72		Median = 5.99	Level 3: Reading two-digit numerals, recognizing the next number in a sequence, identifying the ordinal position of an object, and solving a simple word problem
	Know value of coins	6.18	
	Place value	6.71	
	Reading two-digit numbers	12.71	
	Recognizing ordinal numbers	8.39	
	Adding single-digit numbers	8.88	
	Subtracting single-digit numbers	6.84	Level 4: Solving simple addition and subtraction problems
	Adding two-digit numbers	1.24	
	Subtracting two-digit numbers, without regrouping	0.70	

Note. Averages are weighted at the teacher level. ECLS-K = Early Childhood Longitudinal Study–Kindergarten Cohort.
[a]From Tourangeau, et al. (2009).

Table 2

Descriptive Statistics and Items for Teacher-Reported Reading Content Measures

Content Measures	Individual Items From Spring Kindergarten Teacher Survey	Mean Days/ Month (*SD*)	ECLS-K Achievement Test Proficiency Levels[a]
Basic Reading $\alpha = .60$		18.06 (4.09) Median = 20	Level 1: Identifying upper- and lower-case letters of the alphabet by name
	Alphabet and letter recognition	18.89	
	Work on learning the names of the letters	18.92	
	Practice writing the letters of the alphabet	16.95	
	Writing own name	17.47	
Advanced Reading $\alpha = .57$		11.41 (5.17) Median = 11.53	Level 2: Associating letters with sounds at the beginning of words
	Matching letters to sounds	18.57	
	Work on phonics	18.49	Level 3: Associating letters with sounds at the end of words
	Common prepositions	8.44	
	Conventional spelling	6.11	
	Using context cues for comprehension	11.38	Level 4: Recognizing common words by sight
	Read aloud	12.85	
	Read from basal reading texts	4.31	
	Read text silently	10.78	Level 5: Reading word in context
	Vocabulary	11.73	

Note. Averages are weighted at the teacher level. ECLS-K = Early Childhood Longitudinal Study–Kindergarten Cohort.
[a]From Tourangeau, et al. (2009).

preschool or formal child care participation. Children whose primary experience prior to kindergarten fit into neither of these categories—those whose primary arrangement was parental care, informal care, or family child care settings—are in the reference group. We refer to this group as having experienced "other care."

Teacher, Classroom, and School Characteristics

Our analyses control for observable characteristics of teachers and classrooms that might be correlated with both content measures and student achievement. These measures come from teacher surveys about their background characteristics and qualifications that were administered in the fall and spring of kindergarten. We control for class size, average weekly minutes spent teaching reading and math, as well as teacher education, certification, years teaching kindergarten, number of college courses on teaching math or reading, and demographics such as gender and age. Table 3 displays the means and proportions for the teacher and classroom characteristics for the full sample and for those teachers of students from low socioeconomic status households, defined as those with a family income of less than 185% of the Federal Poverty Line (FPL). The vast majority of the teachers are women (98%). About 35% of teachers in the sample have a master's degree, and on average, sample teachers have taught kindergarten for approximately 8 years. Appendix B in the online journal contains a complete list of the teacher control variables. In some of the analyses that follow, we categorized teachers as spending either a high or a low amount of time on basic and advanced content. Using the content measures we created, teachers who were below the median days per month in the content area were categorized as low while teachers who were above the median were categorized as high. In addition to teacher and classroom controls, the percentage of students eligible for free and reduced-price lunch within the school is included as a school-level control.

Child, Home, and Family Characteristics

Because characteristics of children and families may be correlated with preschool attendance, the schools and classrooms in which children attend kindergarten, and student achievement, we also include a variety of child characteristics as control variables in our analyses. We control for child race and ethnicity, age, sex, and overall health as well as fall of kindergarten math and reading achievement scores and a general knowledge test score. In addition to child characteristics, we control for home and family background variables including geographic region, number of books in the home, and family income. We also control for home environment factors such as family structure, number of siblings, home language, and maternal education.

Table 3
Kindergarten Teacher and Classroom Descriptive Statistics, Overall and for the Low-Income Sample

	Full Sample (1)	Teachers of Students From Low Socioeconomic Status Households (2)
Time on content (days/month)		
Basic math	9.79	9.84
Advanced math	6.46	6.31
Basic reading	18.06	18.18
Advanced reading	11.41	11.45
Time on subjects (minutes/week)		
Lessons on math	186.18	189.47
Lessons on reading	292.33	298.01
Lessons on science	68.11	67.82
Lessons on social studies	74.74	75.82
Full-day kindergarten	0.62	0.62
Small class size (≤17)	0.28	0.28
Teacher demographics		
Female	0.98	0.98
Age	41.15	41.05
Master's degree or higher	0.35	0.35
Years teaching kindergarten	8.23	8.40
Certification and training		
No certification	0.03	0.03
Temporary or probational certification	0.09	0.10
Number of classes on methods of teaching reading	3.14	3.19
Number of classes on methods of teaching math	2.52	2.57
Preschool experiences of students in class		
Center care	0.56	0.36
Head Start	0.13	0.27
Other care	0.31	0.37
Number of student observations	15,892	5,495
Number of teacher observations	3,037	1,073

Note. Descriptives are weighted at the teacher level. Low income is defined as below 185% of Federal Poverty Line. Results are weighted using the appropriate teacher weight (B2TW0).

Appendix B in the online journal contains a complete list of these control variables.

Analytic Plan

To examine the relationship between classroom content coverage and end of kindergarten reading and mathematics achievement, we begin by examining the effect of basic and advanced content coverage on spring achievement test scores. This relationship takes the form:

$$\begin{aligned} \mathrm{ACH}_{\mathrm{iSK}} = \alpha_1 + \beta_1 \mathrm{BASIC}_{\mathrm{iK}} + \beta_2 \mathrm{ADVANCED}_{\mathrm{iK}} + \beta_3 \mathrm{CENTER}_{\mathrm{iFK}} \\ + \beta_4 \mathrm{HEADSTART}_{\mathrm{iFK}} + \beta_5 \mathrm{ACH}_{\mathrm{iFK}} + \beta_6 \mathrm{CHILD}_{\mathrm{iFK}} + \beta_7 \mathrm{FAM}_{\mathrm{iFK}} \\ + \beta_8 \mathrm{TEACH}_{\mathrm{iK}} + \beta_9 \mathrm{SCHOOL}_{\mathrm{iK}} + \varepsilon_{\mathrm{iK}} \end{aligned} \quad (1)$$

where $\mathrm{ACH}_{\mathrm{iSK}}$ is the math or reading achievement test score of child *i* measured in the spring of kindergarten (SK) and $\mathrm{BASIC}_{\mathrm{iK}}$ is a continuous measure of basic math or reading content coverage. $\mathrm{ADVANCED}_{\mathrm{iK}}$ is a continuous measure of the number of teacher-reported days per month of advanced math or reading content. $\mathrm{CENTER}_{\mathrm{iFK}}$ is a dichotomous variable indicating parental reports of whether or not a child was in center-based preschool, and $\mathrm{HEADSTART}_{\mathrm{iFK}}$ indicates whether a child attended Head Start (other care/no care is the omitted category); both were reported in the fall of kindergarten (FK). $\mathrm{ACH}_{\mathrm{iFK}}$ is the fall of kindergarten measure of child *i*'s math or reading skills assessed by achievement tests in the fall of kindergarten. Including this measure allows us to estimate changes in skills across the kindergarten year and to control for unobserved characteristics that might be correlated with both content coverage and prior achievement. $\mathrm{FAM}_{\mathrm{iFK}}$ and $\mathrm{CHILD}_{\mathrm{iFK}}$ are sets of family background and child characteristics included to control for individual differences that might influence both fall achievement and kindergarten content coverage. $\mathrm{TEACH}_{\mathrm{iK}}$ is a set of classroom characteristics included to control for teacher- and classroom-level differences such as class size and teacher background characteristics. $\mathrm{SCHOOL}_{\mathrm{iK}}$ includes a school-level control for the percentage of students eligible for free- or reduced-price lunch. Finally, α_1 is a constant, and ϵ_{iK} is a stochastic error term. We estimate this model separately for mathematics content and math achievement outcomes and for reading content and reading achievement outcomes. Standard errors are clustered at the classroom level to account for the nonindependence of students within classrooms and schools.

The estimated coefficients of interest in Equation 1 are β_1 and β_2, which, if correctly modeled, can be interpreted as the relationship between basic and advanced kindergarten academic content coverage in a given domain and achievement gains in math or reading across kindergarten. We focus on gains as we are interested in how content influences student learning. Prior research focused on the role of contextual influences on the persistence of preschool effects has also relied on gains as opposed to levels

(Crosnoe et al., 2012; Magnuson et al., 2007). A key challenge in this approach is the threat of omitted variable bias, which occurs if school, family, or child characteristics are correlated both with teacher reports of content coverage and their students' achievement and are omitted from our model. Our strategy for reducing bias in β_1 and β_2 is to estimate a model of the form of Equation 1 that includes potential confounding measures of teacher, child, and family characteristics.

We then examine how exposure to basic and advanced mathematics and reading content influences cross-kindergarten achievement gains for children who attended preschool, Head Start, and those children who did not attend a formal early childhood program. We estimate the interaction between preschool experiences and exposure to basic and advanced content in kindergarten with the interaction terms described in Equation 2 as CONTENT × CARETYPE_{iPK}, estimating the coefficients $\beta_{5\text{-}8.}$

$$\begin{aligned} \text{ACH}_{iSK} = \alpha_1 &+ \beta_1\text{BASIC}_{iK} + \beta_2\text{ADVANCED}_{iK} + \beta_3\text{CENTER}_{iFK} \\ &+ \beta_4\text{HEADSTART}_{iFK} + \beta_{5-8}\text{CONTENT} * \text{CARETYPE}_{iFK} \\ &+ \beta_9\text{ACH}_{iFK} + \beta_{10}\text{CHILD}_{iFK+}\beta_{11}\text{FAM}_{iFK} + \beta_{12}\text{TEACH}_{iK} \\ &+ \beta_{13}\text{SCHOOL}_{iK} + \varepsilon_{iK} \end{aligned} \tag{2}$$

For example, β_5 estimates the effect of BASIC × CENTER, or the interaction between basic content coverage in mathematics or reading and participation in center-based child care prior to kindergarten. As our model includes fall achievement, these interactions represent the differential relationship between content exposure and kindergarten achievement gains by early childhood care type. Because research has found stronger effects of preschool attendance for economically disadvantaged children (Magnuson et al., 2004), we also estimate these models separately for low-income children, defined as those from families with incomes below 185% of the Federal Poverty Line.

Results

Table 3 shows that overall, kindergarten teachers spend substantially more time on reading than mathematics (approximately 5 hours per week compared to 3 hours per week, respectively). Teachers also report teaching more reading content than mathematics content, reporting an average of 18 and 11 days per month on basic and advanced reading content, respectively, compared with 10 (basic) and 6 (advanced) days per month on mathematics content. Interestingly, Column 2 indicates that these descriptive statistics are virtually identical for teachers serving students from low-income households. Teachers of students from low-income households report spending the same number of days, on average, on basic and advanced reading and math content as the full sample of teachers.

Table 4 presents means and proportions for the full analytic sample (n = 15,892) and for children who attended preschool (n = 8,926), Head Start (n = 2,101), or other care (n = 4,865) in the year prior to kindergarten.[3] As shown in Table 4, 56% of the sample attended formal center-based child care or preschool in the year prior to kindergarten and 13% attended Head Start. The sample is predominately White (61%), and 6% come from homes where English is not the primary home language. More than half of the sample attended full-day kindergarten (56%). Children who attended preschool are more advantaged than those who attended Head Start or other care as measured by maternal education (14 years vs. 12 for children in Head Start and 13 for other care) and by family income. Students who attended preschool also attended substantially more advantaged schools in kindergarten compared with other groups of children as measured by the proportion of children in the school eligible for free or reduced-price lunch. The group of children who attended Head Start is the most disadvantaged and also has lower average reading and math achievement test scores.

Table 5 presents coefficients and standard errors from regressions modeling the relationship between basic and advanced kindergarten content and children's math and reading achievement gains in kindergarten. All of the outcomes and continuous independent variables are standardized using the full analytic sample, so coefficients are reported in standard deviation units. Columns 1 and 4 present results from regression models including only the fall test score and early child care experiences as controls, for math and reading, respectively. The second and fourth columns show results when the full set of child, family, and classroom controls is added. Columns 3 and 6 show results of interactions between content exposure and preschool child care settings.

As shown in Table 5, Columns 1 and 2, additional days per month on basic mathematics content are associated with smaller cross-kindergarten gains in mathematics, with the coefficient remaining virtually unchanged by the addition of controls ($\beta = -.041$, $p < .01$). An additional 4 days per month of basic mathematics content is associated with gains that are, on average, .041 standard deviations smaller. In contrast, teacher reports of more days on advanced content are associated with larger test score gains ($\beta = .065$, $p < .01$). As the results for interactions in Column 3 show, this pattern is similar among students who attended center care, Head Start, and other child care settings (the omitted category). Additional days on advanced mathematics content had a positive effect on math gains. Conversely, more days on basic mathematics were associated with smaller gains.

It is important to note that additional time on mathematics in general was associated with larger math gains. As the coefficient on minutes on subject indicates, a standard deviation increase in minutes of math per week

Table 4
Student Descriptive Statistics Overall and by Preschool Type

	Full Sample (1)	Center Care (2)	Head Start (3)	Other Care (4)
Preschool experience				
Head Start	0.13	0.00	1.00	0.00
Center care	0.56	1.00	0.00	0.00
Fall K achievement				
General knowledge	22.17	23.95	17.82	20.77
Math	26.12	28.19	21.64	24.26
Fall K math proficiency levels				
1. Count, number, and shape	0.94	0.97	0.88	0.91
2. Relative size	0.59	0.68	0.40	0.49
3. Ordinality and sequence	0.21	0.27	0.08	0.15
4. Add/subtract	0.04	0.05	0.01	0.02
Reading	34.95	37.11	30.38	32.96
Fall K reading proficiency levels				
1. Letter recognition	0.66	0.75	0.48	0.57
2. Beginning sounds	0.30	0.39	0.11	0.23
3. Ending sounds	0.15	0.20	0.04	0.12
4. Sight words	0.02	0.03	0.00	0.01
5. Words in context	0.01	0.01	0.00	0.01
Spring K achievement				
Math	36.50	38.95	30.82	34.45
Reading	46.16	48.64	40.44	44.09
Child characteristics				
White	0.61	0.70	0.32	0.57
Black	0.16	0.12	0.37	0.13
Hispanic	0.16	0.12	0.20	0.21
Asian	0.03	0.03	0.02	0.03
Other	0.05	0.04	0.08	0.06
Female	0.49	0.49	0.50	0.47
Age (months at fall assessment)	68.53	68.54	68.41	68.56
Location				
Urban	0.36	0.36	0.38	0.36
Suburban	0.42	0.47	0.27	0.39
Rural	0.22	0.17	0.34	0.25
Home environment				
Lives with single biological parent	0.23	0.19	0.40	0.22
Maternal education (years of school)	13.44	14.14	12.07	12.74
Number of siblings	1.43	1.28	1.70	1.58
English not primary home language	0.06	0.04	0.08	0.09

(continued)

Table 4 **(continued)**

	Full Sample (1)	Center Care (2)	Head Start (3)	Other Care (4)
Income				
Below 185% of Federal Poverty Line	0.37	0.23	0.75	0.45
School characteristics				
Percentage students on free or reduced-price lunch	38.47	30.36	60.76	43.74
Full-day kindergarten	0.56	0.56	0.63	0.53
Observations	15,892	8,926	2,101	4,865

Note. Averages are from the imputed data set and are weighted by the student weight (BYCOMW0).

(104 minutes) was associated with a .017 increase in math achievement. We also tested whether there was an interaction between minutes per week and basic or advanced content and did not find statistically significant results (available upon request), suggesting that regardless of mathematics content, additional minutes on math have a positive effect.

As Table 5 indicates, the average effects of having attended preschool and Head Start on spring of kindergarten reading test score gains are negative or neutral. Students in either center-based care or Head Start did not gain more than their peers in other care. Additionally, to explore whether there is a relationship between content taught and students' school-entry academic skills, we ran models including an interaction term for kindergarten content and fall achievement test scores (available upon request). We did not find a statistically significant interaction between fall test scores and kindergarten content exposure.

Figure 1 shows graphs of gains for students who attended preschool, Head Start, or other care by whether their teachers reported teaching high (above the median) or low (below the median) levels of advanced content. Regardless of prior child care experiences, students in classrooms where advanced mathematics content is taught more often gain more in mathematics across kindergarten. Interestingly, Figure 1 suggests that the math test scores of children who did not attend preschool but were exposed to more days of advanced mathematics content in kindergarten begin to converge with the scores of children who attended preschool but were subsequently exposed to fewer days of advanced math content.

Columns 4 through 6 of Table 5 show results from regression models using measures of basic and advanced reading content in kindergarten to predict cross-kindergarten gains in reading. Mirroring the math results, Column 5 indicates that more time on advanced reading content is associated with larger test score gains ($\beta = .053$, $p < .01$). The coefficient on basic

Table 5

Coefficients and Standard Errors From Regressions Predicting Spring Mathematics and Reading Achievement With Content Measures for Full Sample

	Mathematics			Reading		
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Basic math or reading	–0.041**	–0.041**	–0.045**	–0.013	–0.010	–0.004
	(0.007)	(0.007)	(0.013)	(0.008)	(0.007)	(0.011)
Advanced math or reading	0.070**	0.065**	0.062**	0.066**	0.053**	0.049**
	(0.007)	(0.007)	(0.012)	(0.008)	(0.008)	(0.012)
Center-based care	0.020	–0.008	–0.008	–0.010	–0.040**	–0.040**
	(0.012)	(0.012)	(0.013)	(0.011)	(0.011)	(0.011)
Head Start	–0.067**	–0.008	–0.009	–0.057**	–0.019	–0.018
	(0.017)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Center-Based Care × Basic			0.004			–0.011
			(0.015)			(0.012)
Head Start × Basic			0.013			0.004
			(0.019)			(0.020)
Center-Based Care × Advanced			0.007			0.014
			(0.014)			(0.013)
Head Start × Advanced			–0.008			–0.026
			(0.018)			(0.016)
Full-day kindergarten		0.084**	0.084**		0.081**	0.081**
		(0.014)	(0.014)		(0.015)	(0.015)
Minutes on subject (standardized)		0.017**	0.017**		0.025**	0.025**
		(0.006)	(0.006)		(0.007)	(0.007)
Small class size (≤17)		–0.015	–0.016		0.012	0.011
		(0.015)	(0.015)		(0.015)	(0.015)
Fall test score	0.812**	0.664**	0.664**	0.817**	0.690**	0.690**
	(0.008)	(0.015)	(0.015)	(0.010)	(0.014)	(0.014)
Controls		X	X		X	X
Observations	15,892	15,892	15,892	15,892	15,892	15,892
R^2	0.68	0.70	0.70	0.69	0.71	0.71

Note. Robust standard errors, clustered by classroom, in parentheses; controls include fall test scores (math, reading, and general knowledge) in addition to the student, family, teacher, and school variables listed in Appendix B in the online journal; outcomes and continuous independent variables shown are standardized. Standard deviations for minutes on math/reading are 104 and 122 minutes, respectively. Regressions are weighted by the appropriate student weight (BYCOMW0). Regressions with mathematics as the outcome include the basic and advanced mathematics measures while regressions with reading as the outcome include the basic and advanced reading measures.
$^*p < .05$. $^{**}p < 0.01$.

reading is near zero and not statistically significant. Again, Column 6 indicates that the effect of content exposure does not vary for children by the preschool settings they experienced prior to kindergarten.

Teacher reports of minutes of reading per week are significantly and positively associated with reading achievement. Interestingly, we also find a statistically significant, negative interaction between minutes per week

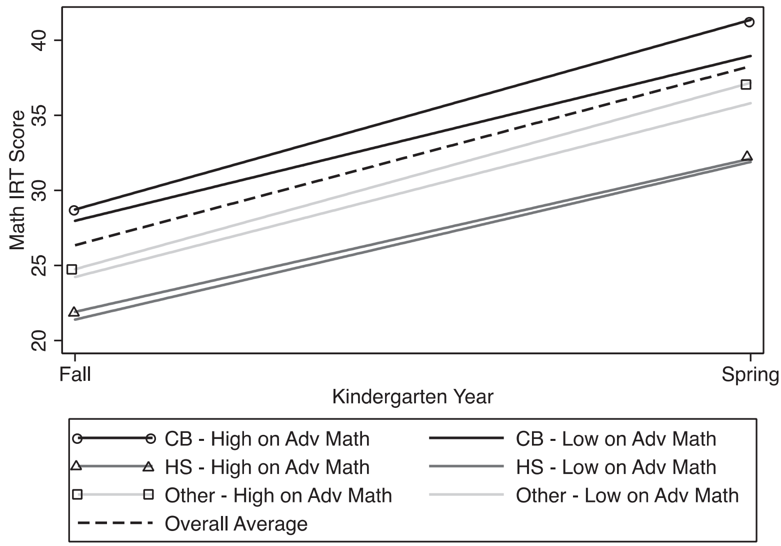

Figure 1. **Cross-kindergarten math achievement by preschool care type and time on advanced math content.**

on reading and teacher-reported days per month spent on basic (but not advanced) reading content. Thus, although the main effect of basic reading content is null, the interaction term (results not shown in table, $\beta = -.012$) suggests that reading time that is spent on basic content is associated with smaller test score gains.

Table 5 documents smaller reading gains in kindergarten among children who attended preschool compared with their peers who were in other care. This fadeout has been documented in other studies using the ECLS-K (Crosnoe et al., 2012; Magnuson et al., 2007). Models including controls show that children who attended Head Start experienced gains that were similar to those of their peers in other care, on average.

Figure 2 shows results for the three groups of students by whether or not their teachers report teaching larger or smaller amounts of advanced reading content. Similar to the results for mathematics achievement, regardless of prior early childhood experiences, children who are exposed to more days of advanced reading content gain more in reading than their counterparts in classrooms where teachers report spending fewer days on advanced content.

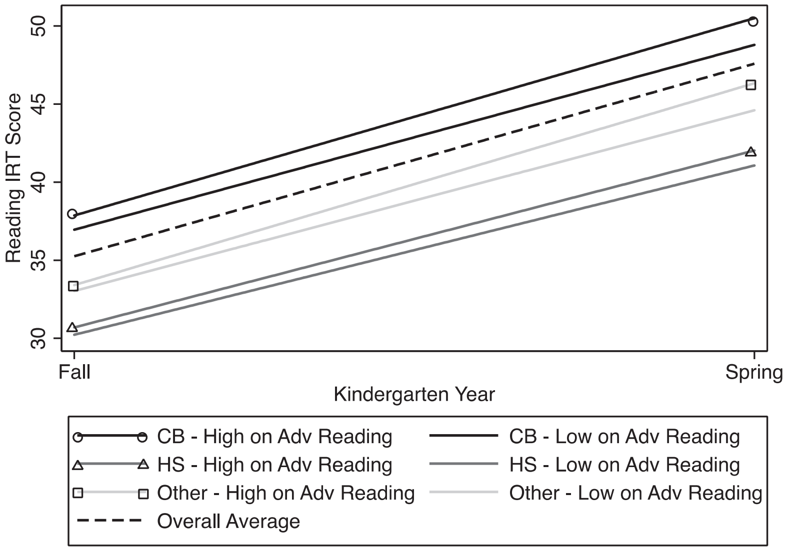

Figure 2. **Cross-kindergarten reading achievement by preschool care type and low versus high time on advanced reading content.**

Table 6 shows results from models that are identical to those shown in Table 5, but for children from families with income that was less than 185% of the FPL. Columns 1 through 3 show that among children from low-income households, more time on advanced content is consistently positively associated with mathematics achievement gains while more time on basic mathematics content is associated with smaller gains. For reading achievement and reading content, Columns 4 through 6 show that more time on advanced reading content is associated with larger gains in reading achievement across kindergarten. Similar to the full sample, basic content had no effect in reading among children from low-income households. Columns 3 and 6 indicate no significant interaction between early care type and exposure to basic or advanced content.

Discussion

Our results indicate that content exposure during kindergarten may be an important means for promoting the early achievement of all children. We find a consistent and positive effect of exposure to advanced content for all children in both reading and mathematics. We find negative or, in the case of reading, null effects of exposure to basic content. More exposure to advanced content and less exposure to basic content, particularly in

Table 6
Coefficients and Standard Errors From Regressions Predicting Spring Mathematics and Reading Achievement With Content Measures for Low-Income Sample

	Mathematics			Reading		
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Basic math or reading	–0.034**	–0.029**	–0.041*	–0.005	–0.002	0.000
	(0.010)	(0.010)	(0.016)	(0.010)	(0.010)	(0.014)
Advanced math or reading	0.063**	0.056**	0.057**	0.051**	0.040**	0.037*
	(0.010)	(0.010)	(0.016)	(0.010)	(0.010)	(0.015)
Center-based care	–0.012	–0.025	–0.027	–0.037*	–0.049**	–0.051**
	(0.019)	(0.019)	(0.019)	(0.017)	(0.016)	(0.016)
Head Start	–0.038	–0.003	–0.006	–0.031	–0.010	–0.009
	(0.020)	(0.019)	(0.019)	(0.019)	(0.018)	(0.019)
Center Based-Care × Basic			0.015			–0.010
			(0.023)			(0.019)
Head Start × Basic			0.024			0.003
			(0.022)			(0.023)
Center-Based Care × Advanced			0.004			0.022
			(0.022)			(0.018)
Head Start × Advanced			–0.011			–0.014
			(0.022)			(0.019)
Full-day kindergarten		0.084**	0.085**		0.068**	0.068**
		(0.020)	(0.020)		(0.021)	(0.021)
Minutes on subject (standardized)		0.009	0.009		0.033**	0.033**
		(0.009)	(0.009)		(0.009)	(0.009)
Small class size (≤17)		–0.025	–0.025		0.026	0.024
		(0.023)	(0.023)		(0.020)	(0.019)
Fall test score	0.852**	0.695**	0.695**	0.822**	0.649**	0.649**
	(0.013)	(0.018)	(0.018)	(0.015)	(0.023)	(0.023)
Controls		X	X		X	X
Observations	5,495	5,495	5,495	5,495	5,495	5,495
R^2	0.63	0.66	0.66	0.60	0.64	0.64

Note. Robust standard errors, clustered by classroom, in parentheses; controls include fall test scores (math, reading, and general knowledge) in addition to the student, family, teacher, and school variables listed in Appendix B in the online journal; outcomes and continuous independent variables shown are standardized. Standard deviations for minutes on math/reading are 104 and 122 minutes, respectively. Regressions are weighted by the appropriate student weight (BYCOMW0). Regressions with mathematics as the outcome include the basic and advanced mathematics measures while regressions with reading as the outcome include the basic and advanced reading measures. Low income is defined as less than 185% of the Federal Poverty Line.
$*p < .05$. $**p < .01$.

mathematics, appears to lead to larger cross-kindergarten test score gains. Our findings have implications for increasing the academic achievement of children in the earliest years of formal schooling and for the content that is taught in kindergarten classrooms.

Our results provide evidence in support of some but not all of our hypotheses. We find support for the idea that exposure to advanced reading and mathematics content is positively associated with cross-kindergarten test score gains among children who attended preschool. We also find, as we expected, that children who attended preschool do not benefit from exposure to basic content. However, we anticipated that children who did not attend preschool would benefit from compensation in the form of basic content. Our results do not provide evidence in support of this hypothesis, indicating that *all* children will likely benefit from more exposure to advanced and less exposure to basic content.

Kindergarten Content and Student Achievement

We find that all children, regardless of their early childhood care experiences, benefit from more exposure to advanced mathematics content. This finding is consistent with recent research focused on the interaction between children's kindergarten entry math skills and kindergarten mathematics content that found all children, regardless of their kindergarten entry mathematics skills, benefited from more advanced mathematics content (Engel et al., 2013). Moreover, we find that even children who did not attend preschool, who on average begin kindergarten with lower reading and math test scores, do not benefit from exposure to basic mathematics content in kindergarten. We find that the average effect of exposure to 4 more days per month of advanced content in math is approximately .06 of a standard deviation, and the average effect of 4 more days per month of basic mathematics content is around –.04. The pattern of results for the effect of reading content on kindergarten reading achievement is similar overall (approximately .05), with the exception of null (as opposed to negative) effects of exposure to basic reading content.

Content Coverage in Kindergarten

Given that all children benefit from more exposure to advanced content, it is important to consider what "advanced" means for kindergarten students. In mathematics, the items in our measure of advanced content cover topics such as addition and subtraction, place value, and ordinality. In reading, students benefit from phonics instruction, reading aloud or silently, and working on reading comprehension. In contrast, basic content in mathematics includes counting out loud, identifying relative quantity, and sorting into subgroups. Basic content in reading includes alphabet recognition, writing the letters of the alphabet, and writing one's own name.

Despite the fact that the associations between more time on advanced content and achievement gains are consistently positive, teachers report spending far more time teaching basic content than they do advanced. On average, teachers report teaching basic reading content nearly every

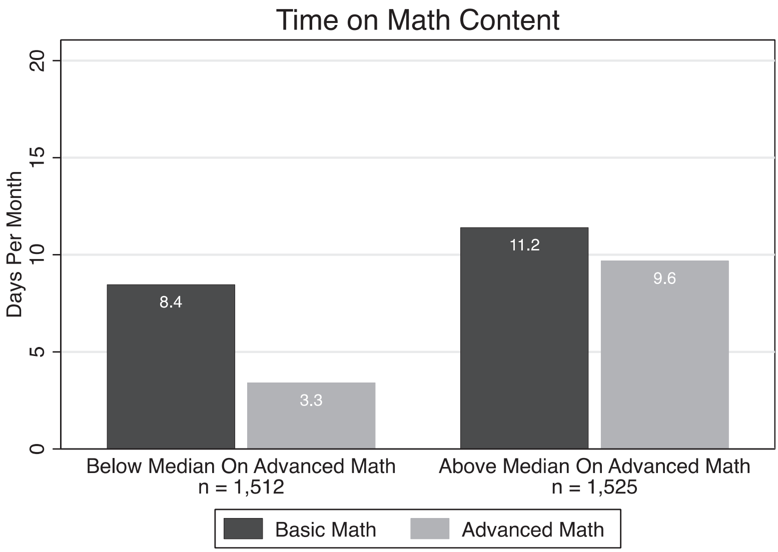

Figure 3. **Days per month on math content by high and low time on advanced math.**

day—18 days per month—and approximately 10 days per month in mathematics. In contrast, teachers report covering advanced reading content 11 days per month and spend a mere 6 days per month on advanced math content. Thus, teachers report more frequent coverage of basic content in both reading and mathematics. The fact that the basic content that receives more emphasis in kindergarten classrooms does not appear to benefit children is a problem that can and should be addressed.

Figures 3 and 4 show time spent on basic and advanced math and reading content by whether teachers are low (below the median) or high (above the median) on time on advanced content in math (Figure 3) or reading (Figure 4). Teachers categorized as high on advanced reading or advanced math also spent more time on basic skills. Strikingly, teachers categorized as high on advanced math spend an average of over 9 days per month covering advanced math topics compared with low teachers who report spending a mere 3 days per month on advanced math content. Similarly, in reading, teachers categorized as high on advanced content report spending over 1 week more per month teaching that content than teachers categorized as low on advanced reading content.

Our results suggest that the way teachers report allocating their time across basic and advanced content in both reading and mathematics is likely to result in smaller cross-kindergarten gains in both subjects for virtually all

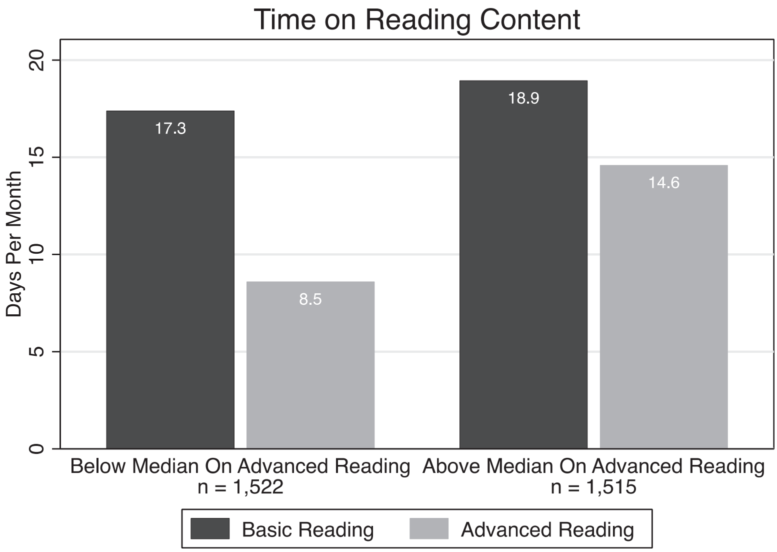

Figure 4. **Days per month on reading content by high and low time on advanced reading.**

students. While we find that children benefit exclusively from exposure to advanced content, their teachers emphasize the basics. This is particularly concerning in mathematics, where we see consistently negative associations between exposure to basic content and cross-kindergarten mathematics achievement gains. As shown in Figures 3 and 4, even in classrooms characterized as high on advanced mathematics or reading content, teachers reported spending substantially more time on basic than advanced content.

Kindergarten Content and Preschool Effects

Building on recent studies that used the ECLS-K to examine the relationship between elementary school contexts and the preschool advantage (e.g., Crosnoe et al., 2012; Magnuson et al., 2007), we add to the knowledge base on the persistence of preschool effects. Magnuson and colleagues (2007) found that children who did not attend preschool and subsequently experienced small class sizes and more time on reading caught up to their preschool-attending peers, who gained less in these contexts. Crosnoe and colleagues (2012) focused on children from low-income households who attended preschool and found that they benefited from phonics instruction in kindergarten if they attended schools serving large numbers of children from low-income families. We find that both students who attended preschool and their peers who did not have larger achievement gains in classrooms where their teachers report teaching advanced content in reading and mathematics more often.

In contrast to prior studies that found differential contextual effects among subgroups of children, we find that advanced reading and mathematics content benefits all children regardless of their household socioeconomic status, academic achievement at school entry, or early childhood care experiences. Given the substantial investments that are made in early childhood education, our results point to an important avenue for sustaining the academic benefits children accrue from preschool participation. Importantly, our results suggest that this avenue—providing more instruction on advanced content and less on basic content—appears to have equally positive effects for all children.

This study has several limitations. First, we use teacher survey reports to measure content coverage. These teacher survey reports are less reliable and accurate and likely contain much more measurement error than measures of classroom content based on classroom observations. For instance, many teachers likely teach both basic and advanced content in mathematics and/or reading on a single day, building on basic concepts to introduce more complex and advanced academic content. Thus, more nuanced questions about content exposure would be better answered using data drawn from classroom observations. For example, questions about the relationship between basic and advanced content cannot be answered well using the content measures provided in the ECLS-K.[4] The current study should be replicated using more detailed measures of reading and mathematics content to confirm our results. Second, the data used in the current study are not the result of an experimental intervention related to content coverage. While we use an extensive set of child, family, teacher, and classroom controls to reduce the threats of selection and omitted variable bias, these threats remain plausible. For example, while we control for student achievement in the fall of kindergarten, it is possible that in the spring of kindergarten, teachers report teaching the content that they do, in part, in response to the pace at which students are learning. Given the relatively large amounts of basic and small amounts of advanced content that teachers report teaching, it seems unlikely that teacher-reported content coverage is driven primarily by student learning. However, caution should be used in interpreting the results of this study.

Finally, the present study is limited by the fact that the sample used for the analysis experienced kindergarten prior to No Child Left Behind and a host of other education reforms that may have shifted the content that children are exposed to during kindergarten. It is possible that kindergarteners are currently exposed to more advanced and less basic content. However, focusing on fourth and eighth graders, a recent report using the 2009 and 2011 National Assessment of Educational Progress (NAEP) suggests that students are not challenged by their coursework and that the topics covered are often too easy (Boser & Rosenthal, 2012). This suggests both that recent education reforms may not have resulted in increased coverage of academically challenging content for all students and that the results we find for kindergarten students—that basic content is overemphasized—may hold true for students as they advance through elementary and middle school.

Conclusion

Increasing time on advanced academic content is a potentially low-cost means for improving student achievement in kindergarten. Our results indicate that shifting the content covered in a kindergarten classroom to 4 more days per month on advanced topics in reading or mathematics is associated with increased test score gains of about .05 standard deviations. While this is a modest gain, changing content coverage might be an inexpensive means of intervening, particularly when compared with options such as lengthening the school day (e.g., full-day kindergarten) or reducing class size. Further, the consistently null (reading) or negative (math) effects of basic content in our study indicate that the often tricky issue of "finding the time" to implement curricular changes might be accomplished with relative ease in this case. Time on advanced content could be increased while time on basic content is reduced without the need to increase overall instructional time. Future studies should explore the effects of increasing advanced and reducing basic content coverage in the earliest years of schooling.

Our study adds an important new dimension to understanding the effects of content coverage in kindergarten. We find that all children, regardless of preschool experiences or family economic circumstances, benefit from additional exposure to advanced reading and mathematics content in kindergarten. Complicating these results, we find that most children gain less in mathematics and stagnate (at best) in reading with additional exposure to basic content and that teachers report spending substantially more time on basic than advanced content. Our study suggests that exposing kindergartners to more advanced content in both reading and mathematics would promote skills among all children.

Notes

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[1]We use the terms *early childhood programs* and *preschool* interchangeably and are referring to the large and varied range of programs experienced by children prior to kindergarten entry.

[2]We use the longitudinal student weight, BYCOMW0, or, where appropriate, the teacher weight, B2TW0.

[3]As prior research (e.g., Magnuson, Meyers, Ruhm, & Waldfogel, 2004; Magnuson, Ruhm, & Waldfogel, 2007) has estimated the effect of preschool and preschool fadeout using the Early Childhood Longitudinal Study–Kindergarten Cohort (ECLS-K) we do not show these results in our main tables. However, Appendix C in the online journal provides estimates of preschool effects and fadeout, replicating this prior research.

[4]As an extension of our analyses, we examined whether there was an interaction between basic and advanced content exposure in mathematics and reading, respectively. In all cases, the coefficient on the interaction term was statistically insignificant and near zero.

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