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REPORT

FINAL REPORT

Pre-Kindergarten Impacts Over Time: An Analysis of KIPP Charter Schools

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EXECUTIVE SUMMARY

Despite the well-documented short-term positive impacts of early childhood education participation—and specifically pre-kindergarten (pre-K)—on multiple outcome domains, numerous studies have also shown that the observed effects of pre-K decrease ("fade out") or disappear altogether over time (Lipsey et al. 2015; Puma et al. 2012). Some experts argue that consistently high quality pre-K, aligned with later educational experiences, might produce more lasting impacts on student achievement than the typical pre-K currently available.

KIPP, a national network of public charter schools, provides a possible model for high quality pre-K aligned with an elementary school educational program. In previous research, KIPP has consistently demonstrated positive impacts on student achievement, including at the elementary school level (Tuttle et al. 2015). As of fall 2016, 27 KIPP elementary schools served students in pre-K. KIPP pre-K exhibits several features experts suggest might lead it to produce more lasting impacts than more traditional pre-K programs. Specifically, because KIPP pre-K students tend to continue their education in a KIPP elementary school—typically at the same school or campus as their pre-K experience—there is an increased likelihood that their later educational experiences will be aligned with their pre-K experiences. With increased alignment, it is more likely that the knowledge and skills acquired from later experiences will build on those developed in pre-K, thus leading to larger and more persistent impacts. Additionally, KIPP pre-K meets several of the criteria widely perceived to represent a high quality pre-K experience.

In this report, we build on a previous study of KIPP elementary schools to estimate the impact of an offer of admission to a KIPP pre-K program and explore whether any impacts persist as students advance beyond kindergarten. We summarize our key findings below.

- **After five years, KIPP pre-K combined with KIPP early elementary school has positive and statistically significant impacts on reading and math achievement.** We capitalized on randomized lotteries for entry to three KIPP pre-K programs to produce experimental estimates of the impact of an offer of admission to a KIPP pre-K. We found statistically significant or substantively important impacts on three of four measures of reading and math achievement, ranging in size from 0.31 to 0.43 standard deviation units. These impacts were educationally meaningful; for example, the Letter-Word Identification (reading skills) impact is approximately equivalent to a student moving from the 66th to the 80th percentile.
- **KIPP pre-K combined with KIPP early elementary school may also have a positive impact on students' executive function.** We used the same experimental design to measure the impact of KIPP pre-K on students' executive function—the "skills that help [to] plan, focus attention, switch gears, and juggle multiple tasks"—five years after admissions lotteries (Center on the Developing Child at Harvard University 2011). Although most impacts were not statistically significant, we found some suggestive evidence that an offer of admission to a KIPP pre-K may enhance some executive function skills, which are widely believed to be related to students' long-term academic success. Specifically, an offer of admission to KIPP pre-K had a positive or substantively important impact on students' working memory and ability to follow simple instructions.
- **KIPP pre-K may provide an additional benefit for reading achievement above and beyond KIPP elementary school.** To isolate the impact of KIPP pre-K, we produced experimental estimates of the impact of an offer of admission to a KIPP elementary school

in kindergarten (a school without pre-K) and compared them to the impacts of an offer of admission to a KIPP elementary school in pre-K. We found that the magnitude of the impacts in reading were larger for the KIPP schools that did offer pre-K than for those that did not do so, although the differences were not statistically significant. There were no differences in math. These results are exploratory, but they provide preliminary evidence that earlier and longer exposure to KIPP improves reading outcomes.

- **The KIPP impact on reading skills persists over time, but impacts on reading comprehension largely dissipate by grade 2.** We restricted our sample to the set of pre-K students with test scores in both kindergarten (three years after they participated in lotteries for admission to a KIPP pre-K) and grade 2 (five years after the same lotteries). We compared the size of the impacts at the two follow-up points and found that students who won an offer of admission to a KIPP pre-K program continued to outperform their peers on the Letter-Word Identification test in grade 2, but their peers had mostly caught up on the Passage Comprehension (reading comprehension) test.

We also identified six key features of the KIPP pre-K programs in our sample, based on interviews with KIPP staff at study schools. These features may provide helpful context about what could be driving the differences in impacts between KIPP pre-K and non-KIPP programs.

1. **The structure of the schools supported alignment across school levels.** Specifically, shared leadership over and/or co-location of the pre-K and elementary grades may have created opportunities for continuity and alignment across grades, and allowed elementary-grade staff to build off students' pre-K experiences at KIPP.
2. **KIPP pre-K programs were heavily focused on academics—particularly emphasizing foundational reading and math skills—during the study period**. Staff ranked reading and math knowledge and skills among their highest priorities during the study period, and employed varied instructional strategies in their classrooms.
3. **Curriculum and assessments were mostly teacher developed and contributed to alignment in instruction across grades.** Staff designed their own materials to instill the knowledge and skills required to be successful in later grades. They also helped to develop assessments used to measure progress toward this objective.
4. **KIPP pre-K was designed to establish values and build a behavioral foundation for later success at KIPP.** These values and behavioral expectations were taught explicitly and reinforced through relationships developed at the school.
5. **Supports for children and families varied across schools, but all schools heavily emphasized building relationships with students and their families.** Two programs provided robust child and family services during the study period. All schools in our sample placed a heavy emphasis on building strong relationships with students and their families.
6. **The training provided to staff varied considerably by school, but most teachers were relatively new to teaching and the pre-K grades.** The teachers in these programs were new to teaching and came from a variety of backgrounds. Administrators or instructional coaches in two programs regularly observed teachers and provided coaching or feedback.

Our findings support the growing consensus about effective pre-K programs and factors that help sustain their benefits and shed light on features that may merit replication and future study.

I. BACKGROUND

A. The KIPP network of schools

KIPP is a national network of public charter schools comprising 200 elementary, middle, and high schools in the 2016–2017 school year and serving 80,000 students.[1] KIPP schools serve a predominantly low-income and minority population; 88 percent of KIPP students are eligible for free or reduced-price lunches, and 96 percent are African American or Latino.[2]

KIPP schools emphasize rigorous academics and character instruction, with the ultimate goal of preparing students to succeed in college and beyond. The KIPP Approach is distinguished by five key principles that evolved from the Five Pillars, a set of operating principles that have historically guided KIPP schools (Text Box):[3]

The KIPP Approach

- **High expectations**: A culture of support and achievement and personalized learning based on a student's needs, skills, and interests.
- **Focus on character**: A belief that KIPP students need both a strong academic foundation and well-developed character strengths to succeed in college and the world beyond.
- **Highly effective teachers & leaders:** An emphasis on empowering educators to lead school teams and investment in training to help them grow as professionals.
- **Safe, structured, & nurturing environments:** Schools that are safe, structured, and nurturing environment so that KIPP students thrive and maximize their learning.
- **KIPP through college:** Counselors that support students as they prepare for college and career, and navigate social, academic, and financial challenges while in college.

All 200 2016–2017 KIPP schools are public charter schools, and nearly all have been charter schools since they opened. Thus, KIPP schools have greater autonomy in setting their own policies than do most traditional public schools but are accountable to their authorizers for achieving satisfactory performance.

B. KIPP has consistently demonstrated positive impacts in previous research

Mathematica's 2015 study of KIPP's Investing in Innovation (i3) scale-up grant, which used both experimental and quasi-experimental methods, found positive and statistically significant impacts of KIPP on student achievement across the elementary, middle, and high school grade levels, although the positive impacts for high schools were limited to those students who entered

[1] KIPP: Results. Are We Serving the Children Who Need Us? Available at http://www.kipp.org/results/national/#question-1:-are-we-serving-the-children-who-need-us. Accessed April 19, 2017.

[2] KIPP: Results. Are We Serving the Children Who Need Us? Available at http://www.kipp.org/results/national/#question-1:-are-we-serving-the-children-who-need-us. Accessed April 19, 2017.

[3] This description is adapted from the KIPP's description of the approach, available at www.kipp.org/approach.

KIPP for the first time in high school. The large positive impacts on test scores were consistent with previous studies of KIPP (Angrist et al. 2010; Furgeson et al. 2012; Gleason et al. 2014; Lake et al. 2012; Tuttle et al. 2013; Woodworth et al. 2008). The study included the first rigorous estimates of the effects of KIPP elementary schools. The elementary school analysis exploited lotteries at oversubscribed KIPP schools—those with more applicants than available seats—to produce estimates of the impact of KIPP elementary schools.

Mathematica found that the KIPP elementary schools in the study sample produced positive and statistically significant impacts on three measures of students' reading and mathematics skills after three years. On tests administered three years after entry, being offered admission to a KIPP elementary school led to an increase of 0.25 standard deviation units on the Letter-Word Identification test and 0.22 on the Passage Comprehension test in reading. In math, an offer of admission led to an increase of 0.28 standard deviation units on the Calculation test.

Evidence of KIPP's impact on other outcomes is less clear. The KIPP i3 study found that KIPP elementary and middle schools had positive impacts on school satisfaction, particularly among parents, and that KIPP high schools had positive impacts on several aspects of college preparation (Tuttle et al. 2015). At all three grade levels, KIPP had few significant impacts on measures of motivation and engagement related to student self-control, academic motivation, academic confidence, grit, school engagement, or effort in school. The study also found that KIPP had no impacts on student behavior at the elementary and middle school levels—the only levels at which Mathematica examined these outcomes.

C. Pre-kindergarten at KIPP

The first KIPP schools, which opened in 1994, were middle schools. In partnership with Doris and Don Fisher, founders of Gap Inc., the KIPP co-founders established the KIPP Foundation to support the expansion of the KIPP network in 2000. In 2004, the KIPP network began serving elementary grades. As of fall 2016, the KIPP network comprised 80 elementary schools, including 27 that served students in pre-kindergarten (pre-K).[4]

The decision to serve the pre-K grades at KIPP is a local one contingent on available resources. According to its regional staff, the push to serve students in the pre-K grades stemmed from a belief that an earlier start at KIPP better prepared students for academic success and facilitated KIPP's ultimate goal of supporting students to enroll and be successful in college. They reported that they viewed early exposure to literacy, language, and school behavioral or cultural expectations as particularly valuable to students who might otherwise enter school behind their peers—those who spoke English as a second language, were from homes not rich in print or language, and for whom pre-K was their first experience of spending time outside of the home. However, the availability of funding for these grade levels was also critical to allow KIPP schools in these cities to serve students in the pre-K grades.

[4] This number includes nine schools providing transitional kindergarten (California) and one school that serves children ages 6 months to 6 years, which is a partnership between KIPP Columbus and the YMCA of Central Ohio.

D. Pre-kindergarten produces positive impacts, but they tend to fade out

Early childhood education has been promoted at the state and local levels as a promising approach to increasing student achievement and school readiness (Flowers 2016). Participation in high quality early childhood education has been linked to improved outcomes across multiple developmental domains (Yoshikawa et al. 2013). Evidence of benefits for children from low-income families is particularly strong (Schanzenbach and Cascio 2013). Positive results have been found in evaluations of model programs (Elango et al. 2016) as well as state pre-K programs. Children who attended state pre-K have been found to have higher scores in math, receptive vocabulary, and early literacy (Gormley et al. 2008; Weiland and Yoshikawa 2013; Wong et al. 2008). In addition, one study found positive impacts on executive function, or "skills that help us plan, focus attention, switch gears, and juggle multiple tasks" (Center on the Developing Child at Harvard University 2011; Weiland and Yoshikawa 2013).

Despite the well-documented short-term impacts of early childhood education participation, and pre-K in particular, numerous studies have also shown that the observed effects of pre-K decrease ("fade out") or disappear altogether over time. For example, a randomized control trial of Tennessee's state pre-K program showed positive impacts at the beginning of kindergarten, but those impacts started to fade by the end of the kindergarten year (Lipsey et al. 2015). Evidence of fade out also has been documented elsewhere; for example, an experimental study of Head Start found positive impacts at the end of the Head Start year; by grade 3, however, there were no detectable differences (Puma et al. 2012). Given the extensive resources required to provide early childhood education on a large scale and the lack of evidence to date that the effects from pre-K are sustained over time, some observers have questioned whether the investment in these experiences is worthwhile.

E. The current study: Does KIPP pre-K produce more lasting impacts?

Some experts argue that consistently high quality pre-K, aligned with later educational experiences, might produce more lasting impacts on student achievement than the typical pre-K currently available. The theory is that the effects of pre-K programs may be better sustained if they are of consistently high quality—not simply in program features, such as staff qualifications and teacher-child ratios, but also in other characteristics, such as responsive teacher-child interactions and targeted developmentally appropriate learning activities (Yoshikawa et al. 2013). Another potential strategy is to better align instructional approaches and goals used in pre-K and the early elementary grades (Stipek et al. 2017; U.S. Department of Education 2016b).

KIPP pre-K presents an opportunity to extend the knowledge base about whether high quality and better-aligned pre-K may produce more lasting academic outcomes. KIPP meets several of the criteria widely perceived to represent a high quality pre-K experience, including staffing by well-educated teachers, low teacher-child ratios, and the use of developmentally appropriate learning activities. In addition, because KIPP pre-K students tend to continue their education in a KIPP elementary school—typically at the same school or campus as their pre-K experience—there is an increased likelihood that their later educational experiences will be aligned with their pre-K experiences. With increased alignment, it is more likely that the knowledge and skills acquired from later educational experiences will build on those developed in pre-K, thus leading to larger and more persistent impacts.

In this study, we build on the KIPP i3 Evaluation design to produce suggestive evidence about the magnitude of KIPP pre-K impacts and whether they persist over time. The evaluation addresses three research questions related to the impacts of KIPP pre-K and their persistence:

1. What is the cumulative impact of KIPP pre-K and KIPP elementary school on student outcomes measured in grade 2? (Research Question 1)
2. In grade 2, is the cumulative impact of KIPP, including pre-K, larger than the cumulative impact of KIPP without pre-K? (Research Question 2)
3. How does the size of any impacts of KIPP change over time for students who attended KIPP pre-K? (Research Question 3)

In the next chapter, we provide an overview of the research designs, data, and samples of schools and students that we employed to answer each research question. In Chapter III, we discuss findings related to these three questions. In Chapter IV, we contextualize our findings, using data from qualitative interviews with KIPP staff to describe the characteristics of KIPP pre-K. In Chapter V, we present our conclusions and discuss the implications of our findings for policy and practice.

II. RESEARCH APPROACH AND STUDY DESIGN

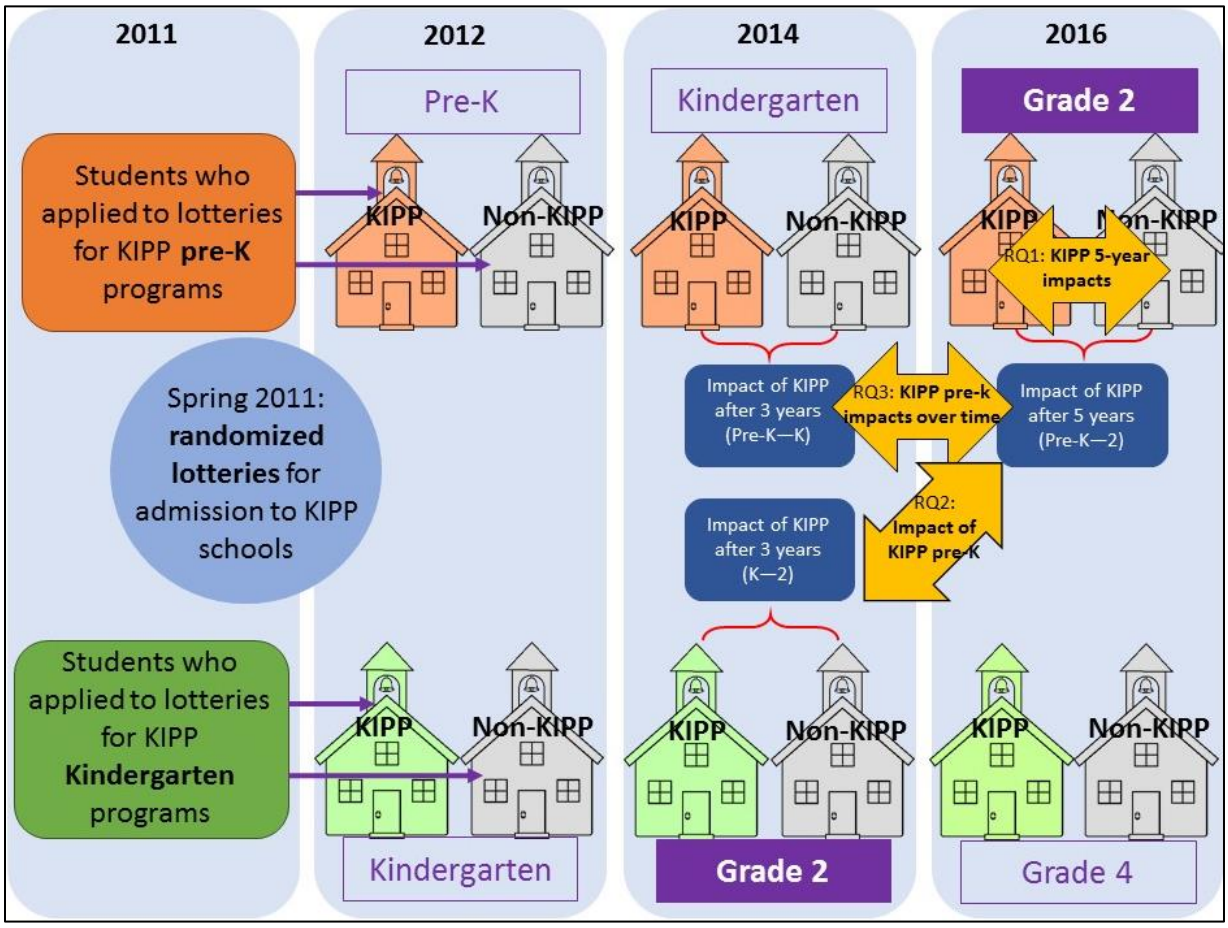
To address the research questions outlined in Chapter I, we built on the elementary school study from the KIPP i3 Evaluation. The i3 elementary study exploited randomized lotteries at oversubscribed KIPP schools—those with more applicants than available seats—to produce estimates of the impact of KIPP elementary schools. Schools conducted the lotteries in the spring and summer of 2011 for students enrolling at age 3 in three elementary schools offering pre-K and for students enrolling in five elementary schools starting in kindergarten for the 2011–2012 school year. The treatment group comprised students who participated in a lottery at either grade and won an offer of admission to a KIPP elementary school; the control group consisted of students who also participated in the lottery but did not receive an offer of admission. For the i3 evaluation, we compared the average impacts for students in the treatment and comparison groups after three years, combining students from both entry-grade levels in the estimates.

A well-executed randomized study design ensures that there are no systematic baseline differences between the treatment and control groups in both observable differences (such as academic achievement; family characteristics; and age, gender, and race) and unobservable characteristics (such as student motivation and perseverance). At the time of admission to KIPP, treatment and control group students were distinguishable only by the luck of their lottery draws; thus, any subsequent differences in their outcomes could be attributed to the impact of having the opportunity to attend a KIPP school.

Figure II.1 illustrates the approach we used to address each research question for the current study. The top panel follows the students who applied at age 3 for admission to a KIPP school that offered pre-K classes ("the pre-K cohort"); the bottom panel follows those who applied for admission beginning in kindergarten to a KIPP school that did not offer pre-K classes ("the kindergarten cohort"). For both cohorts, students were assigned either to the treatment condition (represented by orange [pre-K] or green [kindergarten] schools in the figure) or the control condition (represented by the grey schools in both panels). Moving from left to right, the figure shows the grade in which the typical sample student would be enrolled during the spring and summer of 2014 (when we collected outcome data for the i3 evaluation), and the spring and summer of 2016 (when we followed the pre-K cohort from the i3 evaluation and collected additional data for this study). The blue boxes represent the experimental impact estimates we calculated for the study; the yellow arrows highlight the contrast of interest for each research question.

To address Research Question 1, we focused on students in the pre-K cohort from the i3 evaluation (the top panel in Figure II.1). We compared grade 2 outcomes for the treatment students—those who won admission to (and predominantly attended) a KIPP pre-K—to grade 2 outcomes for the control students—those not offered admission to a KIPP pre-K. Because this comparison uses a random process to determine who can receive the KIPP pre-K treatment, it is the most rigorous way to measure its longer-term effect on student achievement relative to children's other early education options.

Figure II.1. Study design



To isolate the effect of KIPP pre-K (Research Question 2), we tested whether the five-year impact of KIPP for the pre-K cohort (represented by the far right-hand dark blue box in the top panel of Figure II.1) is different from the three-year impact of KIPP for the kindergarten cohort (represented by the dark blue box in the bottom panel). Because both cohorts experienced the impacts of KIPP in kindergarten through grade 2, but only the pre-K cohort experienced the impacts of KIPP in pre-K, any difference represents an estimate of the additional benefit of attending KIPP pre-K over and above that of attending KIPP from grades kindergarten through 2. Unlike the estimates for Research Question 1, these impact estimates are not causal; however, they still provide preliminary evidence as to the marginal benefit of attending KIPP pre-K.

Finally, to explore how the impacts of admission to a KIPP school change over time (Research Question 3), we compared the size of the impacts for the pre-K cohort at kindergarten to those for the same cohort at grade 2 on the same academic tests (represented by the two blue boxes in the top panel of Figure II.1). Comparing impacts longitudinally for the same group of students over time provides us with insight into whether the size of any impacts from KIPP pre-K through kindergarten appears to increase, decrease, or remain steady as the children in both the treatment and comparison groups proceed to later grades.

A. Study samples

The sample for Research Question 1 included three oversubscribed KIPP elementary schools that also provided pre-K—schools that had substantially more applicants in an entry grade than seats to serve students—in two KIPP cities. Across the three schools, we randomized 473 students into treatment and control groups using the admissions lottery. For Research Question 2, we compared impacts for the same pre-K sample from Research Question 1 to impacts from our sample of kindergarteners. The kindergarten sample included five oversubscribed KIPP schools in four KIPP cities. Across the five schools, we randomly assigned 624 students to the treatment and control groups. Table II.1 summarizes the geographic location, entry grade, and year opened for each school in our study sample for each research question.

Table II.1. Characteristics of schools in the samples

School	City	Entry grade	Year opened	Research question		
				1	2	3
KIPP SHARP	Houston	Pre-K3	2008	X	X	X
KIPP SHINE Prep	Houston	Pre-K3	2004	X	X	X
KIPP LEAP Academy	Washington, DC	Pre-K3	2007	X	X	X
KIPP Academy Elementary	New York City	Kindergarten	2009		X	
KIPP Infinity Elementary	New York City	Kindergarten	2010		X	
SPARK Academy	Newark	Kindergarten	2009		X	
KIPP Philadelphia Elementary Academy	Philadelphia	Kindergarten	2010		X	
KIPP Raíces Academy	Los Angeles	Kindergarten	2008		X	

Our analytic sample varied by cohort and for each outcome year. For example, for the five-year estimates of the impact of admission to a KIPP school in pre-K (Research Question 1), we had outcome data from 52 percent of our original treatment sample (96 students) and 51 percent of our original control sample (147 students). For Research Question 2, the analytic sample included 243 students from the pre-K cohort and 386 students from the kindergarten cohort with valid test scores from grade 2. Table II.2 displays sample sizes for each cohort and outcome year by treatment and control group.

Table II.2. Student sample sizes

	Pre-K cohort			Kindergarten cohort		
	Treatment	Control	Total	Treatment	Control	Total
Baseline sample	183	290	473	290	334	624
Analytic sample (kindergarten follow-up)	104	164	268	n.a.	n.a.	n.a.
Analytic sample (grade 2 follow-up)	96	147	243	180	206	386
Analytic sample (longitudinal analysis)[a]	78	121	199	n.a.	n.a.	n.a.

[a]The longitudinal sample contains students with outcome data at both kindergarten and grade 2. We used this sample to answer Research Question 3.

n.a. = not applicable.

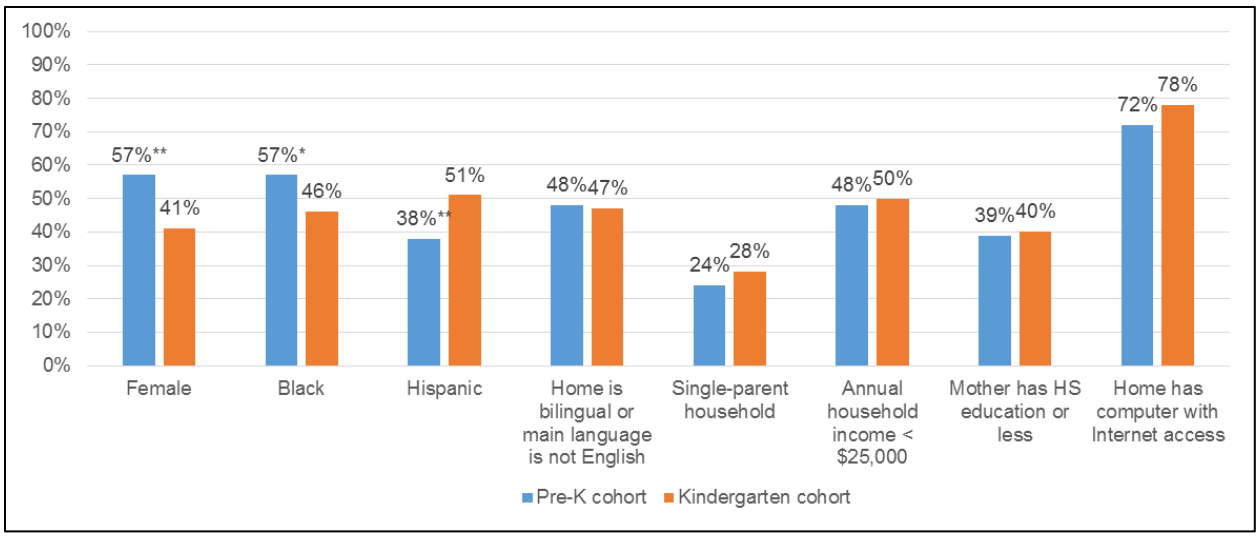
To examine changes in KIPP impacts over time (Research Question 3), we restricted the analytic sample to students who had test outcome data for both kindergarten and grade 2. Across the three pre-K schools, this sample included 199 students—78 in the treatment group and 121 in the control group. This sample poses some additional analytical challenges because the students we observed at both time periods could have been systematically different than students tested only in kindergarten or only in grade 2. Still, the academic impacts trend line for stayers provides useful information about how impacts change over time for the same group of students. (The appendix provides more information on sample composition and the differences between these groups of students.)

Across all analyses, we included lottery winners in the treatment group and lottery losers in the control group, regardless of whether they ultimately enrolled in a KIPP school. As a result, the lottery-based design produces estimates of the impact of an *offer of admission* to a KIPP school (typically referred to as an intent-to-treat, or ITT, estimate) rather than the impact of *attending* a KIPP school. Most lottery winners do attend a KIPP school, however, and most of those not offered admission never do. According to attendance records, among students in our pre-K analytic sample, 81 percent of lottery winters (treatment group) enrolled in a KIPP school between the 2011–2012 and 2015–2016 school years (ever enrolled), and 50 percent were still enrolled in a KIPP school in the 2015–2016 school year—five years after the lottery. A total of 19 percent of lottery non-winners (control group) ever enrolled in a KIPP school; 13 percent remained enrolled in a KIPP school five years later.[5] These differences in enrollment rates show a clear difference between the treatment and control groups in exposure to KIPP schools. We did not include in the analysis all students enrolling in a study school in the entry grade because some were admitted outside of the lottery (for example, if a student had a sibling already enrolled); across all eight schools in both cohorts, 61 percent of open slots were filled via the lottery.

We examined the average characteristics of the students in our analytic sample at the time of the lottery by using information from a baseline survey of the parents of students applying to the KIPP schools (Figure II.2). The two cohorts are similar on several characteristics, such as mother's education, household income, and language spoken at home. However, there are pronounced gender and racial differences across the cohorts. The racial differences are likely due to the regional locations of the schools. (The appendix provides additional detail on sample members' characteristics, types of schools attended, and the baseline equivalence of our samples.)

[5] We collected attendance data for the 2011–2012, 2012–2013, and 2013–2014 school years as part of the KIPP i3 Evaluation from the individual KIPP elementary schools included in the study. We collected attendance data for the 2014–2015 and 2015–2016 school years from the KIPP Foundation, and included data from all KIPP early childhood and elementary schools in the jurisdictions that encompassed our pre-K sample schools. The KIPP Foundation records indicate that some of the students in our sample (both treatment and control) ultimately enrolled in other KIPP schools not included in the study. More detail on the attendance patterns at KIPP schools is provided in the appendix.

Figure II.2. Characteristics of students in the samples



Notes: We obtained these data from the baseline survey of parents of applicants to KIPP elementary schools in spring 2011. The sample includes data obtained for 223 students from the pre-K cohort and 360 students from the kindergarten cohort who also have grade 2 outcome data, inclusive of students assigned to both the treatment and control groups.

*Difference between cohorts is statistically significant at the 0.05 level, two-tailed test.

**Difference between cohorts is statistically significant at the 0.01 level, two-tailed test.

B. Outcome measures and data collection

To measure academic achievement and executive function, we administered a series of tests to students in our sample. To measure academic achievement, we administered four tests of the Woodcock-Johnson III (WJ-III) Tests of Achievement.[6] We also administered two tests of executive function to the pre-K cohort five years after random assignment, when most students were in grade 2: (1) the Hearts & Flowers assessment, which measures cognitive flexibility; and (2) the WJ-IV Verbal Attention test, which measures working memory. Table II.3 describes each study test and details which tests were administered to each cohort and at what point in time.

We standardized the students' WJ-III and WJ-IV scores into z-scores, using information on the performance of a nationally representative norming population. Thus, each student's score represents his or her achievement level relative to the national average for students at that grade level: scores greater than zero represent above-average achievement in the domain being tested; scores less than zero represent below-average achievement. Because no national norming data are available for the Hearts & Flowers assessment, these outcomes were converted into z-scores using sample means and standard deviations, so scores represent students' performance relative to other students in our sample.

[6] We selected the WJ-III because, relative to other tests for this age range, it (1) posed a low testing burden on young students in the amount of time it takes to administer and (2) has a reliability for students ages 6 to 9 of greater than 0.90 for the reading tests and greater than 0.80 for the math tests (McGrew et al. 2007).

Table II.3 Summary of outcome measures and testing periods

Study administered test	Description	Outcome grade (cohort)		
		K (Pre-K)	2 (Pre-K)	2 (K)
Academic outcomes				
WJ-III Letter-Word Identification	Measures reading skills. Children name letters and read words of increasing difficulty.	X	X	X
WJ-III Passage Comprehension	Measures reading comprehension. Children silently read and complete sentences based on understanding of a sentence or passage.	X	X	X
WJ-III Calculation[a]	Measures students' skill in analyzing and solving practical math problems. Children answer questions and solve word problems to demonstrate understanding of math concepts and vocabulary.		X	X
WJ-III Applied Problems[b]	Measures students' ability to perform mathematical computations. Children solve algorithms and equations of increasing difficulty.		X	
Executive function outcomes				
WJ-IV Tests of Cognitive Abilities Verbal Attention	Measures working memory. Students listen to an intermingled series of animal names and digits presented orally, and respond to questions about each of the sequences presented (for example, "What animal came before the 5?").		X	
Hearts & Flowers	Measures working memory, inhibitory control, and cognitive flexibility. Stimuli (a heart or flower) appear on the right or left side of the screen. There are three parts to this task—congruent, incongruent, and mixed conditions. In the congruent condition (hearts), only a heart appears, and students press on the same side as the heart, requiring students to follow a simple rule. In the incongruent condition (flowers), only a flower appears, and students press on the side opposite the flower, requiring students to exercise inhibitory control. In the mixed condition (hearts and flowers), congruent and incongruent trials appear randomly, requiring subjects to switch flexibly between the two rules (cognitive flexibility). Students also use working memory to recall the rules and implement them. For each part of the task, the score captures whether a student answered correctly and their average reaction time.		X	

Note: "Outcome grade" refers to the grade level of a majority of the sample at that point in time.

[a]We did not administer the Calculation test to kindergarten students because the test is not age appropriate.

[b]We administered the Applied Problems test to students in both cohorts for the KIPP i3 Evaluation, but an error in test administration limited variation on the assessment, making it less likely we would detect impacts of KIPP elementary schools. As a result, in this report we do not use data from the Applied Problems test administered in 2014.

To understand the pre-K experience of the students in the sample, we also conducted semi-structured interviews of KIPP staff who were administrators or staff members at the three KIPP pre-K programs serving as the focus of our pre-K impact estimates. Interviewees served in various roles during the time when our sample was attending pre-K, including those of principal, instructional leader, or teacher. Interviews focused on the characteristics of the programs; the instructional approaches, curriculums, and assessments the programs employed; the supports the programs provided to families; and the experiences and training provided to program staff during the 2012–2013 school year, when the students in our impact sample were typically 4 years old, attending their second year of pre-K (PK4). We conducted the interviews in February 2017—five

years after the time period of interest. Although staff were unable to answer some questions, they could often consult other staff or historical documents to provide accurate reporting on the period of interest.

C. A note of caution

Although the experimental estimates of the impact of KIPP after five years (Research Question 1) are based on a rigorous methodological approach, the sample size for that analysis is relatively small. Thus, we may not have sufficient power to detect impacts that are not large in magnitude. In addition to having a small sample, the contrasts we used to address Research Questions 2 and 3 are not experimental, meaning that any impacts we observe may be due to, or influenced by, factors other than KIPP pre-K. For example, the students in our pre-K cohort differed in key, observable ways from those in our kindergarten sample, including gender and race. Although we controlled for these observed differences in our analysis, there may also be unobserved differences across the groups that can affect outcomes. For Research Question 3, changes in the size of the impact of KIPP over time could also result from other changes occurring during the same time period—for example, a new program implemented in the district attended by the comparison students between the two data collection periods. Further, for this research question, we restricted our analysis to a subsample of students we tested at both kindergarten and grade 2. Unobserved characteristics related to students' likelihood of completing tests at both time periods may mean that any patterns we observed for this subsample of students are less representative of those for the full sample. Still, the analyses in this report represent exploratory attempts to learn whether the impacts of KIPP pre-kindergarten might persist for longer than those observed for other programs. If we find suggestive evidence that this persistence is true, it suggests that further, more rigorous study of KIPP and similar pre-K programs is merited.

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III. IMPACTS OF KIPP PRE-K AND EARLY ELEMENTARY SCHOOL

In this chapter, we address the study's three key research questions defined in Chapter I. We find rigorous evidence that the cumulative academic impacts of KIPP pre-K and early elementary school are large and statistically significant after five years. Although the size of the analytic sample limits our ability to draw conclusive findings, we also find suggestive evidence that KIPP pre-K may provide an added benefit above and beyond that of KIPP elementary school without pre-K. Finally, looking at trends over time, we find suggestive evidence that students who won an offer of admission to KIPP pre-K appear to maintain an academic advantage over their peers who did not win such an offer on one measure of reading achievement (Letter-Word Identification) as they reach grade 2, although the size of their advantage on the other measure (Passage Comprehension) appears to decrease, but not disappear, over time. Taken together, these results provide preliminary evidence that KIPP pre-K positively affects student achievement and the impact persists to some degree once students reach grade 2.

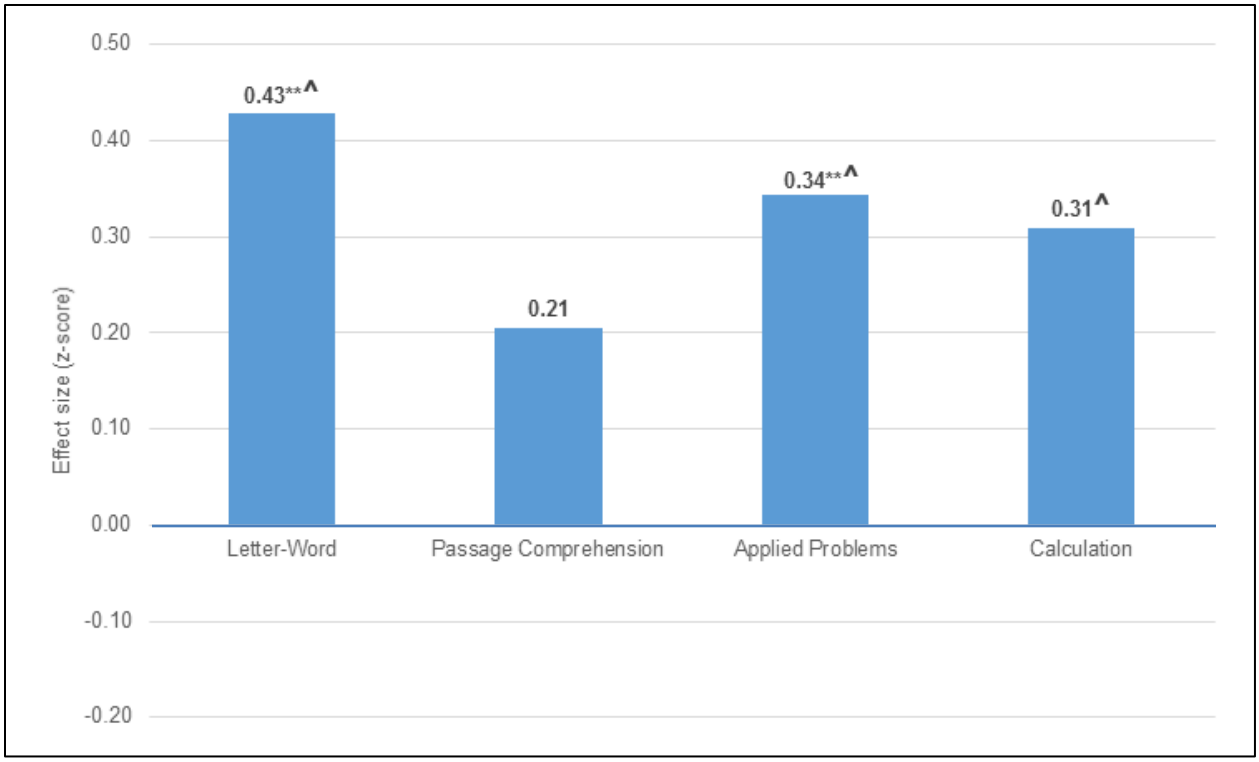
A. After five years, KIPP pre-K and KIPP early elementary has positive and statistically significant impacts on reading and math achievement (Research Question 1)

Being offered admission to KIPP pre-K had a large and statistically significant positive impact on students' Letter-Word Identification score five years after admission, when most students were in grade 2 (Figure III.1). The increase of 0.43 standard deviation units for the treatment group is approximately equivalent to a student moving from the 66th to the 80th percentile.[7] For the Passage Comprehension assessment, an offer of admission had a positive but not statistically significant impact of 0.21 standard deviation units after five years. The precision of our impact estimates is constrained by the size of the pre-K sample we followed from the KIPP i3 Evaluation; we anticipated being able to detect impacts only as small as 0.32 standard deviation units. Nonetheless, this estimate is approximately equivalent to a student moving from the 29th to 36th percentile on the assessment.

In math, an offer of admission to KIPP pre-K had positive impacts of similar magnitude on both outcome measures. On the Applied Problems assessment, this offer had a statistically significant positive impact of 0.34 standard deviation units—approximately equivalent to moving a student from the 47th to the 60th percentile. On the Calculation assessment, the impact of 0.31 standard deviation units was not statistically significant; however, it did meet the What Works Clearinghouse (WWC)'s threshold for being substantively important, defined as an effect size of 0.25 or larger, regardless of statistical significance. This effect size is approximately equivalent to a student moving from the 46th to the 58th percentile on the assessment.

[7] For each outcome measure, we use the percentile corresponding to the control group students' mean score to show average student achievement without the intervention.

Figure III.1. KIPP academic impacts after five years



Source: Study tests administered in spring and summer 2016.

Notes: Outcomes measured on WJ-III Tests of Achievement, administered in the spring of the fifth follow-up year, when most students were in grade 2. All impacts are displayed in z-scores and represent ITT estimates based on regression models that control for baseline covariates. The analytic sample comprises 96 students from the treatment group and 147 from the control group that are part of the pre-K cohort.

*Impact estimate is statistically significant at the 0.05 level, two-tailed test.

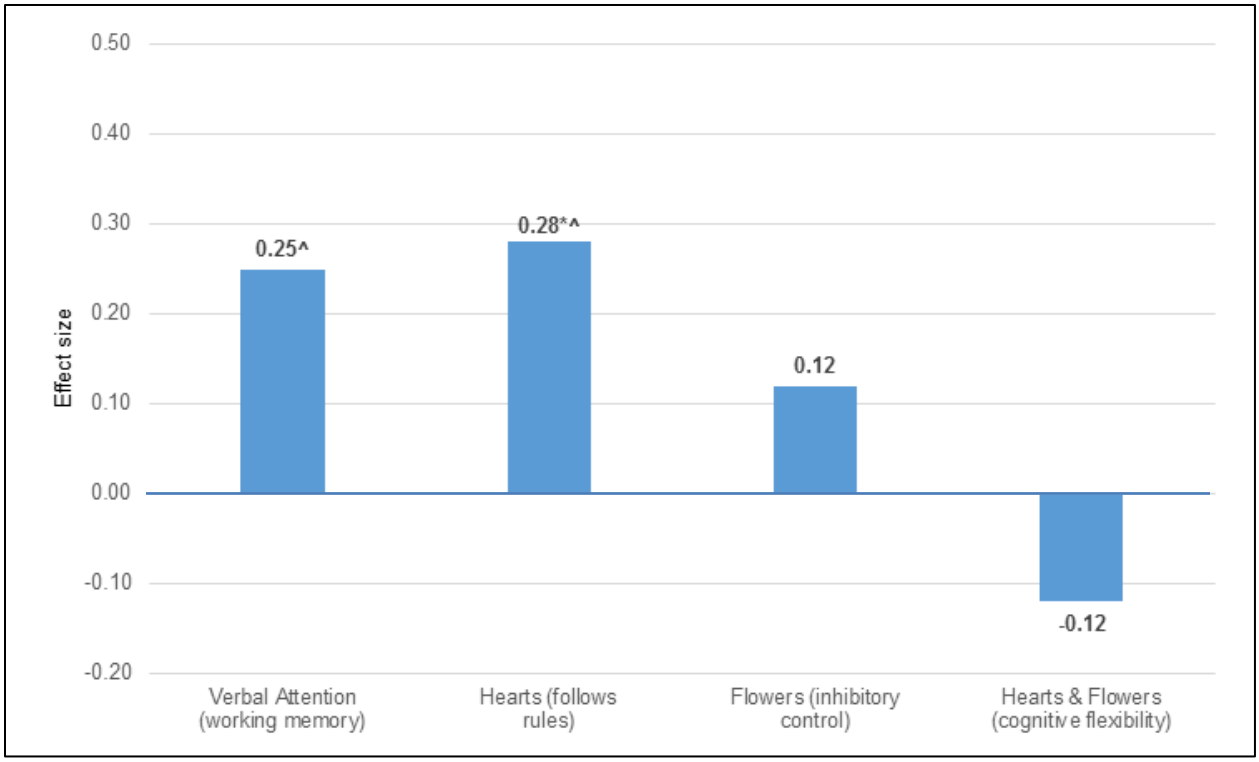
**Impact estimate is statistically significant at the 0.01 level, two-tailed test.

^Impact estimate is substantively important (effect size >= 0.25 standard deviation units).

B. KIPP pre-K and KIPP early elementary may also have a positive impact on students' executive function (Research Question 1)

Although most impacts on students' executive function are not statistically significant, we find some suggestive evidence that an offer of admission to a KIPP pre-K may enhance some of those skills, which are widely believed to be related to students' long-term academic success. An offer of admission to KIPP pre-K had a positive and substantively important impact of 0.25 standard deviation units on students' scores on the Verbal Attention assessment after five years, when most students were in grade 2. This impact was not statistically significant. Results on the Hearts and Flowers assessments varied. An offer of admission to KIPP pre-K had a statistically significant positive impact on students' ability to follow simple instructions (0.28 standard deviation units). The impact on students' inhibitory control was also positive but smaller and not significant. On the other hand, an offer of admission to KIPP pre-K had a negative (but not statistically significant) impact on students' cognitive flexibility (0.12 standard deviation units). Figure III.2 shows complete results for the executive function impacts.

Figure III.2. KIPP executive function impacts after five years



Source: Study tests administered in spring and summer 2016.

Notes: Outcomes are measured on the WJ IV Tests of Cognitive Abilities and the Hearts & Flowers assessment from Adele Diamond's lab at the University of British Columbia. We administered both measures in the spring of the fifth follow-up year, when most students were in grade 2. All outcomes are displayed as z-scores and represent ITT estimates based on regression models that control for baseline covariates. The analytic sample varies by outcome measure—it is between 93 and 96 students for the treatment group and between 144 and 147 students for the control group (all from the pre-K cohort).

*Impact estimate is statistically significant at the 0.05 level, two-tailed test.

**Impact estimate is statistically significant at the 0.01 level, two-tailed test.

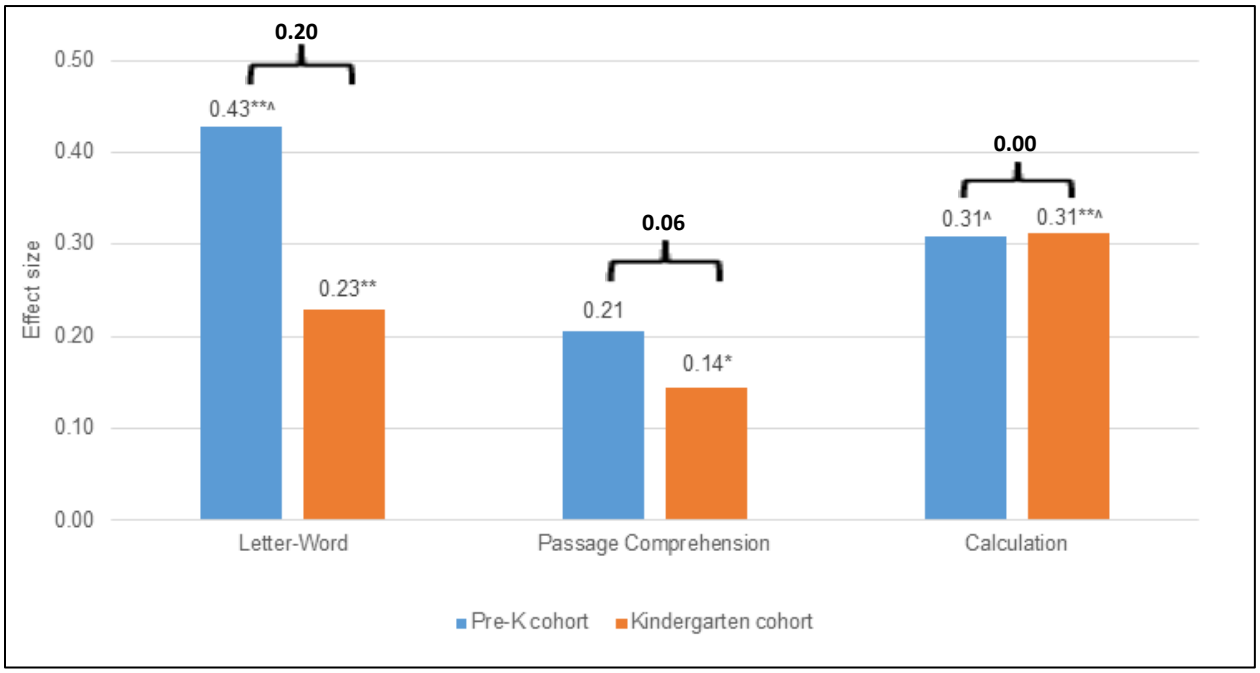
^Impact estimate is substantively important (effect size >= 0.25 standard deviation units).

These latest findings are based on assessments that require students to demonstrate specific skills and consequently minimize reference bias. Executive function measures used in previous studies of KIPP were limited in that they were self-reported by students and parents, and therefore may have suffered from reference bias, wherein KIPP students or parents of students attending KIPP schools may have a consistently different frame of reference when answering survey questions about their attitudes, behavior, and experiences (Tuttle et al. 2013; Tuttle et al. 2015).

C. KIPP pre-K may provide an additional benefit for reading achievement above and beyond KIPP elementary school (Research Question 2)

In reading, the magnitude of the positive impact was larger for the pre-K cohort than the kindergarten cohort on both the Letter-Word and Passage Comprehension tests administered in grade 2 (by 0.20 and 0.06 standard deviation units, respectively, Figure III.3). Neither of these differences is statistically significant; however, the study did not have sufficient power to detect differences of this magnitude. Thus, they may be suggestive of some additional benefit in reading resulting from an offer of admission to KIPP pre-K, above and beyond the impact of an offer to KIPP in kindergarten. In math, however, the impacts for both samples are identical, suggesting no additional benefit of KIPP pre-K beyond the impact of a KIPP elementary school.[8]

Figure III.3. Isolated impact of KIPP pre-K in grade 2



Source: Study tests administered in spring and summer 2016 for the pre-K cohort and in spring and summer 2014 for the kindergarten cohort.

Notes: Outcomes are measured on WJ-III Tests of Achievement, administered in the spring and summer of 2014 for the kindergarten cohort and the spring and summer of 2016 for the pre-K cohort, when most students in both samples were in grade 2. All impacts are displayed in z-scores and are ITT estimates based on regression models that pool all schools and control for baseline covariates. Differences in impact estimates between cohorts are not significant for each test outcome. The analytic sample for the pre-K cohort comprises 96 students from the treatment group and 147 from the control group. For the kindergarten cohort, the analytic sample varies from 176 to 177 students for the treatment group and from 195 to 204 students for the control group depending on the outcome measure.

*Impact estimate is statistically significant at the 0.05 level, two-tailed test.

**Impact estimate is statistically significant at the 0.01 level, two-tailed test.

^Impact estimate is substantively important (effect size >= 0.25 standard deviation units).

[8] All three kindergarten cohort impacts were positive and statistically significant. Appendix Table 6 provides more detail on results specific to the kindergarten cohort. These cohort-specific results are consistent with previous research on KIPP schools that has found positive and statistically significant impacts of KIPP on academic achievement (Tuttle et al. 2013; Tuttle et al. 2015).

Although these results are exploratory and based on a small sample of KIPP schools that offer pre-K, they suggest that earlier and longer exposure to KIPP improves reading outcomes. It is possible that KIPP pre-K has a stronger focus on reading achievement relative to other programs and/or its pre-K curriculum is better aligned with early elementary grades, resulting in a larger cumulative impact at grade 2. We explore these themes further in Chapter IV.

D. The KIPP impact on Letter-Word Identification scores persists over time, but impacts on Passage Comprehension largely dissipate by grade 2 (Research Question 3)

Students offered admission to KIPP in pre-K scored statistically significantly higher on Letter-Word Identification than students not offered admission. The students who won admission continued to score significantly higher than those who did not when they were tested in grade 2 (Figure III.4).[9] The change in the impact estimates over time (1.58 points) was not statistically significant, meaning that the positive impact of KIPP measured in kindergarten was maintained in grade 2.[10] Though the students admitted to KIPP in pre-K continued to outperform their peers over time, both groups of students experienced similar levels of growth on this measure over time.

The results for the Passage Comprehension assessment tell a different story (Figure III.5). In kindergarten, students who won admission to KIPP pre-K had higher scores on the Passage Comprehension assessment than those who did not. The difference in scores was statistically significant. By grade 2, however, that difference decreased considerably and was no longer statistically significant. Although both groups scored higher in absolute terms in grade 2 than in kindergarten, the students who did not win admission to KIPP largely caught up to the students who did by grade 2. The difference in impacts between kindergarten and grade 2 (-8.46 points) is statistically significant.

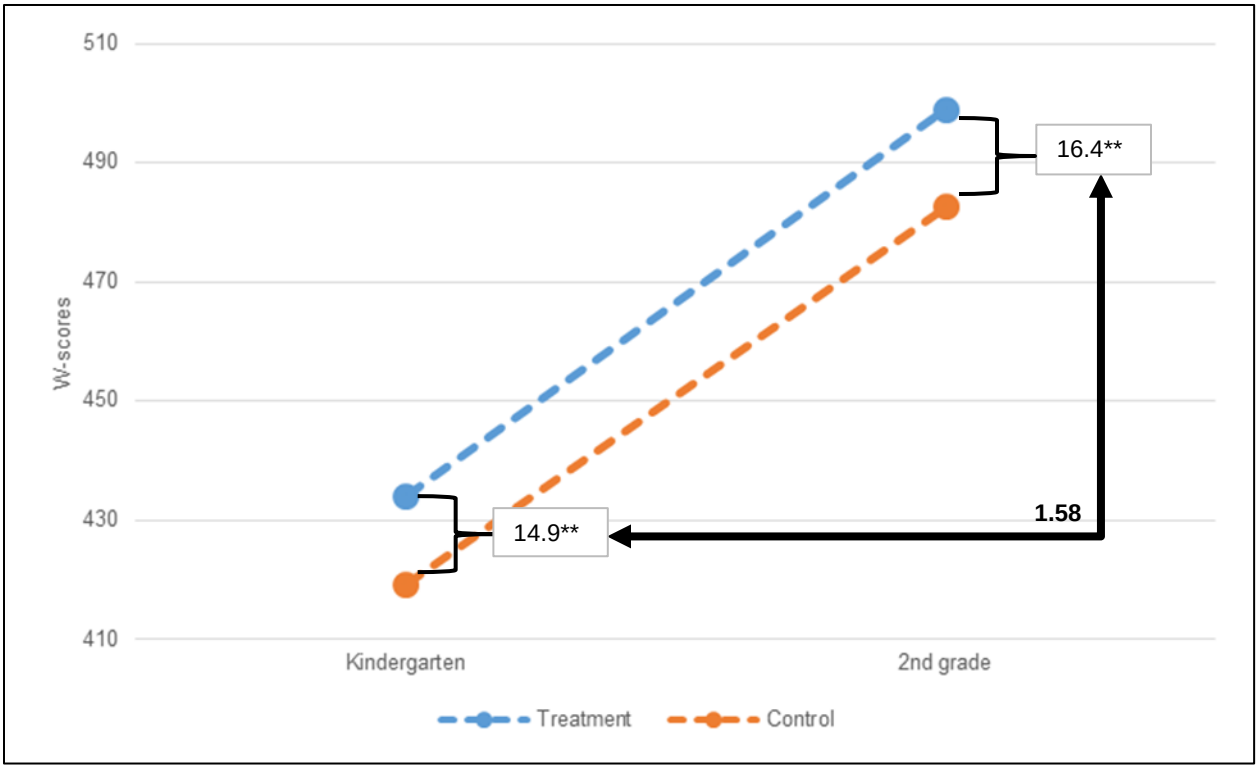
As we mentioned in Chapter II, these analyses are exploratory and should be interpreted with caution. In particular, the sample for this longitudinal analysis is composed of students who completed study-administered testing at two different time periods; this sample differs from the full sample of students who applied to KIPP pre-kindergarten. We discuss these differences in more detail in the appendix.

Taken together, the results in this chapter provide early evidence that KIPP pre-K produces lasting, positive impacts on student achievement. In Chapter IV, we contextualize these findings by describing the experiences of students in the study groups.

[9] Figures III.4 and III.5 display the mean results for the students who won an offer of admission to a KIPP pre-K (blue dots) and students who did not (orange dots) at two time points: three years after the admissions lotteries (when most students in our sample were in kindergarten) and five years after the lotteries (when most students in our sample were in grade 2).

[10] For this analysis, the mean scores for the treatment and control groups are presented as W scores. W scores are equal-interval scores—that is, a change at one point on the scale is equal to a change at another point on the scale. The scores reflect the relative difficulty of the items such that children who correctly respond to more difficult items receive credit for knowing more challenging information. As a result, the W scores allow us to visualize absolute student progress over time.

Figure III.4. Changes in Letter-Word Identification scores over time



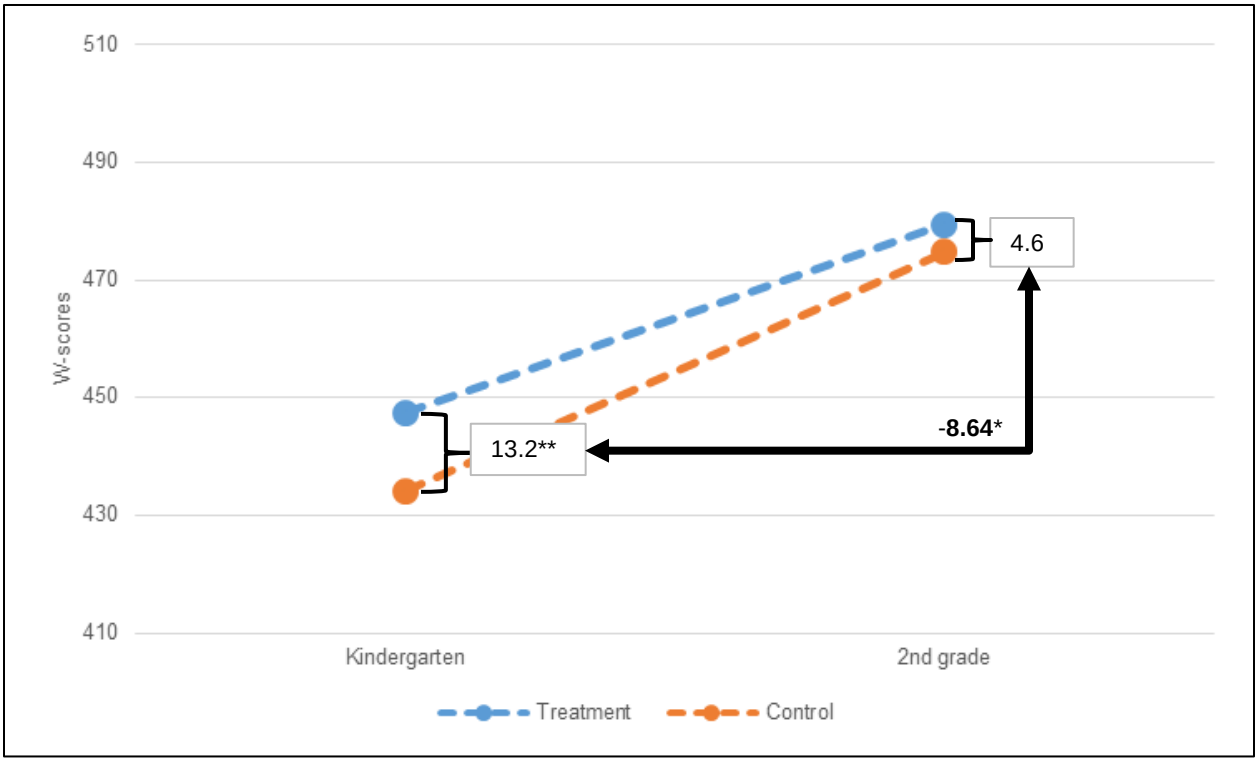
Source: Study tests administered in spring and summer 2014 and 2016.

Notes: Letter-Word Identification is measured on the WJ-III Tests of Achievement, administered in the spring and summer of 2014 for the pre-K cohort in kindergarten and the spring and summer of 2016 for the pre-K cohort in grade 2. Impacts estimates are displayed in the boxes as W-scores, which adjusts for the grade-level difficulty of the test, and are ITT based on regression models that pool all schools and control for baseline covariates. The dotted lines illustrate trends in students' scores on this outcome over time. The bold value at the intersection of the bold arrows displays the change in the size of the impact estimate measured in grade 2 compared with that measured in kindergarten. A positive number indicates the size of the impact of KIPP increases over time; a negative number means that the size of the impact decreased. The sample comprises 78 students in the treatment group and 121 students in the control group from the pre-K cohort.

*Impact estimate is statistically significant at the 0.05 level, two-tailed test.

**Impact estimate is statistically significant at the 0.01 level, two-tailed test.

Figure III.5. Changes in Passage Comprehension scores over time



Source: Study tests administered in spring and summer 2016.

Notes: Passage Comprehension is measured on the WJ-III Tests of Achievement, administered in the spring and summer of 2014 for the pre-K cohort in kindergarten and the spring and summer of 2016 for the pre-K cohort in grade 2. Impacts estimates are displayed in the boxes as W-scores, which adjusts for the grade-level difficulty of the test, and are ITT based on regression models that pool all schools and control for baseline covariates. The dotted lines illustrate trends in students' scores on this outcome over time. The bold value at the intersection of the bold arrows displays the change in the size of the impact estimate measured in grade 2 compared with that measured in kindergarten. A positive number indicates the size of the impact of KIPP increases over time; a negative number means that the size of the impact decreased. The sample comprises 78 students in the treatment group and 121 students in the control group from the pre-K cohort.

*Impact estimate is statistically significant at the 0.05 level, two-tailed test.

**Impact estimate is statistically significant at the 0.01 level, two-tailed test.

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IV. KIPP PRE-KINDERGARTEN EXPERIENCE

Although most students in the study attended a school-based educational program at ages 3 and 4, students in the treatment group were much more likely to be enrolled in KIPP at some point during the five years after admissions lotteries for KIPP pre-K programs. These students also experienced more years of exposure to KIPP on average. Regarding the pre-K experience KIPP schools provided to students in our sample, several program features may have contributed to its large impacts and their greater persistence over time. In particular, KIPP pre-K programs attended by students in our sample focused heavily on academics. Other specific features of the KIPP schools may have contributed to alignment between the educational experience of students in pre-K and early elementary grades. We discuss each of these findings in more detail in this chapter.

A. Schools attended by students in the sample

Among the students in the analytic sample for the pre-K cohort, 81 percent of lottery winners (treatment students) ever enrolled in a KIPP school, whereas 19 percent of those who did not win an admissions lottery to one of our sample schools in spring and summer 2011 (control students) still ended up attending KIPP at some point during the follow-up period (Table IV.1). The 62 percentage-point difference in enrollment rates provides a clear contrast between treatment and control students in exposure to KIPP schools. Contrasting the enrollment for our analytic sample to the enrollment for the baseline sample based on the original lotteries, we find that students who ultimately enrolled in KIPP were more likely to remain in the study than students who did not, regardless of whether the students were initially assigned to the treatment or comparison groups.

The enrollment contrast gradually decreased over the study period but remained large. By the time we measured impacts for the pre-K cohort in grade 2, 60 percent of treatment students in our analytic sample were still enrolled in a KIPP school, compared to 16 percent of control students in our pre-K sample. Although the percentage-point difference in enrollment rates decreased over time, there is still a strong difference between the KIPP exposure of students in the study groups—on average, students in the treatment group attended KIPP for 3.31 years, compared to an average of 0.51 years for students in the comparison group.

Although enrollment rates at KIPP differed, most students in both the treatment and comparison groups attended some form of school-based educational program (at a charter, traditional public, or private school) at ages 3 and 4 (Table IV.2). The large majority of students in both the treatment and control groups (86 percent and 88 percent, respectively) regularly attended a center-based early childhood program when they were ages 3 and 4, according to their parents (not shown). The remaining 14 percent of treatment students and 12 percent of control students did not attend an early childhood program regularly during the pre-K years. At age 3, almost a quarter of students in the control group attended a non-school-based program, such as a day care or nursery school (24 percent), compared with only 12 percent of students in the treatment group; by age 4, fewer than 10 percent of both groups attended a day care or a nursery school.

Table IV.1. Sample enrollment at KIPP

Enrollment at KIPP	Analytic sample		Baseline sample	
	Treatment	Control	Treatment	Control
Percentage ever enrolled at KIPP	81	19	71	16
Percentage enrolled at each time period (grade)[a]				
Fall 2011 (PK3)	78	5	68	4
Spring 2012 (PK3)	76	5	67	4
Spring 2013 (PK4)	66	6	59	6
Spring 2014 (Kindergarten)	65	7	55	7
Spring 2015 (grade 1)	65	16[b]	54	13[b]
Spring 2016 (grade 2)	60	16	50	13
Mean years of enrollment at KIPP	**3.31**	**0.51**	**2.84**	**0.43**

Source: We collected enrollment data from 2011–2012 through 2013–2014 school years for the KIPP i3 Evaluation from the individual KIPP schools in our study sample. We collected enrollment data from the 2014–2015 and 2015–2016 school years for the KIPP pre-K study from the KIPP Foundation; this collection included data from all KIPP schools in the cities where the schools in our study sample were located.

Note: To measure mean years of enrollment at KIPP, we treated students as enrolled in a KIPP school for a given year if they were listed on a roster for a KIPP school in the spring of the year of interest. PK3 = pre-K, age 3; PK4 = pre-K, age 4.

[a]"Grade" refers to the enrollment grade for the typical sample student in each year after random assignment.

[b]A large increase in the rate of KIPP enrollment for our comparison group occurred in the spring of 2015, because the enrollment data included all KIPP elementary schools in the cities where the schools in our study sample were located, starting in the 2014–2015 school year. The KIPP enrollment increase in that year is driven by enrollment at non-study schools. Because the roster data from previous years included only schools in the study sample, our enrollment estimates in the first three years of the study likely underestimate enrollment in KIPP schools, particularly for students who did not win a lottery for admission to a school in our sample.

Students in the treatment group were much more likely to have attended a KIPP school in pre-K than students in the control group, according to both roster data and parent report. As for non-KIPP pre-K, control group students were much more likely to attend either a traditional public school or a non-KIPP charter school than students in the treatment group (roughly one-third of control group students were enrolled in non-KIPP charters or traditional public schools at both time periods, whereas only 5 to 6 percent of treatment students were enrolled at other charters, and 3 to 12 percent at traditional public schools). No students in the treatment group and very few control group students (5 to 7 percent) were enrolled in a private school. Thus, the impacts of an offer of admission to a KIPP pre-K presented in Chapter III are measured relative to the impacts of the landscape of other early childhood education options available to students in the study cities—primarily relative to the impacts of other school-based educational programs as opposed to home-based care or day care or nursery school.

At grade 2, five years after random assignment, the majority of students in the treatment group still attended a KIPP school (62 percent), whereas the majority of students in the control group were attending a traditional public school (55 percent, Table IV.3). However, almost one-third of treatment group students were attending a traditional public school for grade 2 (30 percent), and almost half of the students in the control group were attending a charter school (19 percent at a KIPP school and 23 percent at a non-KIPP charter).

Table IV.2. Type of early childhood program attended by KIPP pre-K applicants

Percentage (among students with non-missing data on school type)	Age 3		Age 4	
	Treatment	Control	Treatment	Control
KIPP[a]	80	8	74	16
Non-KIPP charter school	5	33	6	34
Traditional public school	3	27	12	37
Private school	0	7	0	5
Other center (such as daycare or nursery school)	12	24	9	8
Sample size (n)	**65**	**84**	**68**	**92**

Source: Parent surveys administered in conjunction with consent forms for spring/summer 2016 study-administered testing.

Note: Includes data for the sample for the pre-K cohort. Proportions reflect the schools that students attended during the 2011–2012 and 2012–2013 school years—the first and second years following admissions lotteries. Among students included in the analysis who attended a program regularly at ages 3 and 4, 82 percent of students in the treatment group had non-missing data on the school they attended at age 3, and 88 percent had non-missing data at age 4. Among students in the control group, the percentage with non-missing data was smaller; 68 percent had non-missing data on the school they attended at age 3, and 78 percent had non-missing data at age 4. We determined the type of school using the National Center for Education Statistics Common Core of Data. We treated programs not listed in the public or private school data sets as "other" center-based programs unless they were public or private schools known to have closed.

[a]The percentage of students whose parents reported they attended KIPP at ages 3 and 4 is similar to the estimates based on roster data reported in Table IV.1 for the treatment group, but the rates of KIPP attendance reported by parents are higher for students in the control group, particularly at age 4. This finding suggests that parents of some students in the comparison group chose to enroll their child in other KIPP schools when they did not win a lottery for a KIPP school in the study sample.

Table IV.3. Type of elementary school attended by KIPP pre-K applicants

School type (grade 2)	Percentage	
	Treatment	Control
KIPP	62	19
Non-KIPP charter school	8	23
Traditional public school	30	55
Private school	0	3

Source: Parent surveys administered in conjunction with consent forms for spring/summer 2016 study-administered testing.

Note: Includes data for the analytic sample for the pre-K cohort. Proportions reflect the schools that students attended during the 2015–2016 school year—the fifth year following admissions lotteries. Three percent of treatment students and 4 percent of control students had missing data on school type. We determined the type of school using the National Center for Education Statistics Common Core of Data.

B. Characteristics of KIPP pre-K during the study period

Based on interviews with staff at the KIPP schools in our sample, here we describe several characteristics of the study pre-K programs during the 2012–2013 school year, when the students in our impact sample typically were attending PK4.[11] Although all of the schools offering KIPP pre-K were part of the same network of charter schools, the characteristics of the programs sometimes differed by site (Table IV.4). We describe six key features of these programs below, highlighting those that might have differed from other, more traditional pre-K programs at the time.

Table IV.4. Features of KIPP pre-K programs (2012–2013 school year)

	Program A	Program B	Program C
Grades served	PK3-K	PK3-grade 4	PK3-grade 4
Number of students	200	239	269
Number of lead teachers	9	7	6
Percentage of students with IEP or IFSP	7	0	0
Percentage of students who spoke another language at home	0	51	82
Number of PK3 classes (schedule options)	5 (full day)	6 (half day; 3 morning and 3 afternoon)	6 (half day; 3 morning and 3 afternoon)
Number of PK4 classrooms (schedule options)	4 (extended day)	5 (full day)	6 (half day; 3 morning and 3 afternoon)
Top three school priorities[a]	1. Mathematics knowledge & skills 2. Literacy knowledge & skills 3. Language development	1. Literacy knowledge & skills 2. Mathematics knowledge & skills 3. Social & emotional development	1. Social & emotional development 2. Language development 3. Literacy knowledge & skills
Accreditation	None	State accreditation agency	State accreditation agency
Year founded	2007	2004	2008
Proportion of teachers with B.A. or higher	100	100	100
Proportion of teachers with M.A.	11	0	0
Principal's highest level of education	M.A.	M.A.	M.A.

Source: Semi-structured interviews with local KIPP staff, February 2017.

Notes: IEP = Individualized education plan; IFSP = Individual family service plan; B.A. = bachelor's degree; M.A. = master's degree; PK3 = pre-kindergarten, age 3.

[a]Interviewees ranked their school's top three priorities during the 2012–2013 school year from among the following options: (a) physical development & health; (b) social & emotional development; (c) language development; (d) literacy knowledge & skills; (e) mathematics knowledge & skills; (f) science knowledge & skills; and (g) creative arts expression.

[11] Two staff from Mathematica coded these interviews to identify similarities and differences across each of the pre-K programs, and then met to resolve disagreements.

1. The structure of the schools supported alignment across school levels

The grade-level organization of the schools varied across the programs in our sample. Two pre-K programs were a part of a larger KIPP elementary school. Both schools offered pre-K for 3-year-old students (PK3) through grade 4. In the third program, there was a separate school for the early childhood and elementary grades. However, the pre-K school was still located on the same site as the local KIPP elementary school.

For all three programs, staff reported that the co-location of the pre-K and elementary grades contributed to students and parents feeling comfortable and familiar with the students' school. Whereas the pre-K and elementary grades were part of separate schools at one site, staff reported that parents did not seem to distinguish between the two schools. Staff reported that the established level of comfort seemed to reduce parents' and students' stress levels, as they were familiar with the building and regularly encountered the same staff and students on campus over time. The co-location also meant that teachers could observe their students as they advanced into the elementary grades and monitor their progress over time.

The schools in our sample had the autonomy to determine their own school leadership structure, and schools structured leadership differently across the three programs. Across all sites, separate individuals often provided oversight for the pre-K versus elementary grades. Two of the programs had a principal who oversaw both the pre-K and elementary grades; however, the junior leadership at these schools was generally organized by grade level, with one administrator responsible for earlier grades and another for later grades. For example, at one school, the principal was responsible for the school overall, one assistant principal was responsible for PK3 through grade 1, and the second was responsible for grades 2 through 4. At the third site, there were separate principals for the pre-K and elementary grades.

School leadership structure also contributed to the degree of continuity in instruction between the pre-K and elementary grades. For example, administrators at two schools provided instructional leadership for both the pre-K and early elementary school grades, which meant that teachers in both grades were receiving similar support and likely implementing similar instructional strategies and approaches. At the two pre-K programs that were part of the larger elementary school, more opportunities existed for collaboration between the pre-K and elementary grades. At these sites, teachers met regularly with their counterparts in the grades above and below them to facilitate alignment between their curricula and ensure that students learned the skills needed for the subsequent grade. In the third pre-K program, where the pre-K grades were in a separate school from the later elementary grades, staff reported having less involvement in their students' elementary school experience.

Responsibility for instructional leadership and ongoing support for teachers also varied by program. At different sites, assistant principals, instructional coaches, or grade-level chairs had responsibility for providing instructional leadership. These leadership responsibilities included activities such as setting broad goals for the school, providing coaching and professional development, and ensuring alignment of instruction to standards and across grade levels. In two programs, the principal or school leader worked with other administrative staff to provide instructional leadership; at the third program staff reported that the school leader did not provide instructional leadership at that time; however, they emphasized that the school leader since has taken on responsibility for instructional leadership at the school.

2. KIPP pre-K programs were heavily focused on academics—particularly emphasizing foundational reading and math skills—during the study period

Staff at all three sites emphasized the academic focus of their pre-K programs, particularly in PK4. When asked to rank their top three priorities at the school, staff at all three programs ranked literacy knowledge and skills in their top three priorities for their students (Table IV.4). Two programs also prioritized mathematics knowledge and skills, and two prioritized language development. One staff member described their school as more heavily academic than most pre-K programs, including other charter programs. All sites indicated that PK4 was more heavily academic than PK3; sites reported using more play-based activities in PK3 to familiarize students with program values and expectations for behavior, as well as to develop early language and math skills, before transitioning to the more structured and academic programming in PK4. All sites used a mix of instructional approaches, including small- and large-group instruction, centers, and indoor and outdoor play. One respondent explained that their program used play for developmentally appropriate learning and embedded academics within all play activities. In the two programs for which we have data on time for free and outdoor play time, students also spent an average of 45 minutes in free play and at least 30 minutes in outdoor play. Staff from two sites mentioned an emphasis on the ultimate KIPP goal of preparing students to enroll in and succeed in college, even in the pre-K grades.

All three programs were in the early stages of the development of their pre-K programs; staff emphasized that they were still honing their academic approach when our student sample was enrolled in pre-K. They stressed that their schools were midway through a transition toward using more play-based, developmentally appropriate instruction.

3. Curriculum and assessments were mostly teacher developed and contributed to alignment in instruction across grades

At the time, most of the academic curricula at the three pre-K sites were teacher developed or borrowed from other curricula. All three sites used thematic units and targeted specific academic and behavioral skills. Staff in all three programs emphasized that curricula were developed to ensure students had the necessary skills for the subsequent grade. The curricula at these programs were developed in collaboration with the teachers in the subsequent grade, sometimes with support from principals or instructional coaches, to vertically align instruction across grade levels.

Teachers developed assessments to measure progress toward the skills students would need in the subsequent grade. Two programs created their own assessments to measure students' progress toward developing these skills and administered them four times a year. The third program used a compilation of established assessments to measure vocabulary development, math skills, social-emotional development, and literacy skills and administered these tests only once a year. Programs also used assessments to inform small-group assignment for students and, in some cases, initiate referrals to in-house support services for students.

4. KIPP pre-K was designed to establish values and build a behavioral foundation for later success at KIPP

Staff reported that the KIPP pre-K programs in the study heavily emphasized establishing common values and behavioral expectations that would serve as the foundation for students'

success at KIPP and beyond. Particularly in PK3, the programs explicitly taught values and behavioral expectations, and wove them into all aspects of instruction.[12] Upon kindergarten entry, staff reported that familiarity with values and expected behaviors allowed students to focus on academic content. One interviewee reported that teachers knew their students would stay at KIPP and so were invested in laying a foundation for their success as they advanced to later grades. Interviewees noted that students who entered KIPP in kindergarten sometimes needed extra support in these areas to master the behavioral expectations. The programs reported recognizing good behavior in addition to imposing consequences for bad behavior. Staff from one program emphasized that teachers called parents to report good behavior; staff from another recognized students for good behavior in weekly assemblies.

Staff reported that strong relationships developed at KIPP pre-K helped to reinforce behavioral expectations. Specifically, established relationships between students and teachers and among students created consistent expectations across grades and facilitated a smooth transition to elementary school. In many cases, students also had siblings attending the same KIPP school, meaning that parents were already familiar with the school's values and behavioral expectations. These values and expectations were also explicitly communicated explicitly to families through home visits and regular communications; staff at one program reported that parents often reinforced its values and expectations by using the language of KIPP values in their interactions with their children. These relationships reinforced the idea of the schools as an extended family for students.

5. Supports for children and families varied across schools, but all schools heavily emphasized building relationships with students and their families

Two programs provided robust child and family services, whereas the third program later developed additional support services. These services included access to a nurse, a speech therapist, an occupational therapist, a physical therapist, a social worker, health screenings, assistance with basic needs, parent education and supports, and referrals to outside services. Although at the time of the interviews the programs did not have a comprehensive screening process or provide training to teachers on connecting students to services, teachers could initiate a referral to additional support services based on student observations.

Staff frequently mentioned a heavy emphasis on building strong relationships with students and their families. In at least one school, this relationship began with a home visit, in which the student's teacher met with the student and his or her parents at their home to discuss expectations and get buy-in from the student's family. Two sites reported holding regular parent education nights to teach parents how they could support their students' learning at home. All three sites described enlisting parents in their students' education through regular communication. Finally, staff reported that because students were on the same campus for pre-K and elementary grades and many had siblings at the schools, parents developed a familiarity with the campus and teachers, reducing stress for both parents and students.

[12] Two of the programs used Children Learning Appropriate Social Skills (Project CLASS), a social and interpersonal skills curriculum developed by the Houston Achievement Place, to teach expected classroom behaviors and appropriate interactions with peers. The third program used a color chart that was sent home daily with students to report on their behavior.

The KIPP pre-K programs also provided supports to families in meeting expectations regarding attendance. For example, staff from one program reported providing parents with transportation support or offering to move the student to a different pre-K schedule option, such as from the morning to the afternoon class. All three programs noted that they rarely needed to enforce attendance policies because issues with attendance were rare.

6. The training provided to staff varied considerably by school, but most teachers were relatively new to teaching and the pre-K grades

The teachers in these programs were relatively new to teaching, with an average of less than three years of previous experience. All teachers had a minimum of a bachelor's degree before becoming teachers at KIPP. The KIPP teachers in the study schools often entered teaching through Teach For America or KIPP's Teacher Residency Program; others came via more traditional teacher education programs or after teaching at traditional public schools. Before working at a KIPP pre-K, many teachers did not have previous pre-K teaching experience, but many had taught at other KIPP schools.

The ongoing training and support provided to teachers varied by pre-K program. In two programs, administrators or instructional coaches regularly observed teachers and provided coaching or feedback. The third school did not provide this type of instructional support at the time our sample was in pre-K but subsequently began providing it. KIPP school-based and regional support staff in the cities where the schools were located led ongoing professional development sessions for KIPP pre-K teachers in group settings. In general, trainings were planned and provided based on teachers' individual or group needs. Staff in one program indicated that teachers could also request permission and funding to attend specific trainings in which they were interested. The KIPP Foundation also provides a two-week summer training, known as KIPP Summit, focused on connecting teachers across schools and shared learning; many of the teachers in the sample schools had attended this training.

V. IMPLICATIONS FOR POLICY AND PRACTICE

Policymakers continue to look to pre-K as a potentially important and cost-effective way to increase student achievement, reduce achievement gaps, and produce lasting positive impacts for participating students. A recent review of the trends in state pre-K funding found that pre-K is popular on both sides of the political aisle and total state funding for pre-K has increased 47 percent over the past five years (Diffey et al. 2017). Local educational agencies are also investing considerable resources in pre-K programs. For example, New York City recently announced a plan to expand the universal pre-K it already offers for 4-year-olds to include 3-year-olds within the next four years.

Recent studies have reported conflicting findings on the long-term academic impacts of pre-K. A recent study of North Carolina's state pre-K found sustained favorable impacts through grade 5 (Dodge et al. 2016), whereas a study of Tennessee's state pre-K found short-term positive impacts that faded out or became negative by the early elementary grades (Lipsey et al. 2015). Our findings contribute to a body of evidence suggesting that pre-K can have lasting positive impacts. Specifically, we find the following:

1. Rigorous evidence that the cumulative impacts of KIPP pre-K and early elementary grades are positive and substantively important
2. Suggestive evidence that KIPP pre-K provides an additional benefit above and beyond the impact of KIPP kindergarten through grade 2
3. Suggestive evidence that the positive impacts of KIPP pre-K may be somewhat sustained, at least until grade 2

In this chapter, we hypothesize why the impacts of KIPP pre-K may be more lasting than the impacts of other, more traditional pre-K programs. We conclude by suggesting topics for future research.

A. Factors that might contribute to the persistence of impacts of KIPP pre-K

Program characteristics, motivations, and contexts vary across different pre-K programs, and these features may have implications for how pre-K programs like KIPP sustain impacts. Based on our interviews with KIPP staff, several potential mechanisms stand out as to how KIPP pre-K brings about lasting impacts:

- The academic focus of the programs, as described by KIPP staff, is consistent with the large positive impacts in reading and math at each follow-up; specifically, the prioritization of literacy knowledge and skills and language development may explain the lasting impacts in the domain of early literacy.
- Leadership at two of the KIPP schools observed teachers regularly and provided coaching and feedback for teaching staff. Many researchers posit that this type of ongoing support and professional development is a key ingredient for maximizing the potential of pre-K programs (Yoshikawa et al. 2013; Phillips et al. 2017).

- Researchers and practitioners frequently cite the importance of elementary school experiences in maintaining the benefits of pre-K participation (see, for example, Phillips et al. 2017). Shared leadership over and/or co-location of the pre-K and elementary grades may have contributed to greater alignment and continuity of experiences between pre-K programs and elementary grades in KIPP schools.
    - The co-location of pre-K and elementary programs seems to have created opportunities for pre-K and early elementary teachers to interact with each other and with families. The additional exposure to KIPP and familiarity with KIPP in general as well as its facilities and staff all likely contributed to increased engagement of families and, in turn, supported more positive transitions from pre-K to early elementary grades (LoCasale-Crouch et al. 2008).
    - The purposeful collaboration between teachers across grades with support from educational leadership has been hypothesized as an important ingredient of pre-K to elementary alignment (U.S. Department of Education 2016a).

Our findings provide support to the growing consensus about effective pre-K programs and factors that may help sustain their benefits. They shed light on key features that researchers can continue to explore in future studies and policymakers and practitioners can consider incorporating in the design of new and existing pre-K programs.

B. Topics for future research

In this report, we find promising suggestive evidence that KIPP pre-K produces lasting impacts on students' academic achievement. Additional research could build on these findings by measuring longer-term impacts of KIPP pre-K, better defining the experience of students who did not have the opportunity to attend KIPP pre-K, and attempting to replicate the findings using a more rigorous analysis. We detail some potential research questions below.

- **Do the impacts of KIPP pre-K persist as students advance past grade 2?** We found evidence that the cumulative impact of KIPP pre-K and early elementary grades was positive and the early impacts of KIPP pre-K persisted in part until grade 2. To see whether the impacts we observed in grade 2 persist to later grades, a future study could continue to measure impacts on student achievement for both cohorts using student test scores from district administrative records.
- **What were the early childhood experiences of students in our comparison group?** For the current study, we collected data about the types of schools attended by students in our comparison group and more detailed information on the features of the KIPP pre-K programs in our sample. However, we could not collect similar information on the features of the pre-K programs attended by students in the control group. A future study could collect data on the features of the non-KIPP pre-K programs to identify similarities and differences in the characteristics of the pre-K programs that might explain the observed differences in impacts.
- **How did the early childhood experience of students in our pre-K cohort differ from the experience of students in our kindergarten cohort?** We found suggestive evidence that there was an additional benefit of attending pre-K, above and beyond the impact of the KIPP

early elementary grades. Key to understanding the implications of this finding is developing a better understanding of the early childhood experiences of students in our kindergarten cohort—those who did not have the opportunity to attend KIPP pre-K. A future study could collect and report data on the early childhood experiences of students in our kindergarten cohort and describe how those experiences may have differed from those of students in the pre-K cohort.

- **Are these findings replicated in a more rigorous analysis?** As detailed in Chapter II, the findings in this report are preliminary and constrained by the limitations of our study sample. Specifically, we isolated the effects of KIPP pre-K by comparing outcomes for students across KIPP sites with and without pre-K. However, this comparison is not experimental, meaning that the impacts we observed may be due to, or influenced by, factors other than KIPP pre-K—specifically, characteristics of the students or features of the schools in our sample. A more rigorous research design could test whether these impacts hold in an experimental analysis (for example, by funding KIPP pre-K slots in cities where it is not currently available and randomly assigning students to KIPP pre-K or delayed enrollment in KIPP at kindergarten).

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APPENDIX

DETAILED ANALYTIC METHODS

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This appendix presents additional details about the analysis of the impacts of KIPP elementary schools offering pre-K. We first present information on the sample and the baseline equivalence of students who won an admission lottery (the treatment group) and those who did not win (the control group). We next discuss the data and the analysis and then present complete outcome results. We conclude by discussing results of the sensitivity analyses.

A. Detail on sample

The KIPP Pre-K Study follows an existing student sample from the KIPP i3 Evaluation, which was based on lotteries for admission to KIPP elementary schools in spring 2011. Of the 23 KIPP elementary schools open at that time, 8 were sufficiently oversubscribed to be included in the analysis for the KIPP i3 Evaluation and held admissions lotteries in spring 2011.[13] At 3 of these 8 schools, students enrolled at age 3 (pre-K); at the remaining 5 schools, students enrolled in kindergarten. The different enrollment points created two cohorts of students based on the grade for which KIPP held admissions lotteries: the pre-K and kindergarten cohorts.

Among students in the study sample schools and grades, a total of 1,250 were admitted based on a lottery result.[14] The original lottery sample was larger than required to meet the study's targeted level of statistical power. There was also a substantial imbalance in the size of the treatment and control groups at the school level for several schools. In other words, a larger number of students participating in the lotteries at these schools were offered admission and included in the treatment group than those not offered admission and included in the control group, or vice versa. To conserve resources while simultaneously maximizing our ability to detect impacts, we randomly selected a subsample of 1,097 students at these schools to comprise the baseline sample for inclusion in the study's data collection.

Properly executed randomization should ensure that there are no differences (observed or unobserved) between the treatment and control groups. In principle, we can test the truth of this statement by examining the baseline characteristics of the treatment and control groups for each of our three analytic samples:

1. Students who entered lotteries for admission to KIPP at pre-K and had outcome data in grade 2 (pre-K cohort, Appendix Table 1), including 96 students from the treatment group and 147 students from the control group
2. Students who entered lotteries for admission to KIPP at kindergarten and had outcome data in grade 2 (kindergarten cohort, Appendix Table 2), including 180 treatment students and 206 control students

[13] A ninth school was sufficiently oversubscribed to be included in the study, but ultimately we it dropped from the baseline and analytic samples because more than half of the sample at that site lacked follow-up outcome data.

[14] Students who apply to oversubscribed schools may be guaranteed admission and thus not be eligible for the study. For example, applicants may be admitted to the school outside of the typical lottery process if they have a sibling already attending the school, or if a predetermined number of seats are reserved for district residents and these seats are not oversubscribed.

3. Students who entered lotteries for admission to KIPP at pre-K and had outcome data in both kindergarten and grade 2 (longitudinal sample, Appendix Table 3), including 78 treatment students and 121 control students

To collect baseline characteristics, we administered a survey to the parents of students participating in KIPP lotteries close to the time of random assignment in spring 2011. We filled in missing information from the baseline survey using data from a follow-up parent survey we conducted in spring 2013.

For the pre-K sample, there was one statistically significant difference in baseline characteristics across the treatment and control groups out of 25 characteristics we examined; we would expect at least one difference by chance alone (Appendix Table 1). For this sample, mothers of students in the treatment group were less likely to have a high school or GED diploma as their highest level of educational attainment than mothers of students in the control group. There was a similar difference for mothers of students in our kindergarten sample; mothers of students in the control group were more likely to have attained less than a high school diploma than mothers of students in the treatment group (Appendix Table 2). There were no other statistically significant differences between the treatment and control groups for these two samples. To account for differences in baseline characteristics that might influence students' achievement, the impact models in this report statistically control for all of the baseline characteristics listed in Appendix Table 1.

We restricted the longitudinal analytic sample to students in the pre-K cohort we tested at both kindergarten and grade 2; this restriction resulted in higher attrition for the longitudinal sample than the samples of all pre-K students tested at a given time point (kindergarten or grade 2). The increased attrition could introduce bias into our impact estimates if average attrition patterns were different for the treatment and control groups. To investigate this possibility, we examined baseline equivalence among the same set of variables we examined for the pre-K sample. We found three statistically significant differences between the treatment and control groups: students in the control group were more likely to (1) be Hispanic; (2) have a family with a household income of more than $50,000 a year; and (3) have a mother with only a high school degree or GED relative to the treatment group. Appendix Table 3 provides baseline equivalence results for the pre-K cohort longitudinal sample.

Appendix Table 1. Baseline equivalence of grade 2 analytic sample (pre-K cohort)

Baseline characteristic (proportion, unless otherwise indicated)	Treatment	Control	Difference	*p*-value	SD_t	SD_c	N_t	N_c
Female	0.56	0.58	-0.02	0.76	0.50	0.50	82	117
Age in years	6.15	6.20	-0.05	0.32	0.37	0.33	82	115
Race/ethnicity								
White, non-Hispanic	0.02	0.01	0.01	0.42	0.15	0.09	91	132
Hispanic (any race)	0.28	0.36	-0.08	0.17	0.49	0.48	91	132
Black, non-Hispanic	0.66	0.59	0.07	0.27	0.50	0.49	91	132
Asian, Pac. Isl., AK Native, Native Amer., or Multi-Race	0.04	0.04	0.00	0.93	0.23	0.19	91	132
Language spoken at home								
English	0.61	0.58	0.03	0.54	0.50	0.50	82	117
Another language	0.20	0.23	-0.03	0.61	0.48	0.42	82	117
English and another language	0.18	0.19	0.00	0.95	0.42	0.39	82	117
One adult in household	0.32	0.22	0.10	0.11	0.45	0.42	91	130
Family income								
Less than 15K	0.18	0.26	-0.08	0.25	0.41	0.44	79	111
Between 15K and less than 25K	0.20	0.26	-0.07	0.32	0.41	0.44	79	111
Between 25K and less than 35K	0.29	0.21	0.09	0.20	0.45	0.41	79	111
Between 35K and less than 50K	0.12	0.13	-0.01	0.83	0.30	0.33	79	111
50K or greater	0.21	0.14	0.07	0.23	0.39	0.35	79	111
Mother's education								
Less than high school	0.09	0.09	0.00	0.93	0.31	0.28	82	114
High school or GED	0.21	0.36	-0.15*	0.03	0.41	0.48	82	114
Some college	0.31	0.30	0.01	0.86	0.47	0.46	82	114
College	0.39	0.25	0.14	0.05	0.48	0.44	82	114
Schools applied to								
Other KIPP school(s)	0.05	0.04	0.01	0.77	0.26	0.21	81	112
Other charter school(s)	0.22	0.24	-0.02	0.71	0.37	0.43	79	109
Private school(s)	0.02	0.04	-0.02	0.53	0.11	0.19	80	111
Any other school(s)	0.28	0.28	0.00	0.98	0.43	0.45	78	108
Student has access to computer with Internet at home	0.68	0.77	-0.09	0.17	0.48	0.42	82	115
Number of children's books at home	25	30	-5	0.28	20	37	78	105

Source: We drew baseline characteristics from a baseline survey we administered to the parents of students who applied to KIPP schools in our sample in spring 2011. We filled in missing values for age, gender, race/ethnicity, and a single-parent household indicator from the baseline survey using information from a follow-up survey we administered to the same sample of parents in spring 2013, where possible.

Note: All values in this table are based on non-imputed data. Values are proportions unless otherwise indicated. Due to rounding, the value reported in the "Difference" column may differ slightly from the difference between the values reported in the "Treatment" and "Control" columns.

*Significantly different from zero at the .05 level, two-tailed test.

**Significantly different from zero at the .01 level, two-tailed test.

Appendix Table 2. Baseline equivalence of grade 2 analytic sample (kindergarten cohort)

Baseline characteristic (proportion, unless otherwise indicated)	Treatment	Control	Difference	*p*-value	SD_t	SD_c	N_t	N_c
Female	0.41	0.40	0.02	0.72	0.49	0.49	170	182
Age in years	8.00	8.02	-0.01	0.77	0.33	0.39	162	169
Race/ethnicity								
White, non-Hispanic	0.01	0.01	0.00	0.82	0.08	0.07	172	186
Hispanic (any race)	0.48	0.45	0.03	0.46	0.50	0.50	172	186
Black, non-Hispanic	0.49	0.52	-0.03	0.39	0.49	0.50	172	186
Asian, Pac. Isl., AK Native, Native Amer., or Multi-Race	0.03	0.02	0.00	0.80	0.15	0.15	172	186
Language spoken at home								
English	0.56	0.56	0.00	0.94	0.50	0.50	163	172
Another language	0.23	0.21	0.02	0.56	0.45	0.41	163	172
English and another language	0.21	0.23	-0.02	0.64	0.42	0.42	163	172
One adult in household	0.29	0.30	-0.02	0.74	0.43	0.46	174	186
Family income								
Less than 15K	0.21	0.29	-0.08	0.09	0.41	0.45	156	166
Between 15K and less than 25K	0.23	0.23	0.00	0.98	0.43	0.43	156	166
Between 25K and less than 35K	0.23	0.18	0.05	0.27	0.41	0.39	156	166
Between 35K and less than 50K	0.22	0.19	0.02	0.61	0.41	0.40	156	166
50K or greater	0.11	0.10	0.01	0.74	0.30	0.30	156	166
Mother's education								
Less than high school	0.08	0.22	-0.14**	0.00	0.32	0.41	160	169
High school or GED	0.23	0.24	-0.02	0.72	0.42	0.43	160	169
Some college	0.36	0.27	0.09	0.07	0.48	0.44	160	169
College	0.33	0.27	0.06	0.25	0.46	0.45	160	169
Schools applied to								
Other KIPP school(s)	0.15	0.20	-0.05	0.17	0.33	0.40	160	165
Other charter school(s)	0.47	0.44	0.03	0.51	0.50	0.50	159	161
Private school(s)	0.08	0.09	-0.01	0.78	0.25	0.28	159	164
Any other school(s)	0.58	0.57	0.01	0.86	0.50	0.50	157	163
Student has access to computer with Internet at home	0.82	0.75	0.07	0.11	0.40	0.43	159	170
Number of children's books at home	45	47	-2	0.70	39	44	149	160

Source: We drew baseline characteristics from a baseline survey we administered to the parents of students who applied to KIPP schools in our sample in spring 2011. We filled in missing values for age, gender, race/ethnicity, and a single-parent household indicator from the baseline survey using information from a follow-up survey we administered to the same sample of parents in spring 2013, where possible.

Note: All values in this table are based on non-imputed data. Values are proportions unless otherwise indicated. Due to rounding, the value reported in the "Difference" column may differ slightly from the difference between the values reported in the "Treatment" and "Control" columns.

*Significantly different from zero at the .05 level, two-tailed test.

**Significantly different from zero at the .01 level, two-tailed test.

Appendix Table 3. Baseline equivalence of longitudinal analytic sample (pre-K cohort)

Baseline characteristic (proportion, unless otherwise indicated)	Treatment	Control	Difference	*p*-value	SD_t	SD_c	N_t	N_c
Female	0.55	0.58	-0.03	0.72	0.50	0.50	66	101
Age in years	6.09	6.20	-0.11	0.10	0.37	0.33	66	100
Race/ethnicity								
White, non-Hispanic	0.03	0.01	0.02	0.35	0.16	0.09	74	114
Hispanic (any race)	0.24	0.39	-0.14*	0.03	0.49	0.49	74	114
Black, non-Hispanic	0.69	0.57	0.12	0.09	0.50	0.50	74	114
Asian, Pac. Isl., AK Native, Native Amer., or Multi-Race	0.04	0.04	0.00	0.89	0.23	0.18	74	114
Language spoken at home								
English	0.65	0.60	0.05	0.41	0.50	0.49	66	101
Another language	0.19	0.24	-0.05	0.47	0.49	0.43	66	101
English and another language	0.15	0.16	0.00	0.96	0.40	0.37	66	101
One adult in household	0.31	0.21	0.09	0.14	0.43	0.41	74	113
Family income								
Less than 15K	0.15	0.27	-0.12	0.10	0.41	0.45	63	97
Between 15K and less than 25K	0.24	0.27	-0.03	0.66	0.45	0.45	63	97
Between 25K and less than 35K	0.26	0.20	0.06	0.38	0.44	0.40	63	97
Between 35K and less than 50K	0.08	0.13	-0.06	0.30	0.21	0.34	63	97
50K or greater	0.28	0.13	0.15*	0.03	0.42	0.34	63	97
Mother's education								
Less than high school	0.10	0.09	0.01	0.85	0.33	0.29	66	99
High school or GED	0.18	0.37	-0.19**	0.01	0.40	0.49	66	99
Some college	0.23	0.29	-0.07	0.41	0.43	0.46	66	99
College	0.49	0.24	0.25	0.00	0.50	0.43	66	99
Schools applied to								
Other KIPP school(s)	0.06	0.04	0.02	0.58	0.24	0.20	65	97
Other charter school(s)	0.27	0.28	0.00	0.97	0.38	0.45	63	94
Private school(s)	0.03	0.04	-0.01	0.76	0.13	0.20	64	96
Any other school(s)	0.33	0.31	0.02	0.76	0.43	0.47	62	93
Student has access to computer with Internet at home	0.74	0.77	-0.03	0.69	0.48	0.42	66	100
Number of children's books at home	28	30	-2	0.64	21	39	62	92

Source: We drew baseline characteristics from a baseline survey we administered to the parents of students who applied to KIPP schools in our sample in spring 2011. We filled in missing values for age, gender, race/ethnicity, and a single-parent household indicator from the baseline survey using information from a follow-up survey we administered to the same sample of parents in spring 2013, where possible.

Note: All values in this table are based on non-imputed data. Values are proportions unless otherwise indicated. Due to rounding, the value reported in the "Difference" column may differ slightly from the difference between the values reported in the "Treatment" and "Control" columns.

*Significantly different from zero at the .05 level, two-tailed test.

**Significantly different from zero at the .01 level, two-tailed test.

The baseline equivalence results suggest that exposure to the treatment (in this case, attending a KIPP elementary school) could be affecting attrition and biasing our longitudinal impact estimates for the pre-K cohort. To investigate this possibility further, we compared the mean kindergarten test scores for the treatment and control groups from the longitudinal sample—those students in our pre-K cohort tested in both kindergarten and grade 2—to the mean kindergarten test scores for the treatment and control groups from the sample of students tested only in kindergarten (Appendix Table 4, rows 1–6). We also compared mean grade 2 test score outcomes for the treatment and control groups from the longitudinal sample to the mean grade 2 test score outcomes for the treatment and control groups from the sample of students tested only at grade 2. On average, treatment group students tested only in kindergarten had *lower* test scores in kindergarten than treatment group students tested in both kindergarten and grade 2 (row 3). In addition, control group students tested only in kindergarten had *higher* test scores in kindergarten, on average, than control group students tested in both grades (row 6). Our remaining longitudinal sample thus contains treatment students who performed better, on average, than treatment students tested only in kindergarten, and control students who scored worse, on average, than control students tested in kindergarten only. However, students tested only in kindergarten account for a small proportion of the sample, and these patterns may be due to chance. Nevertheless, we controlled for baseline characteristics in our longitudinal analysis and focused this analysis on trends over time rather than the magnitude of the impacts at kindergarten and grade 2.

Appendix Table 4. Average test scores among students based on testing group, by experimental condition

Row	Experimental condition	Sample	Letter-Word Identification (mean)	Passage Comprehension (mean)	Sample size
		Kindergarten outcomes			
1		Students tested only in K	1.12	0.47	26
2	Treatment	Students tested twice	1.59	0.84	78
3		Difference between groups	-	-	
4		Students tested only in K	1.03	0.38	43
5	Control	Students tested twice	0.94	0.20	121
6		Difference between groups	+	+	
		Grade 2 outcomes			
7		Students tested only in grade 2	0.38	-0.39	18
8	Treatment	Students tested twice	1.03	0.38	43
9		Difference between groups	-	-	
10		Students tested only in grade 2	0.48	-0.50	26
11	Control	Students tested in twice	0.41	-0.57	121
12		Difference between groups	+	+	

Source: Study tests administered in spring and summer 2014 and 2016.

Notes: We measured reading outcomes on WJ-III Tests of Achievement and show them in z-scores. Results show the average test score for each subgroup in either kindergarten (K) or grade 2.

Although this attrition also affects our estimates of the impact of KIPP pre-K and early elementary grades after five years, we have fewer concerns about sample attrition biasing these impact estimates because the grade 2 impact sample also contains students who were tested for the first time in grade 2. On average, treatment students tested for the first time in grade 2 scored *lower* on achievement tests than treatment students tested at both kindergarten and grade 2

(Appendix Table 4, row 9). In addition, control students tested for the first time in grade 2 scored *higher* on average than control students tested in both grades (row 12). Essentially, the effect of students who were not retested in grade 2 leaving our sample was likely counteracted in part by the effect of students who were tested for the first time in grade 2 joining our sample.

B. Detail on analytic methods

Model specification

To estimate the impact of offering admission to a KIPP elementary school for all students with grade 2 outcomes, we used the following model:

$$(1)\ y_i = \beta_1 T_i + \beta_2 (T_i * COHORT) + \sum_{k=1}^{K} \alpha_k SCHOOL_{i,k} + \gamma X_i + \varepsilon_i$$

where *i* and *k* index students and schools, respectively, and *y* is the student-level outcome of interest. *T* is a binary treatment status variable indicating whether the student was offered admission to the school via the lottery; *T *COHORT* is an interaction term allowing the effect of treatment to vary by cohort for the pre-K and kindergarten samples. *SCHOOL* is a set of binary variables indicating the school to which the student applied and thus the lottery in which the student participated. *X* is a set of student-level demographic and other control variables. The α symbol represents school/lottery fixed effects, which are commonly used in the charter school literature (Angrist et al. 2013; Dobbie and Fryer 2015) and capture differences in outcomes across lottery sites. The parameter β_1 represents the average impact of winning a KIPP elementary school lottery for the pre-K cohort; $\beta_1 + \beta_2$ represents the average impact of winning a KIPP elementary school lottery for the kindergarten cohort. These are intent-to-treat (ITT) estimates, in that not all students offered pre-K KIPP enrollment did enroll; that is, the treatment group includes some students who did not in fact attend KIPP pre-K.

Our analysis includes the following student covariates (represented by X_i in Equation 1):

- Gender
- Student age in years
- Race/ethnicity
- Language spoken at home
- Whether there is only one adult in the household
- Family income
- Mother's education
- Whether the student has access to a computer with Internet access at home
- The number of children's books in the home

To estimate the impact of an offer of admission to a KIPP elementary school for the sample of students who had outcomes in both kindergarten and grade 2 (the "stayers"), we used the following time series model:

$$(2)\ y_{tik} = \beta_1 T_i + \beta_2 YEAR_t + \beta_3 (T_i * YEAR_t) + \sum_{k=1}^{K} \alpha_k SCHOOL_{i,k} + \gamma X_i + \varepsilon_i + \mu_t$$

where *t, i,* and *k* index time period, students, and schools, respectively, and *y* is the student-level outcome of interest at time *t*. *T* is a binary treatment status variable indicating whether the student was offered admission to the school via the lottery; *T *YEAR* is an interaction term allowing the effect of treatment to vary by time period. As in Equation 1, *SCHOOL* is a set of binary variables indicating the school to which the student applied, and thus the lottery in which the student participated, and *X* is a set of demographic and other controls. The parameter β_1 represents the average impact of winning admission to KIPP among the "stayers" in the sample, when most students were in kindergarten in 2014; $\beta_1 + \beta_3$ represents the average impact of winning admission to KIPP among those same stayers, when most students were in grade 2 in 2016. These are ITT estimates. We used the same set of covariates as in the previous model.

Weighting

The impact model incorporates sample weights to account for the fact that not all students in the lottery have the same probability of being offered admission to the KIPP school (that is, being selected into the treatment group). Some students have a higher probability of being offered admission, either based on their inclusion in a particular stratum defined by a student characteristic or because they have a sibling in the lottery. If we do not use sample weights or otherwise account for these student characteristics in the impact model, then the characteristics of students in the treatment and control groups may differ on average, potentially leading to a bias in the impact estimate. For example, because several KIPP schools use sibling preference rules in their lotteries, students with siblings will tend to be overrepresented in the treatment group and those without siblings will be overrepresented in the control group. If having siblings affects student performance directly or is correlated with some other student or family characteristic not accounted for, it could bias the impact estimate.

The creation of the sample weights is based on the procedure used in Gleason et al. (2010). In the simple case, where all students interested in attending a particular KIPP school enter the lottery and no preferences are given for siblings or other characteristics, the sample weight for a given student is based on the probability that he or she ended up in a particular experimental group (that is, either the treatment or control group). This probability is used in calculating each student's *base weight*. In particular, the base weight assigned to treatment group members is set to the inverse of the probability of being selected into the treatment group. The base weight for control group members is set to the inverse of the probability of being selected into the control group. We then normalize this weight to account for the fact that the sample will be representative of the set of all consenting lottery participants at that school. We set this normalization factor such that the weights of each experimental group sum to one-half of the total sample size within the school. Thus, the sum of all students' weights within a school will be equal to the overall sample size in that school (that is, the number of consenting lottery participants), with the sum of weights among treatment group students equal to that among control group students.

In schools with sibling preference rules, the basic approach to calculating sample weights is the same as in the simple case above.[15] The difference, however, is in the calculation of the probability of admission. No longer can we simply use the number of students offered admission divided by the number of lottery participants. The exact probabilities of admission depend on the number of sets of siblings who participate in the lottery at the school and the number of students within each sibling set. With sibling preference rules, each sibling in the lottery has a higher probability of admissions than non-siblings, so the probabilities are adjusted to account for the number of siblings in each affected lottery.

Imputation of baseline characteristics

If there were missing values for the model's covariates, we imputed them based on other baseline information we collected from the student so that he or she could be included in the sample and contribute to our impact estimates. Our imputation procedure, known as multiple imputation by chained equations, uses non-missing values of baseline covariates to estimate plausible values of baseline characteristics for observations with missing baseline data. Specifically, this method first generates multiple data sets with estimated ("imputed") values for missing baseline characteristics. A separate impact estimate is then calculated using each of the imputed data sets. Finally, these impact estimates are combined using procedures described in Rubin (1987) that account for the variability of estimates calculated using the different imputed data sets. The standard error of each combined impact estimate is adjusted to reflect this variability. The imputation procedure and impact estimation using imputed data are conducted using standard commands in Stata; 20 imputations are used. Imputation is conducted separately by treatment and control groups, and all baseline characteristics included as covariates in the impact model are included in the imputation model. Finally, no outcome measures are imputed, only baseline characteristics.

Although we used these imputed baseline covariates in our analysis of KIPP's impacts, we did not include any of the imputed values in the tests of baseline equivalence discussed earlier in the appendix. For the analysis of baseline equivalence, we simply treated students missing data on a given variable as being missing from the sample.

C. Detailed results on outcomes

The following tables present additional details about the results described in Chapter III. Appendix Table 5 provides impacts estimates of KIPP schools five years after admission, when most students were in grade 2, for the pre-K cohort.

[15] An example of sibling preference rules occurs when a school enters two siblings separately in an admissions lottery. If one of the two siblings is drawn as a lottery winner and offered admission to the school, the other sibling is pulled from the lottery pool and also offered admission.

Appendix Table 5. Five-year impacts of offer of admission to KIPP elementary school in pre-K

Outcome	Adjusted mean, treatment	Mean, control	Impact estimate	Standard error	*p*-value
Math achievement					
Calculation	0.21	-0.10	0.31^	0.21	0.14
Applied Problems	0.26	-0.08	0.34**^	0.11	0.00
Reading achievement					
Letter-Word Identification	0.85	0.42	0.43**^	0.12	0.00
Passage Comprehension	-0.36	-0.56	0.21	0.15	0.16
Non-academic outcomes					
Verbal Attention (working memory)	0.15	-0.10	0.25^	0.16	0.12
Hearts (follows rules)	0.21	-0.07	0.28*^	0.14	0.04
Flowers (inhibitory control)	0.09	-0.03	0.12	0.15	0.41
Hearts & Flowers (cognitive flexibility)	-0.10	0.01	-0.12	0.17	0.47

Source: Study tests administered, spring and summer 2016.

Notes: We measured math and reading outcomes on WJ-III Tests of Achievement. We measured executive function outcomes on the WJ IV Tests of Cognitive Abilities and the Hearts & Flowers (H&F) assessment from Adele Diamond's lab at the University of British Columbia. All outcomes are shown in z-scores. All impacts in this table are ITT, based on regression models that control for baseline covariates. Means for the control group are unadjusted; means for the treatment group are equal to the means for the treatment group plus the estimated impact. The analytic sample varies with between 93 and 96 students for the treatment group and between 144 and 147 students for the control group (all from the pre-K cohort).

*Impact estimate is statistically significant at the 0.05 level, two-tailed test.

**Impact estimate is statistically significant at the 0.01 level, two-tailed test.

^Impact estimate is substantively important (effect size >= 0.25 standard deviation units).

Appendix Table 6 presents detailed results for cohort-specific impacts when most students were in grade 2. The table also shows the difference in impact estimates across the two cohorts, which isolates the effect of KIPP pre-K.

Appendix Table 7 displays detailed results from our analysis of changes in the impacts of an offer of admission to a KIPP pre-K over time. The longitudinal sample includes students tested both in kindergarten and grade 2. Results are shown in W-scores, which adjust for the grade-level difficulty of the exam.

Appendix Table 6. Isolated effect of KIPP pre-K (exploratory analysis)

Outcome (z-scores)	Impact estimates (grade 2)		Isolated effect of KIPP pre-K (Difference)	Standard error of difference	*p*-value
	Pre-K cohort (KIPP with pre-K)	Kindergarten cohort (KIPP without pre-K)			
Math achievement					
Calculation	0.31^	0.31**^	0.00	0.23	0.99
Reading achievement					
Letter-Word Identification	0.43**^	0.23**	0.20	0.15	0.19
Passage Comprehension	0.21	0.14*	0.06	0.15	0.69

Source: Study tests administered in spring and summer 2016 for the pre-K cohort and spring and summer 2014 for the kindergarten cohort.

Notes: We measured outcomes on the WJ-III Tests of Achievement. All impacts in this table are ITT, based on regression models that pool all schools and control for baseline covariates. The pre-K cohort contains 243 students who applied to three KIPP schools. The kindergarten cohort contains 383 students who applied to five KIPP schools.

*Impact estimate is statistically significant at the 0.05 level, two-tailed test.

**Impact estimate is statistically significant at the 0.01 level, two-tailed test.

^Impact estimate is substantively important (effect size >= 0.25 standard deviation units).

Appendix Table 7. Reading impacts over time for KIPP pre-K cohort

	Mean, treatment	Mean, control	Impact estimate	Standard error	*p*-value
Letter-Word Identification					
Kindergarten	434.14	419.29	14.85**	4.65	0.00
Grade 2	498.93	482.49	16.44**	4.47	0.00
Difference			1.58	4.05	0.70
Passage Comprehension					
Kindergarten	447.43	434.21	13.21**	3.65	0.00
Grade 2	479.41	474.83	4.58	3.71	0.22
Difference			-8.64*	3.60	0.02

Source: Study tests administered in spring and summer 2014 for the pre-K sample and spring and summer 2016 for the pre-K sample.

Notes: We measured outcomes on WJ-III Tests of Achievement. All impacts in this table are ITT, based on regression models that pool all schools and control for baseline covariates. Sample size = 199 students across 3 KIPP schools.

*Impact estimate is statistically significant at the 0.05 level, two-tailed test.

**Impact estimate is statistically significant at the 0.01 level, two-tailed test.

D. Sensitivity analyses

In addition to estimating impacts using our primary model, we also conducted analyses to see whether impact estimates were sensitive to alternative weighting and imputation approaches. We estimated impacts using two alternative imputation strategies for missing baseline covariates: (1) mean imputation—calculating the covariate mean by school and experimental condition (separately for the treatment and control groups), and (2) no imputation—estimating impacts only on the sample with available baseline data. These results were similar to our main impact estimates, which used multiple imputation. We also estimated school-specific impacts and found no evidence that a single school was driving our overall results.

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