



Westminster Public Schools Full-Day Pre-K Randomized Control Trial: Year One Findings

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Executive Summary of Main Findings

In August 2016, Westminster Public Schools (WPS)—a small district serving predominantly low-income and minority students just outside of Denver—launched a full-day pre-k pilot, through philanthropic support to study the effects of a Pay For Success (PFS) financing structure on a project of this type. Prior to this time, WPS was only able to offer half-day pre-k. Aware of the challenges a half-day schedule poses for many young, working- and single-parent families, WPS leveraged philanthropic capital from The Ben and Lucy Ana Fund of the Walton Family Foundation and Gary Community Investments to add 7 new full-day pre-k classrooms. Using PFS components, the grant dollars are partially recoverable, based on outcomes linked to cashable savings, as verified by a rigorous evaluation. **Our aim is to follow three cohorts of pre-k students through third grade, in order to tackle one of the most pressing issues in early childhood education research: the search for evidence of *persistent* effects of early childhood investments in the longer-term.**

In Summer 2016, our research team executed the first of a three-cohort block randomized control trial of full- versus half-day pre-k offerings in WPS. We randomized applicants to receive an offer for a spot either in a full- or half-day classroom. During the pre-k year, we track their enrollment and attendance and conduct primary data collection by directly observing classrooms, administering individual standardized assessments, and collecting parent and teacher surveys. As children move into elementary school, we shift to relying on secondary data provided by WPS to assess intervention impacts. In Spring of 2017, we also randomized a second cohort of pre-k applicants for access to 9 full-day classrooms in the 2017-2018 school year.

Initial evidence from the 2016-17 pilot year (Cohort 1) suggests there may be substantial, positive short-term impacts on student development.

- To date, we have focused on estimating effects on the following 8 outcomes: (1) Peabody Picture Vocabulary Test (PPVT) (an early literacy assessment), (2) Early Screening Inventory (ESI-R) (the special needs assessment), and (3) Teaching Strategies GOLD (TS GOLD) in 6 domains (with some limitations on the TS GOLD due to differential missingness for 20% of our sample). Those domains include language, literacy, math, physical, cognitive, and socio-emotional development.
- All 8 estimates are positive. Most are ≥ 0.10 sd's (with a max of 0.48 sd's). The exception is ESI-R, where the estimates are positive but substantively small and not statistically significant. Some—but not all—of the other 7 estimates are already statistically significant, despite a general lack of power after only 1 year. Any lack of significance is to be expected at this stage since we have only analyzed results from 1 of 3 study cohorts.
- The PPVT findings are particularly interesting in that they are on par with other impactful early childhood interventions.
- There is also evidence of an "attendance effect"—students in full-day pre-k were much more likely to stay in Westminster throughout the year.
- We have also included preliminary analyses of parental perceptions of their childcare arrangements, as well as their children's development. We also explore whether there is any evidence of employment benefits for parents.

Study Motivation

When done well, high-quality early education interventions may fundamentally change a child's trajectory, providing them with a stronger foundation from which to "hit the ground running" on day one of kindergarten. A growing body of research finds that children who attend publicly-funded pre-k exhibit stronger academic skills than similar peers without access (Philips et al., 2017). There is also strong evidence that the benefits of early childhood programs can be long-lasting and life-altering (Campbell et al., 2012; Deming, 2009; Schweinhart et al., 2005).

Although it is clear that early childhood *can* be a strong lever for helping children succeed, there is also growing evidence that the benefits are variable and that the initial gains from attending pre-k often dissipate quickly as children progress through school (see Gibbs, Ludwig, & Miller, 2011 for a review). This is a troubling finding, especially in light of the substantial investments states are making in expanding access to publicly-funded early childhood program. There is an urgent need for rigorous research examining *which characteristics* of pre-k programs are needed to ensure larger and longer-lasting benefits.

One characteristic particularly worthy of examination is the length of the pre-k day. A growing body of K-12 research has shown that intensity of exposure to school (e.g. length of school day, length of school year) leads to gains in children's learning (Fitzpatrick, Grissmer, & Hastedt, 2011; Gibbs, 2014; Hansen, 2011). These findings support the notion that extending the school day for four-year old children will bolster any positive impacts of pre-k. Between 1990 and 2014, the percentage of 3 to 5 year olds enrolled in full-day pre-k has grown steadily, from 34 to 49 percent (Kena et al., 2016). Relatedly, the 2016 release of new Head Start Program Performance Standards substantially increased the number of program hours required. These moves towards longer pre-k days stem, in part, by the belief that longer days will lead to greater pre-k benefits. In addition, extending formal pre-k may ensure that children are in safe, caring spaces for a greater portion of each day. Half-day programming may be impractical to working and single-parent families who may not have the financial resources or work flexibility to pick-up/ drop-off their child at a *second* childcare arrangement in the middle of the work day.

On the other hand, switching to full-day is expensive because it requires doubling the building space and teacher workforce. If the benefits of "intensifying" the pre-k day are modest and the cost is great, districts would be better served using their limited financial resources in other ways. In addition, the possible stress and demand of longer school days on 4-year old children may lead to diminishing or even negative effects. Correlational research suggests that children in center-based care for more hours per week are rated lower on a variety of behavioral measures (Belsky, 2002; Loeb, Bridges, Bassok, Fuller, & Rumberger, 2007; Vandell, Belsky, Burchinal, Steinberg, & Vandergrift, 2010).

Although moving from part to full-day pre-k is a promising strategy for bolstering the benefits of early childhood investments, the sizable costs of such expansion efforts, and the lack of rigorous evidence documenting whether full-day pre-k provides lasting value-added over shorter pre-k programs, create a need for further research.

Brief Study Overview and Primary Research Questions

WPS is a Colorado public school district with a largely non-White (85%), low-income (81% qualify for free- and reduced-priced lunch), and English language learners (46%) student body. In 2016, WPS decided to transition some of their early childhood offerings from half- to full-day sessions via the Full-Day Pre-K Pilot (FDPK) Program. WPS created 7 *expanded* pre-k classes—full-day classes, 5 days per week. Because demand for these new full-day slots exceeded capacity, the District randomly assigned applicants to either full or half-day pre-k offers. In summer 2016, our research team implemented a lottery for the full-day slots (112 in treatment and 112 in control).

For the 2017-18 school year we conducted a similar randomization for 259 students and will do so again for the final cohort in 2018-19. For all cohorts we will use a longitudinal, randomized block design to estimate the causal effects of the FDPK Pilot on a wide variety of outcomes from kindergarten through the third grade.¹ In addition we are gathering rich data from parents and teachers about time-usage both inside and outside of formal pre-k time. This information allows us to describe implementation fidelity, investigate heterogeneity across sites, and explore the mechanisms through which the additional time may be leveraged. The study will provide rigorous experimental evidence on the extent to which one key feature of pre-k—length of day—impacts both initial and middle-term child outcomes across a host of domains.

Despite what we will be able to learn when study children complete pre-k, it remains unknown whether FDPK's impact will translate to more general measures of student achievement and behavior, and more importantly, whether these results will persist into the elementary school years. To address these questions, we plan to work with these three cohorts and follow students' outcomes through their elementary school years. The increased sample size and longitudinal follow-up of students will allow us to address the following critical questions:

- 1) What are the short- and medium-term impact of full day pre-k on student academic and behavioral outcomes?
- 2) How is the additional time in pre-k used, relative to how it would have been used in the absence of the full-day option?
- 3) Is there evidence of heterogeneous treatment effects across school sites or subjects?
- 4) Do families that have access to full-day pre-k report that they have fewer constraints on their ability to work, and do they report working more hours?

¹ Study outcomes include: (1) Peabody Picture Vocabulary Test of literacy skills at the end of pre-k; (2) Early Screening Inventory of need for special education services at the end of pre-k; (3) *TS GOLD* measure of teacher perceptions of cognitive, language, literacy, math, physical, and socio-emotional development in the fall, winter, and spring of pre-k and K; (4) DIBELS measure of literacy skill in the fall, winter, and spring of K - 3; (5) SCANTRON measure of math skill in the fall, winter, and spring of K - 3; (6) *WIDA* Access English language proficiency in spring of K - 3; (7) Student attendance rates; (8) Probability of being retained in grades K - 3; (9) *PARCC*: Math and ELA standardized achievement test scores in grade 3, (10) Parental work hours.

Study Design

Enrollment in the Study.

Families who are interested in enrolling in the full day pre-k program begin by completing a study consent form and filling out a general pre-k application, on which they indicate their first choice of school site. They are then randomized into treatment conditions by their “first choice” school site; families who win the lottery will be offered a slot in the full-day class, while families randomized into the business-as-usual condition (BAU) will be offered a spot in a half-day class. Randomization is conducted within each site and cohort of the study, and results are pooled across both. By tracking outcomes of all lottery participants regardless of whether they choose to take up the offers, we are able to estimate an “intent-to-treat” (ITT) causal effect—that is, differences in outcomes if students are *offered* FDPK relative to whatever they would have chosen to do otherwise. We will also estimate “treatment on treated” (TOT) effects, which examine the impact of attending FDPK on students’ outcomes. Because we find early evidence of positive short-term effects, an essential component of the evaluation will also be to determine whether those effects persist over time and are large enough to register on statewide achievement assessments. In this section, we outline the research design for the full scale impact evaluation of FDPK in the WPS school district.

Data Collection.

The full impact study (including Pilot Year) will span a minimum of 7 years. Figure 1 summarizes the study cohorts and the highest grade completed. 2016-2017 is the **Pilot Year**—that is, when the first cohort of 224 children were randomized to full- and half-day offers. **Year 1** of the study is when the second cohort of students will participate in the lottery and attend pre-k in 2017-2018. The third and final cohort of children will attend pre-k in **Year 2** of the study (2018-2019). In **Year 3** and **Year 4**, we continue to follow all three cohorts as they move through formal schooling up through third grade.

Figure 1. Summary of study cohorts and the highest grade completed

	Pilot Year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
	7/1/16- 6/30/17	7/1/17- 6/30/18	7/1/18- 6/30/19	7/1/19- 6/30/20	7/1/20- 6/30/21	7/1/21- 6/30/22	7/1/22- 6/30/23
<i>Study Timeline</i>	Coh 1 = pk	Coh 1 = k Coh 2 = pk	Coh 1 = 1 Coh 2 = k Coh 3 = pk	Coh 1 = 2 Coh 2 = 1 Coh 3 = k	Coh 1 = 3 Coh 2 = 2 Coh 3 = 1	Coh 1 = 4 Coh 2 = 3 Coh 3 = 2	Coh 1 = 5 Coh 2 = 4 Coh 3 = 3

Treatment Contrast.

Seven full-day classes were opened during the Pilot Year, and an additional 2 full-day classes have been added for Cohort 2. In addition, the hope is to add an additional 2 classes for Cohort 3. Across the three cohorts, approximately 841 study children will apply for slots in 27 full-day classrooms. The *treatment* condition is being given an offer for a spot in a FDPK classroom (about 18 more hours per week than the half-day program). The control group consists of all applicants who do not win the lottery and are offered a half-day slot. When possible control families are offered a half-day slot in the same school site that was their first choice for full-day. However even in cases where this was not possible, the maximum distance between any two schools in this district is about 4.5 miles.

Treatment Fidelity.

One important component of the evaluation study is to examine and document differential treatment conditions experienced by students in the full day pre-k and those assigned to the BAU condition. As a component of our pilot study,

we administer a teacher and parent survey that addresses the following domains: Parent perceptions of their childcare arrangements (whatever they may be), parental perceptions of their child's developmental progress, work constraints imposed on parents due to childcare, and teacher reports of time-usage in the childcare setting.

Anticipating Attrition.

As noted above, the control group is comprised of all families who apply for full-day pre-kindergarten but who ultimately are not assigned to the full-day pilot program. Given the relatively small size of the study, it is essential that virtually all control group participants are preserved throughout the duration of the study (our power analyses do incorporate a 20% attrition rate). Control group tracking is easiest when children whose families lose the lottery opt to participate in other WPS programs such as half-day pre-kindergarten programming, and/or when they enroll in WPS public schools for kindergarten and beyond. For these children, WPS can easily integrate ongoing data collection into the school day. For instance, we coordinate with the District to administer the end-of-year PPVT and ESI-R in the context of the regular half- and full-day pre-k day without much additional administrative costs. However, it should be noted that obtaining those same measures for children who did not enroll in a WPS program is more difficult.

Plan for Managing Attrition. It takes a combination of strategies to ensure that ongoing assessment data is included for control group children. We list a few of those strategies below:

1) *Clear Communication at Start of Study:*

It is essential to ensure all study participants are aware that, by agreeing to participate in the study, they are also agreeing to participate in ongoing data collection efforts. In order to apply for the Pilot program's full-day slots, families are required to complete an online survey, which includes some explanations about what the study will entail. Among other elements of this initial application, one crucial objective will be to collect effective means of continued communication with study families. These elements will be carefully designed through close collaboration with the District.

2) *Integrated Assessments for Study Participants Enrolled in WPS Pre-K:*

For those study participants who either enroll in full- or half-day WPS pre-kindergarten, collecting outcome data can be accomplished within the regular pre-king hours. Thus for these families, the additional time needed to participate in the study will be minimized.

3) *Financial Incentives for Non-WPS Study Participants:*

Since the evaluation team will need to collect outcome data for all lottery losers not enrolled on WPS pre-k programs, these families will need to schedule times to bring their children to WPS school sites to complete testing. This will represent an inconvenience for some families, and thus we include significant financial compensation (i.e., "incentives") for these families in order to offset those personal costs. It is important that families feel that it is worth their time to continue to participate in the study even though their child was not randomized to the full-day pilot program.

Study Outcomes.

The quantitative analysis of causal effects involves bringing together (a) new data that will be collected by the research team, with support from district personnel, (b) existing data sources that are already routinely collected by the District, and (c) surveys designed and administered by the research team. We plan to follow students as they progress through

school using a number of short- and medium-term outcomes of interest. We obtain some of these outcomes through primary data collection during the pre-k year. This includes information from parents about the amount they work and perceptions of how child care may or may not constrain their ability to work. In the Pilot Year of the study we also collected (start and) end-of-school-year PPVT measures of literacy skills and the ESI-R measure of possible need for special education services. In Year 1 of the study we will continue to use PPVT and ESI-R and will also add two new measures: a measure behavioral self-regulation and executive function, Head-Toes-Knees-Shoulders (HTKS) and a measure of classroom quality, the Classroom Assessment Scoring System (CLASS). There is more information below on both of these new measures. However, we also make use of secondary data from the District to supplement these outcomes. WPS collects a [host of relevant outcome data](#) on students throughout the school year in every school grade. These include:

- DIBELS: A measure of literacy skill in the fall, winter, and spring of K, 1, 2, and 3;
- Scantron: A measure of math skill in the fall, winter, and spring of K, 1, 2, and 3;
- WIDA Access: A measure of English language proficiency in spring of K, 1, 2, and 3;
- TS GOLD: A measure of teachers' perceptions of students' cognitive, language, literacy, math, physical, and socio-emotional development in the fall, winter, and spring of pre-k and K;
- Special needs diagnosis;
- Attendance data;
- Grade retention data;
- PARCC: Statewide standardized achievement test math and ELA scores beginning in grade 3

Figure 2 provides a visual timeline of the availability of relevant outcomes, by study cohort. We also administered surveys to all pre-k teachers and study parents to assess some elements of perceived socio-emotional development (see below for preliminary results from these surveys). Finally, because the District is carefully tracking the increased cost of this particular intervention, we will be able to conduct a cost-benefit analysis with regard to standardized achievement score gains and (possibly lower) expenditures on unnecessary special needs services.² Taken together, we anticipate this rich combination of outcome data—about student behaviors and attendance, socio-emotional, physical, and cognitive development, English language acquisition rate, and ultimately performance on statewide math and reading assessments—will provide a rich portrait of how full-day pre-kindergarten experiences might support low-income, minority, and English language learners young students as they navigate the crucial first few years of school.

² The district has hypothesized that many kindergarten students are inappropriately flagged for special needs services because many have had very little exposure to formal schooling. They suspect that some students are simply not familiar with the norms and routines of schooling and thus may appear to misbehave or have trouble concentrating. It is possible that these behaviors would be minimized if more kindergarten children had experience a greater exposure to school settings through a full-day pre-k program.

Figure 2. Visual Timeline for the Availability of Outcome Data across Study Years

		Pilot Year				Year 1 of SRF			Year 2 of SRF			Year 3 of SRF			Year 4 of SRF		
		SY 2016-17		Summer 2017:	SY 2017-18		Summer 2018:	SY 2018-19		Summer 2019:	SY 2019-20		Summer 2020:	SY 2020-21		Summer 2021:	
		Summer 2016	Fall	Spr	Y1 Report	Fall	Spr	Y2 Report	Fall	Spr	Y3 Report	Fall	Spr	Y4 Report	Fall	Spr	Y4 Report
Cohort 2017	Students Who Start @ Age 4	Research team implements initial randomization (7 classes, 224 students)	Semester 1 (of 2) in pre-k (PPVT, ESI-R, GOLD)	Semester 2 (of 2) in pre-k (PPVT, ESI-R, GOLD)	For Coh2017 4 Year Olds, Examine PPVT, ESI-R, GOLD Outcome Diffs After 1 Year of Treatment	Arrive in K (Fall DIBELS; GOLD; W-APT)	By End of K (Win, Spr DIBELS; WIDA; Win & Spr Math Scantron?)	For Coh2017 4 Year Olds, Attrition and K Readiness	Arrive in 1st (Fall DIBELS; Fall Math Scantron?)	By End of 1st (Win Spr DIBELS; WIDA; Win & Spr Math Scantron?)	For Coh2017 4 Year Olds, Attrition and 1st Ach.	Arrive in 2nd (Fall DIBELS; Fall Math Scantron?)	By End of 2nd (Win, Spr DIBELS; WIDA; CogAT)	For Coh2017 4 Year Olds, Attrition and 2nd Ach.	Arrive in 3rd (Fall DIBELS; Fall Math & Read Scantron?)	By End of 3rd (PARCC Scores; Win Spr DIBELS; WIDA; Win & Spr Math Scantron?)	For Coh2017 4 Year Olds, Attrition and 3rd PARCC Ach.
Cohort 2018	New Students Who Start @ Age 4				Research team implements second randomization (9 classes, 288 students)	Semester 1 (of 2) in pre-k (PPVT, ESI-R, GOLD)	Semester 2 (of 2) in pre-k (PPVT, ESI-R, GOLD)	For Coh2018 4 Year Olds, Examine PPVT, ESI-R, GOLD Outcome Diffs After 1 Year of Treatment	Arrive in K (Fall DIBELS; GOLD; W-APT)	By End of K (Win, Spr DIBELS; WIDA; Win & Spr Math Scantron?)	For Coh2017 4 Year Olds, Attrition and K Readiness	Arrive in 1st (Fall DIBELS; Fall Math Scantron?)	By End of 1st (Win Spr DIBELS; WIDA; Win & Spr Math Scantron?)	For Coh2017 4 Year Olds, Attrition and 1st Ach.	Arrive in 2nd (Fall DIBELS; Fall Math Scantron?)	By End of 2nd (Win, Spr DIBELS; WIDA; CogAT)	For Coh2017 4 Year Olds, Attrition and 2nd Ach.
Cohort 2018	New Students Who Start @ Age 4							Research team implements third randomization (11 classes, 352 students)	Semester 1 (of 2) in pre-k (PPVT, ESI-R, GOLD)	Semester 2 (of 2) in pre-k (PPVT, ESI-R, GOLD)	For Coh2018 4 Year Olds, Examine PPVT, ESI-R, GOLD Outcome Diffs After 1 Year of Treatment	Arrive in K (Fall DIBELS; GOLD; W-APT)	By End of K (Win, Spr DIBELS; WIDA; Win & Spr Math Scantron?)	For Coh2017 4 Year Olds, Attrition and K Readiness	Arrive in 1st (Fall DIBELS; Fall Math Scantron?)	By End of 1st (Win Spr DIBELS; WIDA; Win & Spr Math Scantron?)	For Coh2017 4 Year Olds, Attrition and 1st Ach.

Estimated Statistical Power.

We examined the minimum detectable effect size (MDES) for a longitudinal randomized block design. The MDES is calculated for two-tailed hypothesis tests with a statistical significance level of .05 and power at 80%. Across the three cohort years, we expect a sample size of approximately 864 students applying to 27 full-day classes. We assume a balanced allocation of treatments within sites (50% assigned to treatment, 50% to control). As discussed above, our data collection procedure includes baseline literacy and special needs assessment scores from the beginning of the pre-k school year, as well as an unusually robust set of time-varying pre-treatment and time-invariant student covariates.³ Given the richness of our baseline covariate information, we assume a student-level R^2 of .65, which we believe to be conservative. Finally, because our study examines student outcomes longitudinally, sample attrition is likely to occur. In our power calculations, we assume an attrition rate of 20%. Given these assumptions, our minimum detectable effect size is .14 standard deviations, which we believe is a magnitude of both scientific and policy interest.

Monitoring the Randomization.

Once students are randomly assigned into full day pre-k or BAU conditions, we check that treatment and control groups are balanced on all baseline covariates, such as gender, parental education, home primary language, and race/ethnicity. We present this cohort balance analysis below for Cohort 1 and Cohort 2. Because of random assignment, we expect that full day and BAU pre-k participants should be balanced on all pre-intervention covariates; however, if chance imbalances do occur, we control for these covariates in our final estimation models. Further, we examine the data to determine if treatment non-compliance occurred, where students assigned into the full day pre-k condition enter the BAU condition, and students assigned to the BAU condition “showed up” for full day pre-k. In the event that treatment non-compliance does occur, our main analyses focus on estimating intent to treat effects, and in subsequent analyses, we will look at the treatment on treated analyses by using random assignment as an instrumental variable for treatment receipt.

In addition, we examine the data to determine if differential attrition of the outcome occurred by intervention conditions or by participant demographic characteristics. Our sensitivity analyses examine how robust our treatment effects are to sample attrition through Manski bounds (Lee, 2009). Finally, we address any missingness of covariate information through a series of strategies, including controls for missing information in the outcome model, or by using multiple imputation methods (Schafer, 1997).

³ Because parents must fill out a long health, background, and child assessment application before they can be enrolled in pre-k, we have an unusually in-depth set of student-level pre-treatment covariates, including student age on the first day of pre-k, gender, race, ethnicity, home primary language, history of parental drug/alcohol use, parental education and income, history of neglect/abuse/homelessness, parent perceptions of child’s current language and social skills, whether a parent was a teen parent, family structure, and some health data (e.g., birth weight).

Cohort 1: Successful Randomization & Implementation

Cohort 1 Baseline Characteristic Balance.

Once students were randomly assigned into treatment or control conditions, we checked that these groups were balanced on all observed baseline covariates, such as gender, parental education, home primary language, and race/ethnicity (for a full list, see Figure 3). We also examined pre-scores on the ESI-R assessment and the PPVT—two of the primary assessments given at the start and end of the pre-k year.

We estimated group mean differences in 19 available pre-treatment covariates (see Figure 3) within school site (given the use of a block-randomized design). In Figure 3, we present those differences (in standard deviation units) and the 95% confidence interval for each. Each orange data point represents the average *difference* between the treatment and control groups on the given factor. Ideally, these orange data points would be close to zero—no pre-existing differences between the groups (or not statistically distinguishable from zero). Estimates above the horizontal dashed line at $Y=0$ indicate that the treatment group has a higher mean value on the given variable than the control group, while estimates below the line indicate that the treatment group has a *lower* mean value on the given variable. Randomization is considered “successful” when there are not statistically significant differences in mean pre-treatment covariates (i.e., the 95% confidence interval (in green) around each estimated difference (orange) includes zero). For the most part, there were no significant differences in pre-treatment covariates between those randomized to treatment and control in Cohort 1. There also does not appear to be any systematic patterns of advantage/disadvantage between the groups.

Figure 3. Cohort 1 Randomization Balance



The one exception to this was a possible difference in the percentage of families in each group that reported moving frequently (an effect size of -0.305 , and an associated p -value of 0.021). It appears that the parents of students randomly assigned to the treatment group were slightly less likely to report frequent moving than in the control group. It should be noted that indicating frequent moving was, overall, an uncommon event (only 10% of parents marked “yes” to this question). In addition, finding that one out of about twenty estimates is statistically significant is to be expected by chance. We were pleased to see that we did achieve balance on key pre-treatment covariates, including baseline assessment scores, poverty measures, and parental education. We also conducted a stacked regression (a.k.a., seemingly unrelated regression) in order to test the joint null hypothesis that these groups are indistinguishable on the full set of covariates. The p -value associated with that f -test is a marginal 0.043 , due to the inclusion of the “frequent moves” variable (when omitting that one factor, the p -value is 0.162). Taken together, we believe this provides strong initial evidence that the Cohort 1 randomization was successful. Nonetheless, we include pretreatment covariates in our statistical models to address any possible imbalances that might arise by chance.

Cohort 1 Crossover and Movements.

Below we present information about the observed treatment status of members of both the treatment and control groups in Cohort 1. Recall that study participants remain in the study even if they opt to find childcare elsewhere:

- **Treatment Group (114 students):** Members of this group were offered a spot in a full-day class.
 - 02 students (02%) switched to half-day (crossover);
 - 14 students (12%) either did not enroll in WPS or left at some point during the year;
 - 98 students (86%) remained in a full-day classroom throughout the year
- **Control Group (112 students):** Members of this group were offered a spot in a half-day class.
 - 10 students (09%) switched to full-day (more on this crossover below);
 - 33 students (29%) either did not enroll in WPS or left at some point during the year;
 - 69 students (61%) remained in a half-day classroom throughout the year.

We were aware at the onset of the study that state policy required that exactly 16 students be enrolled in each full-day classroom, at least through the first half of the school year (December). For this reason, at the time of the lottery we also generated a randomized-order waitlist for full-day slots comprised of study participants who did not win a spot in their first-choice full-day site. When spots opened up in full-day classrooms in the first semester (due to lottery winners not taking up or discontinuing use of their offer), we used this waitlist to determine which study family would be given the spot.

We expected to see greater crossover from control-to-treatment, rather than in the opposite direction. We assume that some families that applied for full-day care actually *required* full-day childcare (e.g., in order to work), and if they lose the lottery, they would seek full-day scheduling elsewhere. To the extent that treatment non-compliance does occur, our main analyses focus on estimating intent to treat effects, and in subsequent analyses, we will look at the treatment on treated analyses by using random assignment as an instrumental variable for treatment receipt.

Cohort 1 Observed Attrition.

It is worth noting that any study participant's decision to not take up their offer of a full- or half-day spot does not constitute attrition in this study. They continue to be included in all assessments and survey efforts throughout the year unless they indicated they prefer not to be contacted. No families requested to be removed from the study. We refer to randomized applicants who do not take up their slot as "Non-WPS Participants." We reached out to these families and scheduled them to bring their child to one of the nearby school sites to complete the assessments, and we thanked them for their time by providing a \$100 cash card in both the fall and spring. As a result of these efforts, we were able to assess all but 13 of the Non-WPS Participants in the fall of 2017. We have put into place a number of specific strategies to improve our ability to retain Non-WPS Participants in future cohorts. For instance, we are extending the available assessment appointment times into the evenings and weekends this coming year. We also raised funds to dedicate additional resources to following up with these participants.

Naturally, families who "win" the full-day lottery are more likely to take up their spot in WPS. Indeed, 71% of the control group and 87% of the treatment group ultimately attended WPS. All WPS children are assessed during regular classroom time. Because we are not always successful in reaching Non-WPS Participants and ensuring they show up for their assessment appointments, this leads to some imbalance in assessment data missingness. We show this imbalance below:

- **Percent of Participants with Test Scores: PPVT & ESI-R (Start and End of Year)**
 - Overall: PPVT Fall (89%), PPVT Spr (89%), ESI-R Fall (95%), ESI-R Spr (91%)
 - Control: PPVT Fall (85%), PPVT Spr (83%), ESI-R Fall (93%), ESI-R Spr (87%)
 - Treatment: PPVT Fall (92%), PPVT Spr (94%), ESI-R Fall (97%), ESI-R Spr (97%)

We continue to monitor the data to determine if differential attrition of the outcome occurred by intervention conditions or by participant demographic characteristics. Our sensitivity analyses will examine how robust our treatment effects are to sample attrition through Manski bounds (Lee, 2009).

Statistical Methods for Analyzing Outcomes

Each year, the number of available outcome measures, study participants, and years of schooling increases. We will monitor the progress of the experiment by conducting statistical analyses annually to estimate the effects of full-day on outcomes as they become available. In Model (1), we present the generic structure of the statistical model that will be used to analyze the RCT data:

$$Y_{ijy} = \beta_0 + \beta_1(T_{ij}) + \beta_2(\text{PreScores}_{ijy-1}) + (X_{ij[y-1]})\beta + \alpha_j + \varepsilon_{ijy} \quad (1)$$

Generically, let Y_{ijy} represent some outcome for student i whose first choice school was site j at time y . Our outcomes include student achievement, language development, mobility, special needs, attendance, and socio-emotional development in each year of the study. Because of the randomization, one could simply model this as a function of T_{ij} —the dummy variable coded to 1 if the child was randomly assigned to receive an offer of full-day pre-k and 0 if offered a half-day spot—as well as a series of site-by-cohort fixed effects, indicated by α_j . However, for the sake of power, we also include baseline literacy and special needs assessment scores from the beginning of the school year (time $y-1$), as well as an unusually robust set of time-varying pre-treatment and time-invariant student covariates, $X_{ij[y-1]}$ (the adjusted R-squared values from our analyses of Cohort 1 Year 1 results presented in the LOI are generally around 0.70).

We will explore allowing the coefficient on the treatment dummy to vary randomly across school sites but expect this random effects model to be underpowered. We will also use a two-stage least squares approach to use randomization results to instrument for actual pre-k experiences (full- versus half-day). When appropriate we will also model binary outcomes using logistic regression.

Main Findings from Cohort 1, Year 1

Despite the fact that the analysis of Pilot Year data may be underpowered, we have recently explored whether there is any evidence of positive (if yet-to-be-significant) effects of the full-day pre-k offer on student outcomes. We examined three outcomes in particular: (1) PPVT, (2) ESI-R, and (3) TS-GOLD⁴ (for descriptions of these measures see page 7). We present both the more conservative ITT and more concentrated TOT estimates since both are of policy relevance in this context.

Results from the Year 1 statistical analysis of outcomes is presented in Table 1. All 16 estimates (8 for ITT in the upper panel, and 8 for TOT in the lower panel) are positive. Most of the estimates are at least 0.10 standard deviations, and the largest effect is 0.485 standard deviations (this is the TOT estimate for the TS Gold⁵ Literacy domain). One general exception is the estimates for the ESI-R outcome, where the estimates are positive but substantively small and not statistically significant. Some—but not all—of the other estimates are already statistically significant, despite a general lack of power after only one year. Of course, a lack of significance is to be expected at this stage since we have only analyzed results from one of three study cohorts. The PPVT findings are particularly interesting in that they are on par with other impactful early childhood interventions (e.g., Tennessee STAR, Literacy Express, Headstart). We find that these treatment effects are robust to both the unadjusted and adjusted outcome models, indicating that covariate imbalance was not an issue after randomization. The adjusted outcome models include controls for student and family baseline characteristics, such as pretest and demographic factors (see Table 1 footnote for specifics). All models include school choice fixed effects. Importantly, we see evidence of an "attendance effect"—students randomly offered a spot in full-day pre-k were 1.4 times more likely to remain enrolled in Westminster throughout the school year than those randomized into the group offered a slot in half-day.

⁴ It is important to point out that TS Gold was not intended to be an outcome of the study (since it is not available for study families who choose not to enroll in pre-k at Westminster). However, 85% of the study families did enroll in WPS (though the 15% that did not enroll in WPS are still part of the study sample). Therefore, we have access to TS GOLD data for most—but not all—of our sample. Though not perfect, we examined whether any differences in the cognitive, language, literacy, math, physical, and socioemotional skills between treatment and control children in WPS are evident to this point.

⁵ Of course, one should interpret these findings with caution, as we do not have TS GOLD outcomes for about 15% of the study participants. In addition, TS GOLD measures are based off of teachers' perceptions of their own classroom children—these assessors are certainly not blind to students' treatment group. For these reasons, these cannot be interpreted as a "causal effect" of full-day pre-k. However, through some sensitivity checks, we find that the general substance of the results—higher skill development among those assigned to full-day—are relatively robust.

Table 1. Predicted Difference in 8 Student Outcomes in May of Pre-K (ITT vs. TOT).

Intent-to-Treat Estimates								
	<u>PPVT</u>	<u>ESI-R</u>	<u>TS Gold</u>					
	<i>Literacy</i>	<i>Special Needs</i>	<i>Cognition</i>	<i>Language</i>	<i>Literacy</i>	<i>Math</i>	<i>Physical</i>	<i>Socio-Emotional</i>
Assigned to Full	0.259 *	0.024	0.199 *	0.093	0.386 ***	0.199 *	0.177 *	0.102
	(0.103)	(0.151)	(0.082)	(0.087)	(0.086)	(0.080)	(0.086)	(0.074)
Constant	0.166 *	0.171	0.093	0.106	0.152 *	0.078	-0.006	0.026
	(0.081)	(0.119)	(0.065)	(0.069)	(0.068)	(0.064)	(0.068)	(0.059)
R²	0.712	0.423	0.798	0.773	0.827	0.831	0.777	0.830
Adj. R²	0.633	0.262	0.733	0.700	0.772	0.776	0.706	0.776
N	200	202	182	182	182	182	182	182

Treatment-on-Treated Estimates								
	<u>PPVT</u>	<u>ESI-R</u>	<u>TS Gold</u>					
	<i>Literacy</i>	<i>Special Needs</i>	<i>Cognition</i>	<i>Language</i>	<i>Literacy</i>	<i>Math</i>	<i>Physical</i>	<i>Socio-Emotional</i>
Attended Full-Day	0.383 *	0.036	0.250 *	0.117	0.485 ***	0.250 *	0.221 *	0.128
	(0.154)	(0.223)	(0.102)	(0.108)	(0.105)	(0.099)	(0.108)	(0.092)
Constant	0.077	0.163	0.053	0.087	0.074	0.038	-0.041	0.005
	(0.110)	(0.159)	(0.077)	(0.081)	(0.079)	(0.074)	(0.081)	(0.069)
N	200	202	182	182	182	182	182	182

Note: Models include first-choice school (i.e., block) fixed effects, as well as fall pre-scores on all assessments (and, where relevant, the language and format in which these assessments were taken). The models also include student-level control variables (for the sake of power) for gender, race/ethnicity, free/reduced price lunch eligibility, and age at the start of pre-k. To control for any possible family context differences we also include parental education, whether or not child had a teen parent, whether the home language is English, as well as indicators for (pre-treatment reports of) history of family drug/alcohol abuse, family special needs, frequent moving, physical abuse, interactions with social services, difficulties obtaining secure housing, and perceived child underdeveloped language or social skills prior to pre-k. We include missingness dummies in cases where respondents have missing pre-treatment covariates.

Descriptive Findings from the Cohort 1 Parent Survey

In the spring of each pre-k year, we administer a survey to the parents of all study children. To thank parents for their time, we provided each family a \$25 Visa Cash Card. The surveys were made available online and in hard copy (English and Spanish). The complete survey can be found in Appendix A. We contacted parents initially via email, and followed up with WPS-enrolled study non-respondents by providing hard-copies of the survey in the class itself. For study non-respondents whose children did not attend Westminster, we also mailed hard copies of the survey via regular mail. In addition, we followed up via phone with a few of the remaining families.

Together, these efforts allowed us to achieve a very strong response rate of 80 percent, which will be suitable for publishing findings based on the survey analyses (70 percent is often considered a minimum threshold). Though 80 percent is considered a very high response rate, we hope to brainstorm with WPS faculty and staff ways to attain even higher numbers of responses in the second and third years—perhaps by communicating more directly to families via WPS' Early Childhood Center personnel or teachers.

In the parent survey, we asked questions around four broad topics related to child care during the hours of 8am to 6pm Monday through Friday:

- (A) Perceptions of WPS pre-k services;
- (B) Preferred forms of secondary childcare during non-WPS hours and perceptions of that care;
- (C) Parental reports of their own child's skill development
- (D) The interplay between work and pre-k care.

The survey was intended to capture both overall feedback about WPS pre-k, but more importantly to examine whether there are any differences in these perceptions based on assignment to the treatment or control group. In general, treatment children were largely exposed to full-day pre-k during the work week, while control children were only in pre-k 3 hours per day, 4 days per week. We hypothesize that this may lead to some differences along the four dimensions listed above.

(A) Perceptions of WPS Preschool Services.

Study parents whose children attended WPS in 2016-2017 were asked a set of questions about their perceptions of WPS pre-k. For a list of all questions, see Figure 4. We were particularly interested in whether parental responses to these questions depended on whether they were assigned to full- versus half-day pre-k slots. The responses to these questions were placed on a standardized scale (1= Strongly Disagree, 2= Somewhat Disagree, 3=Somewhat Agree, and 4= Strongly Agree), and we calculate the mean response across parents to each item. We also compare the mean response among treatment and control respondents to see if there are any statistically significant or practically large differences in response patterns.

Figure 4. Survey Questions Related to Parent Perceptions of WPS Preschool

12. When thinking about WPS preschool, please rate how much you agree with each statement:				
My Child's WPS class...	Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
(A) ... has convenient hours.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(B) ... is conveniently located (close to home, work, transportation)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(C) ... provides an affordable childcare option for my family.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(D) ... is a clean and safe environment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(E) ... has plenty of books, toys, and engaging material.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(F) ... makes me feel welcome.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(G) ... helps my child learn social skills (like sharing and following directions).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(H) ... helps my child learn academic skills (learning letters and numbers) that will help them in elementary school.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

13. When thinking about your child's primary WPS teacher, rate how much you agree with each statement.				
My Child's Main WPS teacher...	Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
(A) ... is warm and affectionate.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(B) ... talks to me about my child's learning progress.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(C) ... talks to me about my child's behavior.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

We find very high reported satisfaction with WPS pre-k services in both the treatment and control group (see Table 2). For instance, the average response to the item, "WPS Has Convenient Hours" was 3.55 (on a scale from 1 to 4). We do see that the treatment group had a slightly higher response to this question (by about 1/8th of a scale point), but this difference is not very large or statistically significant. We see a similar pattern for the other ten items reported in Table 2—that is, high average responses and no large differences between treatment and control group. For a complete visualization of all responses, see Figure 5.

Table 2. Parental Reported Satisfaction with WPS Preschool, Overall and Separately by Treatment Status

Survey Question	Overall Mean	Control Group	Treatment Group	Difference	Difference P-Value	Is the Difference Statistically Significant?
WPS Has Convenient Hours	3.55	3.47	3.60	0.13	0.341	No
WPS Has Convenient Locations	3.70	3.63	3.76	0.13	0.254	No
WPS Pre-K is Affordable	3.72	3.66	3.77	0.11	0.316	No
WPS Classrooms Feel Clean and Safe	3.76	3.76	3.76	0.00	0.981	No
WPS Has Plenty of Books, Toys, and Engaging Materials	3.75	3.76	3.74	-0.02	0.846	No
WPS Makes Me Feel Welcome	3.77	3.85	3.72	-0.14	0.241	No
WPS Helps My Child Learn Social Skills	3.80	3.82	3.78	-0.04	0.742	No
WPS Helps My Child Learn Academic Skills	3.81	3.80	3.81	0.00	0.968	No
My Child's Main WPS Teacher is Warm and Affectionate	3.74	3.80	3.69	-0.11	0.380	No
My Child's Main WPS Teacher Talks to Me about My Child's Behavior	3.76	3.75	3.76	0.01	0.938	No
My Child's Main WPS Teacher Talks to Me about My Child's Learning Progress	3.73	3.77	3.71	-0.06	0.630	No

Footnote: 1= Strongly Disagree, 2= Somewhat Disagree, 3= Somewhat Agree, and 4 = Strongly Agree.

Figure 5. Parental Perceptions of WPS Preschool Services, by Treatment Status.



(B) Preferred Forms of Secondary Care.

It is important to understand how parents manage childcare during the work week when WPS pre-k is not available. We asked survey parents the following question: "On a typical week (Mon-Thurs) between 8am and 6pm, where does your child spend the MOST time, not including time in WPS schools?" Among the survey respondents, 65 percent indicated that most of this non-WPS time was spent in parental care. An additional 21 percent indicated that most of this non-WPS time was spent in the care of a relative other than the parent (e.g., an aunt or grandparent). The remaining 14 percent relied on Head Start, private pre-k or other center-based care, or care by a non-relative.

Because full-day pre-k provides 30 hours of care during the work week, while half-day care only covers 12 hours per week, we anticipated that treatment families would spend very different amounts of time in these alternative care settings. We asked parents to report the number of hours spent in each of five possible non-WPS care settings: (A) in a Head Start center, (B) in private pre-k or other non-WPS childcare center, (C) in non-relative care (e.g., care by a babysitter, neighbor, family childcare provider), (D) in relative care other than a parent (e.g., aunt, grandparent), (E) in parental care (mother,

father, or legal guardian). The overall number of hours (and differences in mean number of hours between treatment and control groups) are reported in Table 3.

Table 3. Number of Hours Spent in Non-WPS Childcare Settings, by Treatment Group

Survey Question	Overall Mean	Control Group	Treatment Group	Difference	Difference P-Value	Is the Difference Statistically Significant?
Number of Hours Outside WPS Time Spent in Private Preschool or Other Non-WPS Childcare Center	1.64	2.14	1.23	-0.91	0.395	No
Number of Hours Outside WPS Time Spent in a Head Start Center	1.16	1.56	0.83	-0.73	0.321	No
Number of Hours Outside WPS Time Spent in Non-Relative Care (e.g., care by a babysitter, neighbor, family childcare provider)	1.66	2.64	0.85	-1.79	0.046	*
Number of Hours Outside WPS Time Spent in Relative Care Other than a Parent (e.g., aunt, grandparent)	2.41	2.57	2.27	-0.31	0.762	No
Number of Hours Outside WPS Time Spent in Parental Care (mother, father, or legal guardian)	11.58	15.84	7.66	-8.18	0.029	*

We find that parents with access to WPS’ full-day pre-k make less use of all five forms of alternative care. For instance, the average parent respondent in the control group indicated that their child spends 2.14 hours in private pre-k or other non-WPS childcare settings, while the average parent respondent in the control group reports only 1.23 hours. While this difference is not statistically significant, we suspect that this is largely because of small sample size in our first cohort alone. We also find that children assigned to the control group spent nearly twice as many hours in Head Start and in parental care. They also spent more than three times as many hours in non-relative care.

Taken together, these findings suggest that the availability of full-day pre-k alters how parents approach childcare during the week. Since it is clear that the main strategy for childcare during this time is to have the child *with* a parent, this may have implications for parental work arrangements, as well.

(C) Parent Reports of Child’s Skill Development.

We also explored whether parents of children assigned to full-day classrooms reported seeing greater skill and socio-emotional development in their children at home. We asked parents about their child’s current ability to count, recognize letters and colors, listen, share, take turns, and exhibit enthusiasm and curiosity. In Table 4, we report the percentage of parent respondents who affirmed that their children demonstrate the given behaviors by the end of the pre-k year. We do so overall (across all parental respondents) and separately for the treatment and control group.



In general, parents of treatment and control children did not perceive large differences in the behaviors of their children, and those differences were typically not statistically significant. There were a few differences between these groups that may prove to be statistically significant, with a larger sample size. For instance, while 30.4 percent of control group parents indicated their child could recognize all the letters of the alphabet, 11.1 percent *more* of the treatment group parents did so. Likewise, 70 percent and 77.3 percent of control and treatment respondents, respectively, indicated their child usually listens to a story from beginning to end. Finally, we observe that 75.9 percent and 88.8 percent of control and treatment respondents, respectively indicated their child is usually enthusiastic and curious in approaching new activities (in fact, this difference is the one finding in Table 4 that is large enough to be statistically significant).

Table 4. Parental Reports of Child Behaviors at Home, by Treatment Status

Survey Question	Overall Mean	Control Group	Treatment Group	Difference	Difference P-Value	Is the Difference Statistically Significant?
Can Your Child Recognize All the Letters of the Alphabet?	36.2%	30.4%	41.6%	11.1%	0.121	No
Can Your Child Count to 50 or Above?	31.7%	33.3%	30.1%	-3.2%	0.643	No
Can Your Child Identify All of the Colors Red, Yellow, Blue, & Green by Name?	92.6%	93.2%	92.0%	-1.1%	0.781	No
Does Your Child Usually Listen to a Story From Beginning to End?	73.8%	70.0%	77.3%	7.3%	0.271	No
Does Your Child Usually Share Toys (etc) Easily with Other Children when Playing?	70.5%	69.0%	71.9%	2.8%	0.679	No
Does Your Child Usually Take Turns... Without Being Told to Do So?	63.9%	63.7%	64.2%	0.5%	0.949	No
Does Your Child Usually Complete Learning Tasks Involving 2+ Steps in an Organized Way?	72.7%	70.4%	74.8%	4.4%	0.513	No
Is Your Child Usually Enthusiastic and Curious in Approaching New Activities?	82.5%	75.9%	88.8%	12.8%	0.026	*

Overall, we find that parents do perceive that their children possess important academic and socio-emotional skills and the end of the pre-k year. In some cases, we see that parents of children that were assigned to full-day pre-k report greater



development in these areas than their counterparts assigned to half-day pre-k. However many of these differences are either not substantively large or not yet statistically significant.

(D) The Interplay between Work and the Provision of Preschool.

Some early childhood researchers have speculated that there may be important policy implications of full- versus half-day pre-k even if a full-day pre-k experience has no direct impact on students' development. The main benefits of public pre-k could come in the form of family supports (see, e.g., Whitehurst, 2016). The provision of safe, affordable childcare offered at times that are more compatible with standard work hours may allow parents to return to work sooner and/or take on full-time (rather than part time) positions. This could have a two-fold positive impact: First, children could benefit from the externalities associated with having a larger family income. Second, access to more hours of publicly-funded pre-k may lighten the financial burden of childcare at a critical time in young parents' lives (Council of Economic Advisors, 2016). Taken together, this could mean that full-day pre-k could have the indirect positive impact of bringing more resources into the homes of young children.

We explore this by asking parents about their employment, childcare costs, and the extent to which childcare constrains their ability to work. See Table 5 for findings. At this time, we see no evidence that more of the adults in the child's home are employed (full- or part-time) if randomly assigned an offer of full-day pre-k. We asked study parents if their current childcare arrangements (as of spring 2017) prevent them from working as much as they would like. We hypothesized that families randomly assigned to an offer of half-day pre-k would be more likely to feel this way. We find that 44.1 percent of respondents in the control group indicate that childcare hinders work, while 33.5 percent of respondents in the treatment group say the same thing. The 10 percentage-point difference here is not yet statistically significant, but is meaningfully large and is consistent with the theory that the provision of full-day pre-k helps parents work. Finally, we do find a statistically-significant difference in the reported weekly childcare costs of treatment and control families (about \$35/week for treatment families, and nearly double—\$68/week—for control families. This suggests that greater financial resources may be left over after childcare for families that had access to full-day pre-k in Westminster.

Table 5. Parental Employment, Constraints on Work, and Childcare Costs

Survey Question	Overall Mean	Control Group	Treatment Group	Difference	Difference P-Value	Is the Difference Statistically Significant?
% of Adults in Home Employed Full-Time	60.1%	63.8%	56.5%	-7.3%	0.260	No
% of Adults in Home Employed Part-Time	13.5%	14.4%	12.8%	-1.6%	0.712	No
% of Adults in Home Not Currently Employed	19.6%	22.1%	17.4%	-4.7%	0.318	No
% of Respondents Who Said Their Current Childcare Arrangements Prevents Them From Working As Much As They Would Like	38.6%	44.1%	33.5%	-10.6%	0.160	No
Average Cost of All Childcare Per Week	\$50.32	\$67.63	\$34.76	-\$32.87	0.039	*

Though not directly an outcome of the current evaluation, we also asked parents about their plans for their child’s education in the coming school year (2017-2018). We found that 65 percent of study respondents indicated they planned to send their child to WPS next year. Another 21 percent of respondents indicated they planned to send their child to kindergarten in a different public school district. The remaining 15 percent families intended to send their child to a private school, a charter school, wait another year before starting kindergarten, or did not indicate their plans. We also found that, while 59 percent of control families planned to enroll in WPS, a greater percentage—70 percent—of those families that won the study lottery and were offered a full-day spot planned to enroll in WPS. This may suggest that a positive experience in full-day increased the likelihood of continuing with public education in Westminster.

Additional Funding Activities

Our aim is to follow each of three cohorts through third grade, in order to tackle one of the most pressing issues in early childhood education research: the search for evidence of *persistent* effects of early childhood investments in the longer-term. The total predicted cost for an evaluation study of this scope is \$880,127.

WPS launched the full-day pre-k pilot through Pay for Success (PFS) financing. WPS also leveraged philanthropic capital from the Walton Family Foundation and Gary Community Investments to add seven new full-day pre-k classrooms in 2016-2017. This was an initial investment of \$200,000 for the Pilot Year and Year 1 of the study.

We have been writing and submitting grants to relevant funders to obtain additional support for this work to assess the impacts of full-day pre-k as children navigate through third grade. In July 2017 we were awarded an additional grant from the Smith Richardson Foundation for \$238,952, which will support nearly all of the most labor-intensive years of the evaluation—that is, each of the three cohorts’ pre-k year (i.e., through January 2019). We have also submitted a letter of interest to the Laura and John Arnold Foundation (LJAF) for a grant of \$441,175 to support the next 4.5 years of this project. In August 2017, we received promising feedback from the LJAF program officers, indicating an interest in funding this work. They have asked us to update them at the end of fall 2017 with start-of-kindergarten findings for Cohort 1, and implementation data for Cohort 1. We will pursue this source of support and are optimistic that, pending continued success with the study implementation, LJAF will be a likely funding partner for the latter years of the study. Figure 6 outlines the timeline of the project cohorts and the funding sources.

Figure 6. Overview of Sample Cohorts and Funding

	Pilot Year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
	7/1/16- 6/30/17	7/1/17- 6/30/18	7/1/18- 6/30/19	7/1/19- 6/30/20	7/1/20- 6/30/21	7/1/21- 6/30/22	7/1/22- 6/30/23
<i>Study Timeline</i>	Coh 1 = pk	Coh 1 = k Coh 2 = pk	Coh 1 = 1 Coh 2 = k Coh 3 = pk	Coh 1 = 2 Coh 2 = 1 Coh 3 = k	Coh 1 = 3 Coh 2 = 2 Coh 3 = 1	Coh 1 = 4 Coh 2 = 3 Coh 3 = 2	Coh 1 = 5 Coh 2 = 4 Coh 3 = 3
<i>Funding from WPS:</i>	\$125,000	\$75,000					\$200,000
<i>Funding from SRF:</i>			(fall) \$138,952 \$100,000				\$238,952
<i>Remaining Need:</i>			(spr) \$115,209	\$80,170	\$78,174	\$84,870	\$82,752 \$441,175
<i>Annual total:</i>	\$125,000	\$213,952	\$215,209	\$80,170	\$78,174	\$84,870	\$82,752 \$880,127

Study Improvements in Year 2

As we move into the second year of the project we have made a few strategic changes. These changes were prompted by conversations with relevant colleagues in the field of educational research, as well as feedback from potential funders. (1) First, we have taken on all responsibility for conducting one-on-one child assessments for all future pre-k cohorts (more on this below). (2) In addition, we have added two new primary data collections to the pre-k year, HTKS and CLASS, which are described below in detail.

(A) External Assessment Team

One motivation for obtaining additional funding for the project was to build a team of assessors who are trained to administer the four external assessments. This was a significant investment of \$52,000 per semester which allows us to hire eleven external assessors and train them in all of the assessments including CLASS, which has a proprietary training and certification process. Additionally, we were also able to extend the CLASS training to several district personnel. Assembling this team of assessors allows us to minimize the impact on teachers and districts staff by providing external assessors who can complete the various assessments in a relatively short period of time. It also helps to ensure the integrity of the study results by utilizing external assessors as opposed to school and district staff.

(B) Additional Measures

HTKS is a measure of executive function and behavioral self-regulation. The examiner guides the student through scripted interactions with four behavioral rules guiding them to touch their head, toes, shoulders, and knees. The assessment requires students to integrate executive function skills such as following instructions, using their working memory to process commands, using inhibitory control, and using cognitive flexibility (McClelland & Cameron, 2012; Ponitz, McClelland, Matthews, & Morrison, 2009; Wanless, McClelland, Tominey, & Acock, 2011). We believe the addition of this socio-emotional measure is important because researchers currently hypothesize that the effects of early childhood interventions may not register on traditional academic metrics (like the PPVT) but remain important predictors of future success in school. Neither the PPVT or ESI-R are designed to capture this type of child outcome. In addition, the HTKS is short—can be administered typically in 5 minutes—and thus was easily incorporated into the existing assessment activities.

In addition, reviewers for our Smith Richardson Foundation proposal suggested that we add additional data collection about the actual activities taking place inside full- versus half-day classrooms. If we find that full-day scheduling is generally better for children, the next obvious question is: why? In what ways was the extra time leveraged to improve student outcomes? How is time used differently in these two settings? Is the quality of interactions between students and teachers different in a full-day setting? These are important questions both for Westminster Public Schools as they move forward, as well as the larger field which will look to Westminster as a model.

In order to address this concern, we have arranged to train a team of assessors to implement the CLASS observational protocol. The CLASS tool is a nationally-recognized assessment that measures multiple dimensions of teaching that have been linked to student achievement. Assessors are trained to use a rubric to score student-teacher interactions on the dimensions outlined below. The training program is rigorous in that it ensures that observers understand the rubric dimensions and practice rating them with classroom videos. Assessors also have to pass an exam in order to be certified to use the CLASS rubric after training. This training provides a level of reliability across observers, ensuring that they are using the tool consistently across classrooms and teachers. Assessors score four, 20 minute cycles and then average the

scores across those cycles on the dimensions. At the pre-k level there are two main domains, which each have several dimensions:

- Emotional and behavioral support
 - Positive Climate
 - Negative Climate
 - Teacher Sensitivity
 - Regard for child perspectives
 - Behavior Guidance
- Engaged support for learning
 - Facilitation of learning and development
 - Quality of feedback
 - Language modeling

In addition, the individuals conducting the CLASS assessments will also record how time is being used (on a minute-by-minute basis). We will administer the CLASS and Time-Use tools four times per year in order to provide a more complete snapshot of how full-day and half-day classes differ from one another.

Next Steps

In Fall of 2017, the research team will gather baseline data for all study children in Cohort 2. We will also conduct CLASS assessments four times during the school year to deepen study insights into differences in full- and half-day classes. In Spring of 2018, our team will return to the pre-ks to gather end-of-year outcome data for Cohort 2. In addition, we will also administer parent and teacher surveys for Cohort 2 around April 2018. During this time, we will analyze Cohort 2 pre-treatment covariate balance, data response rates, data missingness, treatment group crossover, and attrition. These allow us to monitor the successful implementation of the study.

In addition, in Spring of 2018, we will collaborate with WPS staff to conduct the third and final randomization for this study (Cohort 3). Parents will apply for pre-k during the spring semester, and we will conduct the lottery close to the end of the school year (around April or May 2018).

Finally, we must continue to follow Cohort 1 as they enter kindergarten and beyond. The most important data collection task for Cohort 1 will be to work with WPS to collect secondary assessment data that is required by the District. This [2017-2018 Calendar of Required Westminster Public Schools Assessments](#) indicates that kindergarten students will be exposed to several assessments that we would like to collect for the study. Table 6 outlines the relevant kindergarten outcomes.

Table 6. Relevant Kindergarten Outcomes

Measure	Fall	Winter	Spring
Enrollment in K in WPS	--Yes--		
Daily Attendance	--Yes--	--Yes--	--Yes--
TS-GOLD	--Yes--	--Yes--	--Yes--
DIBELS <i>(Reading assessment)</i>	--Yes--	--Yes--	--Yes--
W-APT <i>(English Language Screener)</i>	--Yes--		
WIDA <i>(CO English Language Proficiency)</i>		--Yes--	--Yes--
Scantron performance <i>(Reading and Math)</i>			--Yes--

We hope to work closely with WPS to ensure that we receive this secondary data as quickly as possible. Our ability to secure additional funding for the later years of the project requires us to demonstrate a continued capacity to collect these outcomes in K-3 and demonstrate causal effects of the full-day lottery that persist as children move through elementary school.

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Appendix A: Parent Survey

You are receiving this survey because in Summer 2016 your child participated in the Full-Day Preschool Lottery Study in Westminster Public Schools ("WPS"). We'd like to ask you some questions about your childcare experiences during this recent school year (2016-2017).

The survey takes about 10 minutes. We recognize that families with young children are very busy. To thank you for your time, we would like to give you a \$25 Visa Cash Gift Card when you complete the survey and return it. The deadline to submit the survey is **Thursday, May 18, 2017**.

PART 1: BASIC INFORMATION

1. Please provide your full name:

First: _____

Last: _____

2. You currently have (at least) one child that is 4 or 5 years old. Our records indicate that you applied for preschool Westminster Public Schools (WPS) in Summer 2016. Do you have 1 child or 2 children (TWINS) that applied for WPS preschool last summer?

- (A) I have **1 child** that applied for WPS preschool last summer.
- (B) I have **twins** that applied for WPS preschool last summer.



3. What is the name of your child who you signed up for WPS preschool in Summer 2016 (age 4 or 5)?

Reminder: Only answer Question #3 if you chose (A) for Question #2.

First: _____

Last: _____

PART 1B: BASIC INFORMATION FOR PARENTS OF TWINS

Reminder: Skip to **QUESTION # 6** if you do **NOT** have twins
(that is, if you chose (A) for Question #2)

4. You indicated that you have twins that applied for WPS preschool last summer.
What are their **FIRST** names?

Child A: _____

Child B: _____



5. What is the LAST name for your twins?

Instructions for Parents with Twins:

The following questions sound like they ask about one child. In the case that you have twins who applied for preschool last summer, we would like you to answer the following questions as if they asked about both twins unless otherwise noted.

Continue to Question #6

PART 1 (CONTINUED): BASIC INFORMATION
(All Parents)

6. What is your relationship to this child?

- Mother Father
 Grandparent Foster parent / legal guardian
 Other (please explain): _____

7. How many of the people in your current household are children (under age 18)?

(Please write a number in the box.)

... children currently live in my household.

8. Including you, how many of the people in your current household are adults (age 18 or above)?

(Please write a number in the box.)

... adults currently live in my household.

9. In Question #8, you told us the number of adults living in your household. Of those adult(s) in your household (including yourself), how many...

(Please write a number for each category)

... work full-time (30 hours/week or more)? → *Your Answer* : _____ adults work full time

... work part-time (less than 30 hours/week)? → *Your Answer* : _____ adults work part time.

... are not currently employed? → *Your Answer* : _____ adults are unemployed.

10. Since August 2016, has your child attended preschool in Westminster Public Schools (WPS)?

- (A) Yes - WPS Full Day Session (8am - 3pm)
- (B) Yes - WPS AM Session (8am - 11am)
- (C) Yes - WPS PM Session (12pm - 3pm)
- (D) No



**If you chose (A), (B), or (C) (attended WPS),
continue to Question # 11.**

- Continue to next page -

PART 2. YOUR EXPERIENCES WITH WPS PRESCHOOL

**Reminder: Skip to PART 3 if your child
did NOT attend a WPS preschool this year**

Part 2 questions are about your child's experience in his/her WPS preschool class during the recent school year.

11. What is the name of the WPS school where your child has attended preschool? (Choose only one)

- | | | |
|---|--|--|
| <input type="radio"/> Early Childhood Center
(8030 Irving St. Westminster, CO) | <input type="radio"/> Fairview Elementary
(7826 Fairview Ave. Denver, CO) | <input type="radio"/> Flynn Elementary
(8791 Lowell Blvd. Westminster, CO) |
| <input type="radio"/> F. M. Day Elementary
(1740 Jordan Dr. Denver, CO) | <input type="radio"/> Hodgkins Elementary
(3475 W 67th Ave. Denver, CO) | <input type="radio"/> Sherrelwood Elementary
(8095 Kalamath St. Denver, CO) |
| <input type="radio"/> Skyline Vista Elementary
(7395 Zuni St. Denver, CO) | <input type="radio"/> Sunset Ridge Elementary
(9451 Hooker St. Westminster, CO) | <input type="radio"/> Tennyson Knolls Elementary
(6330 Tennyson St. Arvada, CO) |
| <input type="radio"/> Westminster Academy
(7482 Irving St. Westminster, CO) | | |

12. When thinking about WPS preschool, please rate how much you agree with each statement:

My Child's WPS class...	Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
(A) ... has convenient hours.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(B) ... is conveniently located (close to home, work, transportation)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(C) ... provides an affordable childcare option for my family.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(D) ... is a clean and safe environment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(E) ... has plenty of books, toys, and engaging material.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(F) ... makes me feel welcome.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(G) ... helps my child learn social skills (like sharing and following directions).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(H) ... helps my child learn academic skills (learning letters and numbers) that will help them in elementary school.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



13. When thinking about your child's primary WPS teacher, rate how much you agree with each statement.

My Child's Main WPS teacher...	Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
(A) ... is warm and affectionate.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(B) ... talks to me about my child's learning progress.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(C) ... talks to me about my child's behavior.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

- Continue to next page -

PART 3: DAYTIME CHILDCARE OUTSIDE WPS

(All Parents)

We'd like to ask you some questions about how you arrange care for your child during regular preschool hours on Mondays, Tuesdays, Wednesdays, and Thursdays.

- If your child is **not registered in a WPS preschool program**, we'd like you to think about:
8am to 6pm on Mon -Thurs.
 - If your child is registered in the WPS **full-day** preschool program, we'd like you to think about:
The 3 hours after they leave WPS full day: 3pm to 6pm on Mon -Thurs.
 - If your child is registered in the WPS **morning** preschool session, we'd like you to think about:
The 7 hours after they leave WPS half-days: 11am to 6pm on Mon -Thurs.
 - If your child is registered in the WPS **afternoon** preschool session, we'd like you to think about:
The 4 hours *before* they arrive at WPS (8am-12n) *AND* the 3 hours *after* they leave the PM session (3pm-6pm).
14. **Think about the times above. On a typical week (Mon-Thurs), does your child spend time in any of the following (non-WPS) care settings? If yes, enter the average number of hours per day.**

	Choose One:		If YES, average # of hours per day on...			
	Yes	No	<u>MON</u>	<u>TUE</u>	<u>WED</u>	<u>THU</u>
(A) Head Start center	<input type="radio"/>	<input type="radio"/>	___ hours	___ hours	___ hours	___ hours
(B) Private preschool or other non-WPS childcare center	<input type="radio"/>	<input type="radio"/>	___ hours	___ hours	___ hours	___ hours
(C) Non-relative care (e.g., care by a babysitter, neighbor, family childcare provider)	<input type="radio"/>	<input type="radio"/>	___ hours	___ hours	___ hours	___ hours
(D) Relative care other than a parent (e.g., aunt, grandparent)	<input type="radio"/>	<input type="radio"/>	___ hours	___ hours	___ hours	___ hours
(E) Parental care (mother, father, or legal guardian)	<input type="radio"/>	<input type="radio"/>	___ hours	___ hours	___ hours	___ hours

15. On a typical week (Mon-Thurs) between 8am and 6pm, where does your child spend the **MOST** time, not including time in WPS schools?

- (A) in a Head Start center
- (B) in private preschool or other non-WPS childcare center
- (C) in non-relative care (e.g., care by a babysitter, neighbor, family childcare provider)
- (D) in relative care other than a parent (e.g., aunt, grandparent)
- (E) in parental care (mother, father, or legal guardian)

16. What is the **name** of your child's Head Start, private preschool, or other non-WPS childcare center:

_____ (leave blank if not applicable)

17. Think about the time (Mon-Thurs 8am-6pm) that your child typically spends **in the care setting you selected in QUESTION #15**. How much do you agree with the following statements about that time?



This childcare option (from Question # 15)...	Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
(A) ... has convenient hours.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(B) ... is conveniently located (close to home, work, transportation)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(C) ... provides an affordable childcare option for my family.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(D) ... is a clean and safe environment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(E) ... has plenty of books, toys, and engaging material.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(F) ... makes me feel welcome in this setting.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(G) ... helps my child learn social skills (sharing, following directions).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(H) ... helps my child learn academic skills (learning letters and numbers) that will help them in elementary school.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

18. Think about the **primary person** who cares for your child in the care setting you selected in **QUESTION #15**. How much do you agree with the following statements about that person?

This person...	Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
(A) ... is warm and affectionate.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(B) ... talks to me about my child's learning progress.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(C) ... talks to me about my child's behavior.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

19 & 20. When your child is at the care setting you selected in QUESTION #15:

Typically... ... other children are cared for there at the same time. (Please write a number in the box.)

Typically... ... adults are usually present to provide childcare (Please write a number in the box.)

PART 4. QUESTIONS ABOUT YOUR CHILD

If you have TWINS, first look back at QUESTION #4.

Think about the child you listed as "Child "A" when you answer Questions #21 – 25

(We'll ask you about the other twin on the next page)

We'd like to ask you some questions about your child.

21. In a typical week, how often do you or any other family member read books together with this child?

- Not at all 1 - 2 times per week
 3 - 6 times per week 7 times per week (everyday)

22. Can this child recognize the letters of the alphabet?

- None of them Some of them
 Most of them All of them I don't know

23. How high can this child count?

- Not at all Up to 5 Up to 10
 Up to 20 Up to 50 Up to 100 or more I don't know

24. Can this child identify the colors red, yellow, blue, and green by name?

- None of them Some of them
 All of them I don't know or not applicable

25. How often does this child demonstrate the following behaviors?

	Usually or always	Sometimes	Rarely or Never	I don't know
Listens to a story from beginning to end	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Shares toys or other things easily with other children when playing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Takes turns in a game situation with toys and other things without being told to do so	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Completes learning tasks involving two or more steps (e.g., cutting and pasting) in an organized way	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Is enthusiastic and curious in approaching new activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

If you DO NOT have twins, skip to Question #31 (PART 5)

PART 4B. (FOR PARENTS OF TWINS): QUESTIONS ABOUT “CHILD B”

Reminder:

Skip to PART 5 if you DO NOT have twins

If you DO have TWINS, first look back at QUESTION #4 to remember which twin is “Child B”.

Now think about “Child “B” when you answer Questions #26 – 30

26. In a typical week, how often do you or any other family member read books together with Child B?

- Not at all 1 - 2 times per week
 3 - 6 times per week 7 times per week (everyday)

27. Can Child B recognize the letters of the alphabet?

- None of them Some of them
 Most of them All of them I don't know

28. How high can Child B count?

- Not at all Up to 5 Up to 10
 Up to 20 Up to 50 Up to 100 or more I don't know

29. Can Child B identify the colors red, yellow, blue, and green by name?

- None of them Some of them
 All of them I don't know or not applicable



30. How often does Child B demonstrate the following behaviors?

	Usually or always	Sometimes	Not yet or rarely	I don't know
Listens to a story from beginning to end	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Shares toys or other things easily with other children when playing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Takes turns in a game situation with toys and other things without being told to do so	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Completes learning tasks involving two or more steps (e.g., cutting and pasting) in an organized way	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Is enthusiastic and curious in approaching new activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

- Continue to next page -

PART 5: FINAL QUESTIONS

(All parents)

31. Consider ALL the care THIS child receives in a typical week. Include babysitters, after school care, preschool, etc. (Please do NOT include costs for other children in your household.) What is the total amount you pay for all childcare in a typical week? (If all childcare is free, please write \$0)

The total amount that I typically pay for childcare per week for THIS child is:

\$

32. Do your current childcare arrangements prevent you from working as much as you would like?

- Yes
- No

33. What are your plans for childcare next year (August 2017 - May 2018)? (Select the most likely choice)

- Wait one more year before this child starts kindergarten.
- Enroll this child in kindergarten in WPS
(Reminder: Children born after 09/30/2012 will be too young to enroll in kindergarten in fall 2017)
- Enroll this child in kindergarten in a different public school district (other than WPS)
- Enroll this child in kindergarten at a private school
- Other (please explain): _____

34. We may want to contact you in the future about this study to know more about how your child is doing in school. Please enter your most up-to-date contact information here:

Primary phone: _(_)_-_____

Primary email: _____

35. Optional: Please use the space below to provide us with any additional comments about your experience with your child's childcare this past year. _____

- Continue to instructions for receiving your gift card -

