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Do better schools help to prolong early childhood education effects?

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ABSTRACT

As scholars investigate factors to prolong early childhood education (ECE) effects on student achievement, a neglected hypothesis is that subsequent school quality promotes this goal. We test this, using data from 1844 students who attended kindergarten in the Tulsa Public Schools (TPS) in 2006 and who were identifiable in the school district a decade later. Approximately half of those students attended an ECE program. We establish a close link between school quality and magnet schools which we use as a proxy for higher quality schools. Using propensity score weighting with multiple imputation, we find that ECE alumni are more likely to attend a magnet middle school and a magnet high school. We find that magnet middle school attendance yields higher test scores, after controlling for multiple variables. We conclude that higher quality middle schools could help school districts to sustain short-term gains from ECE for a diverse cross-section of students.

Introduction

Enthusiasm for early childhood education (ECE) programs has grown in recent years, triggering sharp increases in state funding and enrollment rates for four-year-olds (Barnett et al., 2017). Numerous research studies have validated these investments by documenting substantial improvements in school readiness for students attending high-quality ECE programs (Phillips et al., 2017; Yoshikawa et al., 2013). The research evidence is bolstered by developmental theory, which stresses the critical importance of the early childhood years in the development of cognitive and socio-emotional skills, given the rapid growth of neurons during this period (Shonkoff & Phillips, 2000). The short-term efficacy of high-quality preschool programs is now firmly established.

Scholarly consensus on longer-term effects has proven more elusive. Although several studies following ECE students into elementary school or middle school have documented persistent advantages for ECE alumni (Barnett, Jung, Youn, & Frede, 2013; Bassok & Miller, 2014; Dodge, Bai, Ladd, & Mutschkin, 2017; Gormley, Phillips, & Anderson, 2018), two well-crafted studies have not (Lipsey, Farran, & Durkin, 2018; Puma et al., 2012). There seems to be persistence in some situations and fadeout in other situations, but the field lacks a consensus in predicting when fadeout will occur and how extensive it will be.

In this paper, we ask whether enrollment in a higher quality public school, proxied by magnet schools, is more likely if a student participated in an ECE program as a four-year-old. We also ask whether that helps to prolong the initial ECE advantage. Our laboratory is Tulsa, Oklahoma, where magnet schools are marginally better than other public schools. We argue, in effect, that superior magnet schools should attract ECE alumni and challenge and stimulate them enough to mitigate fade out effects that have often plagued ECE programs. Using a rich data base, we examine the middle school enrollment practices of ECE alumni, overall and among subgroups of students. Next, we ask whether enrollment in a magnet middle school encourages later enrollment in a magnet high school. Finally, we investigate whether enrollment in a magnet school boosts student achievement, after controlling for student and family characteristics.

The ECE Fadeout Puzzle

Virtually every scholar who has studied the longer-term effects of ECE programs has found some evidence of fadeout: either partial or total (Duncan & Magnuson, 2013). For example, studies of school-based pre-K in Tulsa have found large short-term improvements in cognitive skills, followed by some fadeout but also a persistent pre-K advantage in math test scores in both third and seventh grade (Gormley et al., 2018; Hill, Gormley, & Adelstein, 2015). Some scholars have also found a more complicated pattern – e.g., cognitive fadeout followed by the sudden appearance of non-cognitive differences in adolescence or early adulthood or non-cognitive differences that grow while cognitive

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differences diminish (Deming, 2009; Heckman, Pinto, & Savelyev, 2013). On balance, research supports the proposition that ECE programs produce lasting benefits (Phillips et al., 2017; Yoshikawa et al., 2013), with the national Head Start Impact Study and the Tennessee Voluntary Pre-K study as notable exceptions (Lipsey et al., 2018; Puma et al., 2012).

In an effort to integrate these disparate findings, scholars have offered possible explanations for variations in fadeout across research sites. One popular explanation is ECE program quality (Samuels, 2018). For example, critics of the Tennessee pre-K and national Head Start studies argue that these programs were either below average in quality or highly variable in quality (Chaudry, Morrissey, Weiland, & Yoshikawa, 2017; Mead, 2015). According to this perspective, fadeout is likely to be more dramatic when ECE program quality is relatively low. However, Farran and Lipsey (2015) dispute claims that the Tennessee pre-K program was below average in quality. Unfortunately, these debates have often focused on relatively weak measures of program quality, such as educational inputs rather than classroom observations of teacher-child interactions, which makes it difficult to reach firm conclusions.

A second popular explanation is the elementary school curriculum. According to one line of argument, sustained ECE effects require that elementary school teachers ratchet up their pedagogy so that more advanced ECE alumni learn lots of new material and advance to a higher level of knowledge and understanding (Gormley et al., 2018). If kindergarten, 1st grade, and 2nd grade teachers ignore the "pre-K revolution" and continue to do exactly what they have been doing, then ECE alumni may stagnate and the achievement gap between alumni and non-alumni may narrow considerably. Studies show that redundant elementary school instruction in math can be harmful to high-achieving students (Engel, Claessens, & Finch, 2013). On the other hand, it is not clear that this helps to explain fadeout. In fact, one recent study (Jenkins et al., 2018), using data from Head Start and TRIAD (an early mathematics demonstration program) plus kindergarten and 1st grade instructional content data, found no statistically significant interactions between instructional content and preschool enrollment on student achievement. In the authors' words: "Instructional measures did little to explain fadeout" (Jenkins et al., 2018, p. 366).

A third explanation, neglected by most researchers, is magnet schools. In a study of the Chicago Child Parent Centers program, using path analysis, Reynolds and Ou (2011) found that preschool participants were more likely to attend magnet schools between the ages of 10 and 14 and that magnet school enrollment was associated with a higher high school graduation rate and a lower juvenile arrest rate. It is important to note that the magnet schools in question had "selective enrollment policies that require good school performance and high expectations for success" (Reynolds & Ou, 2011, p. 564). This suggests that high-quality magnet schools, combined with a strong preschool program, could provide some students with a double boost: pre-K creates the initial surge, which a magnet school helps to sustain. Magnet schools that consider academic performance in the admissions process could be especially advantageous to pre-K alumni who excel in elementary school because they would be more likely to accept outstanding students.

A fourth explanation, which might be viewed as a blend of the second and the third, posits that school quality matters (Bailey, Duncan, Odgers, & Yu, 2017), though it undoubtedly takes different forms. School quality is a difficult concept to define. It might manifest itself as a more robust, more challenging curriculum; stronger teacher workforce; or more motivated student body. But as with magnet schools, students in a higher quality education setting could sustain the initial boost from ECE. Within the Tulsa School District, magnet schools are considered to be stronger schools across a variety of metrics; for example, test scores and student-teacher ratios are better in magnet schools. Therefore, we use magnet school status as a proxy for school quality because these schools encompass more than just higher test scores. Next, we discuss the relationship between magnet schools and school quality.

School quality and magnet schools

Unlike charter schools, which have received considerable attention in the literature, magnet schools, often established by large urban school districts, have not been a magnet to education researchers (Engberg, Epple, Imbrogno, Sieg, & Zimmer, 2014). That is unfortunate because the number of students attending magnet schools is roughly comparable to the number attending charter schools, which have been studied much more thoroughly (Polikoff & Hardaway, 2017). Magnet school enrollments, at 2.6 million students, are similar to charter student enrollments at 2.7 million (National Center for Education Statistics (NCES), 2016) and exceed Catholic school enrollments, at 1.8 million students (National Center for Education Statistics (NCES), 2016).

The original rationale for magnet schools, dating back to the late 1960s and early 1970s, was to encourage white students to attend schools with a substantial black student population (Frankenberg, Siegel-Hawley, & Orfield, 2008; Rossell, 2005). By offering opportunities to specialize in a popular subject, such as a foreign language, the performing arts, or STEM, school districts reconstituted schools in black neighborhoods to make them more attractive to white students. They then established admissions criteria that departed from the traditional neighborhood school presumption, in pursuit of racial integration. As magnet schools evolved, some school districts sought to attract black students to white neighborhoods, and some school districts advertised magnets as being good all-around rather than being good in one specific curricular area. Some school districts also created hybrid schools, with a magnet program embedded in a regular neighborhood school. From the outset, magnet schools were viewed as integral parts of the public school system, unlike charter schools, which have typically been situated outside the public school system.

Over the years, scholars have asked whether magnet schools boost student achievement, school diversity, or both. In one early study using national data, Gamoran (1996) found that students in public magnet high schools performed better on standardized tests in science, reading, and social studies compared to other public high school students (there were no statistically significant differences in math). Using data from Connecticut, Bifulco, Cobb, and Bell (2009) found that interdistrict transfers to magnet middle schools yielded gains in reading, and interdistrict transfers to magnet high schools yielded gains in reading and math. Racial diversity also improved for transferring students. In a study of 21 schools in 11 school districts, Betts, Kitmitto, Levin, Bos, and Eaton (2015) found that conversion to a magnet school improved racial and ethnic diversity for both traditional magnets (disadvantaged schools that seek to attract more advantaged students) and destination magnets (advantaged schools that seek to attract more disadvantaged students). However, they found no evidence of test score improvements attributable to magnet school status. Similarly, Engberg et al. (2014) found no evidence that magnets improve test scores, though they did find that magnets improve student behavior. However, school quality more generally has been shown to boost higher test scores and graduation rates (Hastings & Weinstein, 2008; Jackson, 2010; Pop-Eleches & Urquiola, 2013).

In a synthesis of 18 studies, Wang, Herman, and Dockterman (2018) reached three conclusions about magnet school effects on student achievement: first, magnet school effects tend to be "minimal or modest" but positive; second, magnet schools seem to produce larger impacts in high school than in elementary school, perhaps because students play a bigger role in affirmatively choosing their high school; and third, magnet schools produce some positive effects that go beyond standardized test scores (e.g., advanced course-taking, graduation rates) and generally produce bigger gains for more disadvantaged students. Although more research needs to be done, results thus far have been fairly encouraging.

Equal opportunity

The rationale for expanding state-funded pre-K programs has often highlighted the critical importance of boosting the educational performance of low-income students, including students of color. For example, Chaudry et al. (2017, p. 72) defend their blueprint for a sharp expansion of pre-K and Head Start by arguing that we need to "ensure that all children have an equal playing field for succeeding in school." Targeted pre-K programs promote equal educational opportunity explicitly by directing funds to at-risk students, including students of color and students from low-income households. Universal pre-K programs do this indirectly by offering the prospect of better outcomes through peer effects for disadvantaged students who attend the same pre-K program as middle-class students (Gormley, 2017a; Weiland & Yoshikawa, 2013). This same emphasis on the educational outcomes of the most disadvantaged students can be found in the Elementary and Secondary Education Act, in the No Child Left Behind, and its successor act, Every Student Succeeds Act. All of these statutes sought, albeit in different ways, to reduce the achievement gap between black and white students, between Latino and white students, and between low-SES and high-SES students, which continues to be a source of great concern (Manna, 2011; Reardon & Portilla, 2016). When examining the effects of ECE programs on state outcomes, it is important to pay close attention to subgroup differences, including variations by race and household income (or its surrogate, school lunch eligibility).

Across studies, there is limited agreement on differences in ECE's short-term impact by demographic subgroups (Ladd, 2017). For example, studies suggest larger pre-K effects among low-income children (e.g., Gormley, Gayer, Phillips, & Dawson, 2005; Weiland & Yoshikawa, 2013), though results also suggest favorable effects for middle-income youth. Hispanic students tend to have the most consistently favorable effects, compared with children of other backgrounds. For example, in Tulsa, Hispanic students' favorable pre-K effects were large and effect sizes were more favorable than many other sub-groups of children (Gormley, 2008). The story of black student success from pre-K is not as consistent as that of Hispanic students (Ladd, 2017). Finally, there is some indication that subgroup differences by race may instead be driven by income status, given that children from minority backgrounds are overrepresented in lower income groups, at least at the national level (Bassok, 2010).

Whether fadeout of ECE effects varies by subgroup remains unclear, because many studies of longer-term effects do not report subgroup effects thoroughly (Dodge et al., 2017) or at all (Barnett et al., 2013). A national study of Head Start's longer-term effects found more fadeout for blacks and less fadeout for whites and Hispanics (Deming, 2009). That same study found more fadeout for girls than for boys. Our own studies in Tulsa were inconclusive on gender; on race, we generally saw more fadeout for black and less for Hispanic students (Gormley et al., 2018; Phillips, Gormley, & Anderson, 2016).

Tulsa public schools: ECE and magnet programs

Tulsa Public Schools (TPS) is a large, urban school district that is ideal for studying the link between ECE and school quality. At the time of our study, TPS enrolled more students, over 40,000, than any other school district in Oklahoma. It also had a very diverse student body with respect to race-ethnicity, family income, and home language. In terms of our study interests, TPS offers both universal pre-K and Head Start (under a state-sanctioned partnership with the Community Action Project of Tulsa County) to four-year-old children and has magnet middle and high schools. These ECE programs maintain high quality standards, as required by Oklahoma state law. For example, all teachers must have a bachelor's degree and must be early childhood certified; and child/staff ratios of ten-to-one must be maintained.

As noted previously, magnet schools emerged in the late 1960s and the early 1970s as a plausible strategy for promoting racial integration in U.S. schools. In Tulsa, school administrators became interested in the magnet school idea in the early 1970s, after a federal district court judge ruled that TPS was not complying with Brown v Board of Education (1954) or the Civil Rights Act of 1964 and ordered that segregated schools be shut down. In the early 1970s the George Washington Carver Middle School and the Booker T. Washington High School, both located in historic black neighborhoods, reopened as magnets with a mandate to achieve a more favorable racial balance (McDonald, 2015). Over time, additional magnet schools were established, including schools in historic white neighborhoods that were expected to attract black and Latino students.

Unlike some school districts, TPS has both magnet middle schools and magnet high schools. Five of the fifteen middle schools are magnets and three of the ten high schools are magnets. Two of the magnet schools are housed within a standard high school. In addition, TPS has two types of magnet schools: admission and lottery. The admission magnet, which is also referred to as an academic magnet, requires that students apply and are selected on the basis of grades, test scores, attendance, and teacher recommendations. For lottery magnets, students apply and are selected based on a random drawing. For standard middle and high schools, students attend based on their geographic proximity to the school.

As Table A.1 in the appendix suggests, there is a striking positive relationship between magnet school status and school quality in Tulsa, for both middle schools and high schools. The evidence comes from school report cards, issued by the Oklahoma Department of Education for the 2014–15 school year, based on standardized test scores and attendance, not adjusted for student characteristics. Among middle schools, 3/5 magnet schools but 0/8 non-magnet schools received an A, B, or C letter grade. Among high schools, 4/4 magnet schools but 0/7 non-magnet schools received an A, B, or C letter grade. Although some magnets are better than others and some non-magnets are better than others, magnets as a whole are clearly superior to non-magnets in Tulsa, based on objective evidence from the state of Oklahoma (though value-added models might yield different results).

Expectations

Based on our review of the literature, we had several expectations about the relationship between ECE and school quality, which is operationalized by magnet school status. We break down our expectations based on type of magnet school and process of admission (high school only). Attending either an academic magnet school or a lottery magnet school first requires students to apply to the school. We believed that ECE could be a factor in first applying to a school because of the widespread assumption that magnet schools are more attractive and more competitive academically. We describe the types of magnet schools in turn and use the term magnet school in the manuscript to denote the type of school and also as a designator of higher school quality.

Academic magnet

Acceptance into an academic magnet school at both the middle school and high school levels is based in part on student grades and teacher recommendations. Because ECE increases student test scores (Gormley et al., 2018), we expected students enrolled in ECE to be accepted into academic magnets at higher rates.

Lottery magnet

Because acceptance into a lottery magnet school is based on chance and not on academic merit, we did not expect a direct relationship between ECE and lottery magnet attendance at the middle school or high school levels. However, it was expected that there might be an indirect relationship, with ECE encouraging more applications.

Therefore, they might be more likely to have their child enroll in a magnet school.

Academic outcomes

Magnet schools in Tulsa are generally regarded as among the best of the city's public schools, therefore, we expected students enrolled in these schools to perform better on standardized tests compared to students who did not attend magnet schools.

Methods

Study sample

Our sample is from Tulsa, Oklahoma, where we have continued to track approximately 1850 of 4033 students who enrolled in the Tulsa Public Schools kindergarten program in the fall of 2006 and who were still students in the Tulsa Public School System as of 10th grade. Approximately half of our students were enrolled in an ECE program as four-year-olds: most of these students enrolled in the school-based pre-K program, while approximately 200 of these students were enrolled in Head Start just prior to kindergarten. While previous studies have analyzed the effects of pre-K and Head Start separately, we combined them because we expected effects to be similar and because both programs receive some funding through the state's universal pre-K system. Our matching strategy resulted in a final pool of 1844 students. In middle school, 23.1% of our sample attended a lottery magnet, 14.7% attended an academic magnet, and 62.2% attended a traditional middle school. For high school, 15.8% attended an academic magnet, 7.8% attended a lottery magnet, and 76.3% attended a traditional high school.

Measures

We used data collected from three sources: (1) state/district administrative data from 2006/2007, 2013/2014, and 2015/2016 academic years for children enrolled in TPS; (2) parent survey data from children enrolled in TPS as collected in August 2006; and (3) U.S. Census data.

Treatment

We define ECE participation based on enrollment in pre-K or Head Start in 2005/2006 and on attendance using TPS administrative records. To be included in our treatment group, students must have attended pre-K or Head Start for at least 50% of the academic year (90 days or more). The comparison group was thus youth who were not in pre-K or in Head Start (though they could have attended < 50% of the days). In our analysis of middle school magnet attendance, ECE participation was the primary treatment variable.

Covariates

TPS staff provided administrative data for each child enrolled in TPS K during the 2006/2007 academic year. From administrative records, information was available on: school attended, date of birth, race/ethnicity, gender, whether the student was redshirted, and school lunch status. A Woodcock-Johnson test administered at kindergarten entry (Woodcock, McGrew, & Mather, 2001) and state tests administered in third grade yielded information on early academic access. The Woodcock-Johnson subtests included letter word i.e., applied problems, and spelling; we used the first two as control variables here. The parent survey administered in August 2006 contained the following information: the child's previous preschool experience, parental marital status, whether the child currently lived with his or her biological father, the highest level of education attained by the mother, and the availability of internet access at home. The overall response rate was approximately 64%. Finally, we obtained the block group median income from when the children were in K to represent neighborhood economic resources and used these data to designate whether a student was living in public housing in 2006/2007.

Table 1
Data available for Magnet School application process.

	Middle school		High school	
	Lottery	Admission	Lottery	Admission
Apply			X	X
Accept			X	X
Attend	X	X	X	X

Magnet schools

For the first part of the analysis, our focus was on application, acceptance, and attendance in a magnet school. As mentioned previously, we have data on application and acceptance for high school magnets as of 9th grade, but not for middle school magnets. For middle school, we only know which school a student attended. However, our data permit us to distinguish between lottery magnets and academic magnets for both middle school and high school. Therefore, the main dependent variables included attending a magnet middle school, application to a magnet high school, acceptance to a magnet high school, and attendance at a magnet high school. Table 1 summarizes the data we have for middle and high school.

Academic outcomes

Finally, we obtained TPS data for academic outcomes for the second step of our analyses. We examined state standardized test score data as collected during the spring of 2014 (for most students, seventh grade; for students retained in grade once, sixth grade). Our data source, the Oklahoma Core Curriculum Test (OCCT), is a criterion-referenced state assessment administered annually (Oklahoma State Department of Education, 2014). We focused on the OCCT math and reading tests to test the effects of middle school magnets. We obtained PSAT data to test the effects of high school magnets on achievement.

Analytic strategy

In the absence of random assignment to ECE, we selected a propensity score weighting approach to estimate the impact of ECE on magnet school attendance and application. In three recent papers (Gormley et al., 2018; Hill et al., 2015; Phillips et al., 2016), researchers estimated the effects of the Tulsa Public School's (TPS) ECE programs on standardized test scores as of third grade and seventh grade, using propensity score weighting. In this paper, we use a similar analytic strategy given demonstrated success at generating groups (ECE and non-ECE) that are similar on observable background characteristics. When estimating the impact of magnet school attendance on test scores, we are able to strengthen our analysis by controlling for academic performance in elementary school.

We estimated the ATT (average treatment effect on the treated) rather than the ATE (average treatment effect) in propensity score estimates. As noted above, we included both pre-K and Head Start in our ECE measure. Although Oklahoma does have "universal" pre-K, current enrollment patterns are close to 75%. Head Start enrollment is much smaller. For simplicity, treatment refers to attending an ECE program and control refers to not attending ECE. Due to sample attrition, we used multiple imputation to appropriately estimate missingness on covariates, which was completed prior to calculating propensity score weights. Missing data on covariates from administrative data were rare.

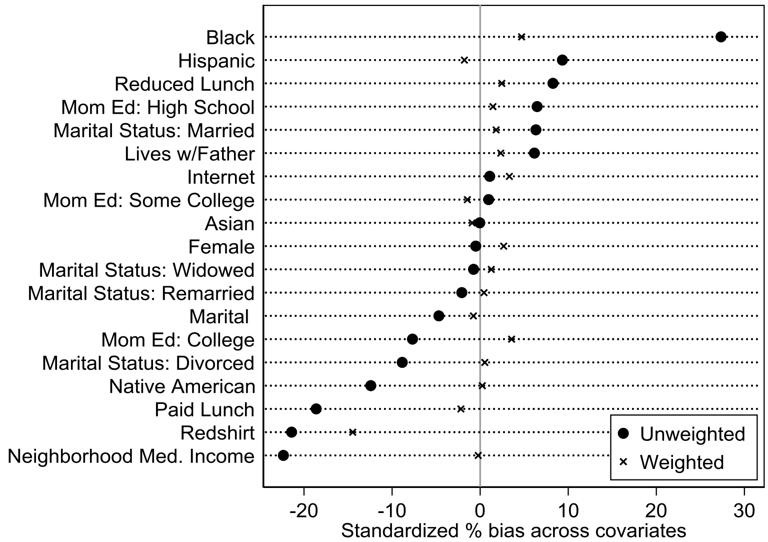

Fig. 1. Standardized Bias across Covariates for Unweighted and Weighted Sample.

We did not impute values for gender, race, and free lunch status. In addition, we did not impute any outcome data (i.e. magnet school enrollment or test data). Table A.2 in the appendix summarizes the missingness in the data set. We imputed values for missing covariates with the Stata mi estimate program using imputation by chained equations to create 20 complete data sets based on observed data (StataCorp, 2017; White, Royston, & Wood, 2011). Each of these 20 data sets was analyzed individually. Results were combined according to Rubin (1987) to produce our final estimates and standard errors, which adjusts for variability across imputed datasets.

Our estimation approach focused on achieving the best covariate balance (Harder, Stuart, & Anthony, 2010), and weighting by the odds to produce well-balanced groups. We selected iterations, non-linearities, and interactions to optimize the model and minimize the absolute standardized difference (ASD; the difference in means for each covariate divided by the pooled standard deviation) between the students who attended ECE (the treatment) and students who did not. Fig. 1 shows the reduction in differences between the unmatched and matched data sets for our covariates. The goal is to have minimal or no difference in observable characteristics between students who attended ECE and those who did not. Prior to applying weights, differences in ECE students and non-ECE students were evident. After the weights were applied, the differences between the groups decreased substantially (see Fig. 1).

For middle school analyses, we used multiple regression with covariates (and imputed data) to examine the extent to which ECE is associated with attendance in middle school magnet schools. When we turned our focus to high school magnets, we included a control for whether or not students attended a magnet middle school. Students who attended a magnet middle school were far more likely to attend a magnet high school than those who did not. We also included an interaction term between attending a magnet middle school and ECE participation to determine whether the combined experiences of ECE and attending a magnet middle school were differentially related to high school magnet attendance. To test the sensitivity of the model, we ran separate models for pre-K and Head Start for both middle school and high school with the overall sample (i.e. no subgroups). Results are consistent with the overall models. Pre-K results were statistically significant and consistent in magnitude with the overall model. Head Start failed to achieve statistical significance for the middle school models and some high school models, but is consistent in direction with the overall model. When we analyzed the effect of magnet schools on test scores, we included magnet middle school attendance as an independent variable.

Finally, when we analyzed students who attended an academic magnet school, we compared those students to students who attended a standard high school, excluding students who attended a lottery magnet. In the same vein, we excluded students who attended an academic magnet when analyzing lottery magnet students. In other words, we examined the impact of middle school magnet attendance (either type) compared with no magnet school attendance. Within each set of analyses, we first focused on all students. Then, we stratified the sample with respect to race and lunch status and ran separate models for each group. This allowed us to determine whether the effects were different by subgroup.

Results

We report findings below for students overall and for subgroups based on race/ethnicity and school lunch eligibility. Fig. 2 shows the simple breakdown of attendance/application/acceptance to magnet schools by ECE attendance. Without controlling for any covariates, students who attended ECE had higher rates of attending magnet schools than those who did not attend ECE, consistent with our expectation. We were also interested in attendance/application/acceptance for subgroups to determine whether effects are consistent across groups. Table 2 breaks down magnet school status by race and then by lunch status and suggests that for students in all subgroups, those who attended ECE were more likely to attend middle school magnets and apply, be accepted, and attend high school magnets. Next, we turn to our regression analysis.

ECE and magnet enrollment

All models include the covariates as described; estimates were averaged across 20 multiply imputed datasets using Stata's mi estimate. We report coefficients from the linear probability model because of ease of interpretation. Logistic regression results, which yield statistically similar findings, are available by request.

Is ECE Attendance associated with middle school magnet schools Attendance?

The results predicting middle school admissions magnet attendance from propensity score weighted multiple regression estimates are found in Tables A.3 and A.4 in the appendix. Tables A.5 and A.6 contain the

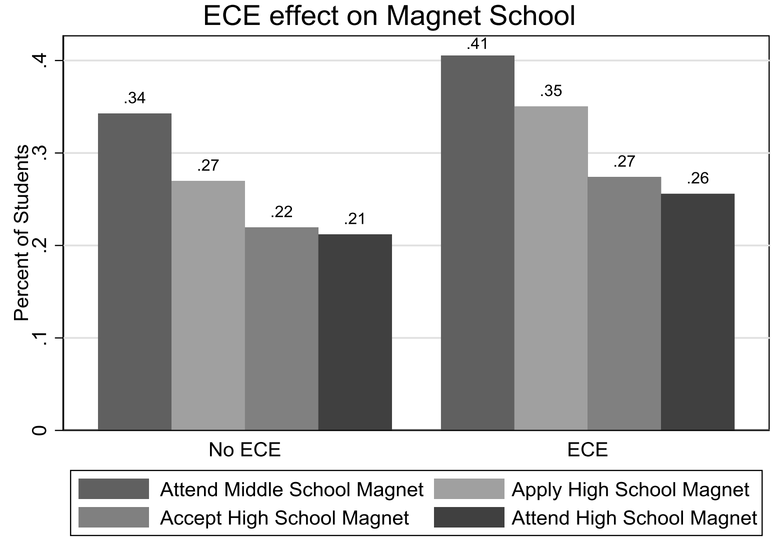

Fig. 2. Percent of Students who Applied and were Accepted to Magnet Schools by ECE.
Note: These are the percent of students in each category and does not include any covariate adjustments.

Table 2
Magnet application, acceptance, and attendance by race and ECE and Lunch Status and ECE.

	Race	% Attend middle sch.	% Applied high sch.	% Accept high sch.	% Attend high sch.	No. of students
ECE	White	49.6	41.9	35.6	31.4	258
	Black	33.6	28.1	19.2	18.4	423
	Hispanic	40.9	37.7	29.5	28.8	281
	Asian	70.6	58.8	58.8	58.8	17
	Native Am.	40	35.8	31.3	26.8	67
No ECE	White	46.2	35.8	32.6	30.9	304
	Black	20	17.3	10.0	10.0	220
	Hispanic	30.6	25.8	20.3	19.8	182
	Asian	69.2	69.2	69.2	69.2	13
	Native Am.	29.9	15.4	10.3	10.3	78
ECE	Free	31.9	28.9	20.9	20.2	747
	Reduced	44.9	33.9	31.2	28.4	109
	Paid	72.3	69.3	51.3	45.5	189
No ECE	Free	22.2	17.8	12.7	12.3	527
	Reduced	30.7	28.1	21.9	21.9	64
	Paid	65.5	50.2	45.9	43.9	205

Note: Each entry represents the percent of students who fit that category. For example, 49.6% of students who identified as white and attended ECE, attending a middle school magnet.

results for the lottery magnet. Fig. 3 plots the 95% confidence interval for the ECE coefficient for each model from those tables. For admission magnet, ECE increased attendance by approximately 7% ($p = 0.001$). Turning to subgroup analyses, ECE was not a statistically significant predictor for white students; however, we found a positive and statistically significant relation at the 5% level for Hispanic students ($p = 0.007$) and at the 10% level for black ($p = 0.06$) and Native American students ($p = 0.052$). When we turn to lunch status, ECE had a positive and significant association for students who received free lunch on admissions magnets ($p < 0.01$). However, we did not find an ECE effect for students on reduced or paid lunch.

Turning to lottery magnets, there was a similar overall effect; ECE students were approximately 7% more likely to attend a lottery magnet ($p < .01$). However, there were minimal effects by subgroups by race. The ECE coefficient was a positive and statistically significant association for only the black student subgroup ($p = .018$), who were 9% more likely to attend a magnet if they attended ECE than did not. Differing from the admission magnet subgroup analyses by lunch status, we found that ECE is positive and significant for reduced price ($p = .047$) and paid lunch students ($p = .022$).

Is ECE Attendance associated with high school magnet schools Attendance?

Turning to high school analyses, we obtained additional data on those who applied to and those who were accepted at magnet schools. In the first set of analyses, we did not control for middle school magnet. Fig. 4 plots the coefficient for ECE for our six different outcome models. Table A.7 in the appendix contains the full regression results. Students who attended ECE were 7% more likely to apply to an academic magnet ($p < 0.001$) and 5% more likely to be accepted to an academic magnet ($p = 0.007$) than students who did not attend ECE. Both results were statistically significant at the 5% level. ECE was only marginally significant in predicting application to a lottery school (p-value = 0.057), but was statistically significant in predicting acceptance ($p = 0.035$). Combining magnet school types, the results were even stronger. ECE predicted both application ($p < 0.001$) and acceptance ($p < 0.001$) to magnet schools.

In the second set of analyses, we controlled for attendance at a magnet middle school and an interaction between magnet middle school attendance and ECE attendance. Controlling for middle school magnet attendance indicates whether or not attending ECE, over and above attending a magnet middle school, was associated with high school magnet status. Analyses with the interaction between magnet middle schools and ECE demonstrates if there is an additional benefit among students who attended ECE *and* a middle school magnet program.

Table 3 contains the coefficients of interest for the overall sample and subgroups by race. The table reports the coefficients and standard errors for ECE, magnet middle school, and the interaction between the two for each model. Table A.8 in the appendix contains the full regression results for the overall sample. When examining all students, the strongest predictor of applying and acceptance to a high school magnet was attending a middle school magnet. Students who attended a middle school magnet were 54.5% more likely to apply to a magnet high school ($p < 0.001$) and 47.5% more likely to be accepted than students who attended a standard middle school ($p < 0.001$). ECE was not directly associated with high school magnet status, though, as noted earlier, it was indirectly associated with high school magnet status because ECE graduates were more likely to attend a magnet middle school.

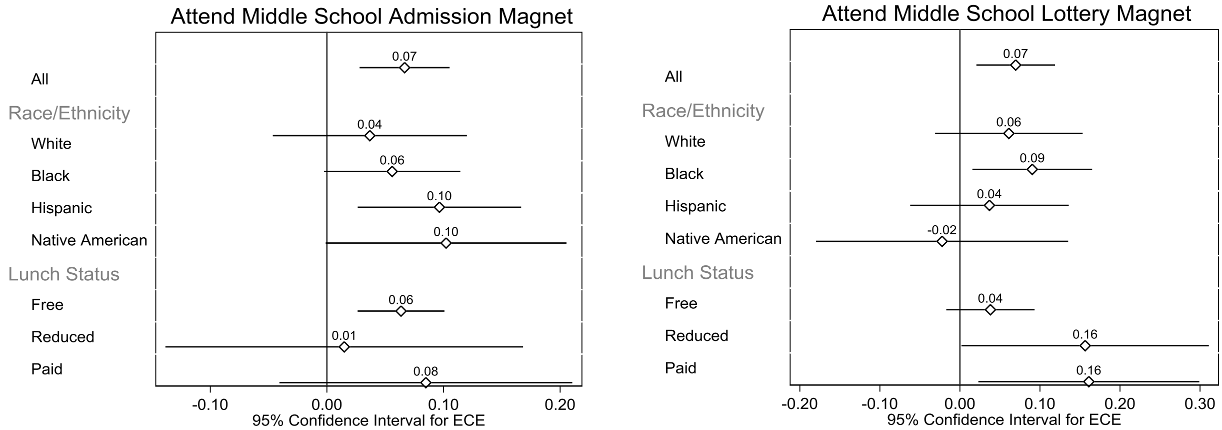

Fig. 3. Predicting Academic and Lottery Magnet Middle School Attendance.
Note: Each coefficient represents the effect of ECE from a different linear probability model. The graph on the left predicts attendance in an academic magnet first for all students and then the data is subset based on the group listed. The graph on the right replicates this for attendance in lottery magnet middle schools. Covariates are included in all of the models. For each coefficient, 95% confidence intervals are also included.

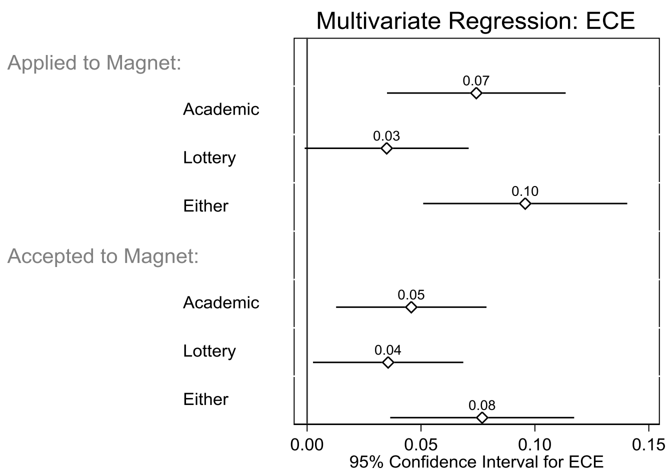

Fig. 4. Predicting Academic and Lottery Magnet High Schools.
Note: Each coefficient represents the effect of ECE from a different linear probability model. Covariates are included in all of the models. For each coefficient, 95% confidence intervals are also included.

Results varied across subgroups. For white students, ECE was associated with higher rates of applying to an academic magnet (approximately 5%; $p = 0.048$), applying to both (approximately 7%; $p = 0.041$), and being accepted into either magnet or lottery (approximately 6%; $p = 0.043$). Attending a middle school magnet (vs. not) had a larger effect for white students than our overall sample. White students who attended a middle school magnet were 65.9% more likely to apply to a magnet high school ($p < 0.001$) and 63.4% more likely to be accepted than students who attended a standard middle school ($p < 0.001$). The interaction term between ECE and middle school magnet was not significant for this group.

Focusing on black students, ECE by itself was not statistically significant. Attending a middle school magnet was statistically significant across all six models; however, not to the degree it was for white students. Black students who attended a middle school magnet were 44.5% more likely to apply to either a lottery or academic magnet high school (p-value < 0.001) but only 28.5% more likely to be accepted to either than black students who attended a standard middle school (p-value < 0.001). The interaction is not significant for applying to magnets but is statistically significant in acceptance to academic magnets. Black students who attended a middle school magnet and ECE were 17.5% more likely to be accepted into an academic magnet than black students who did not attend a magnet or go to ECE ($p = 0.025$).

Results were similar when focusing on Hispanic students. ECE by itself was not statistically significant but middle school magnet was significant. Hispanic students who attended a middle school magnet were 58.5% more likely to apply to either a lottery or academic magnet high school ($p < 0.001$) and 53.8% more likely to be accepted to either than students who attended a standard middle school ($p < 0.001$). The interaction was not significant for acceptance to magnets, but was statistically significant in applying to academic magnets ($p = 0.01$), suggesting that the combination of attending ECE and going to a magnet middle school promotes application to a magnet high school.

Lastly, for Native American students, ECE by itself was not a predictor. Middle school magnet attendance was only marginally significant for two of the outcomes (applied both p-value = 0.087; accepted both p-value = 0.076). However, the interaction was significant (applied both $p = 0.016$; accepted both $p < 0.01$). For Native American students, it was the combination of ECE and attending a magnet middle school that increased the likelihood that they will attend a magnet high school.

We also ran the analysis for subgroups based on free lunch status. Table 4 contains the coefficients of interest from these models. First, we report the results for students receiving free lunch. Students who attended a middle school magnet were 52.7% more likely to apply to either a lottery or academic magnet high school ($p < 0.001$) but only 42% more likely to be accepted to either than students who attended a standard middle school ($p < 0.001$). We found an interaction effect for both the application ($p < 0.01$) and acceptance ($p = 0.027$) to an academic magnet. For both reduced and paid lunch students, magnet middle school was statistically significant, but ECE and the interaction term were not.

Is magnet school attendance associated with higher test scores?

We have established that ECE played a role in enrollment in magnet schools, particularly for some subgroups. The next question was, did attending these magnet schools matter for academic outcomes? To test the effect of middle school magnet enrollment, we focused on seventh grade state standardized tests for math and reading. Attending a middle school magnet was clearly not endogenous to academic outcomes. Students who had a higher standing academically were more likely to be accepted into an academic magnet by definition. Similarly, high performing students might be more motivated to apply to both lottery and academic magnets than low performing students. Therefore, it is important to control for academic success prior to attending a magnet school. We have data at two time points to help control for early

Table 3
Coefficients (and Standard Errors) of ECE and Middle School Magnets on High School Magnet Attendance by Race.

Students	Variables	Applied to magnet			Accepted to magnet		
		Academic	Lottery	Both	Academic	Lottery	Both
All	ECE	0.008	−0.000	0.016	0.005	0.010	0.020
		(0.015)	(0.012)	(0.019)	(0.010)	(0.011)	(0.014)
	Magnet middle	0.402*** **	0.362***	0.545***	0.321***	0.294***	0.475***
		(0.047)	(0.050)	(0.042)	(0.040)	(0.045)	(0.041)
	ECE X magnet	0.000	0.000	0.000	0.000	0.000	0.000
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	Sample size	1592	1387	1810	1633	1497	1810
White	ECE	0.049**	0.006	0.075**	0.028	0.025	0.059**
		(0.025)	(0.025)	(0.032)	(0.023)	(0.024)	(0.029)
	Magnet middle	0.603***	0.311***	0.659***	0.560***	0.283***	0.634***
		(0.0604)	(0.0783)	(0.0550)	(0.0615)	(0.0711)	(0.0565)
	ECE X magnet	−0.0502	−0.0380	−0.0597	−0.0937	−0.0630	−0.106
		(0.0708)	(0.0970)	(0.0680)	(0.0739)	(0.0852)	(0.0708)
	Sample size	514	373	557	517	399	557
Black	ECE	0.0181	0.00242	0.0213	0.00376	0.00192	0.00466
		(0.0247)	(0.0177)	(0.0304)	(0.0144)	(0.0175)	(0.0218)
	Magnet middle	0.336***	0.192**	0.455***	0.151**	0.150**	0.285***
		(0.0929)	(0.0951)	(0.0842)	(0.0631)	(0.0742)	(0.0755)
	ECE X magnet	0.120	0.0449	0.0702	0.174**	0.0232	0.129
		(0.104)	(0.107)	(0.0931)	(0.0774)	(0.0843)	(0.0856)
	Sample size	564	497	623	577	554	623
Hispanic	ECE	−0.0321	0.00283	−0.0189	−0.0154	0.0139	0.00858
		(0.0272)	(0.0203)	(0.0341)	(0.0215)	(0.0159)	(0.0248)
	Magnet middle	0.247***	0.578***	0.585***	0.244***	0.492***	0.538***
		(0.0926)	(0.0835)	(0.0756)	(0.0808)	(0.0819)	(0.0750)
	ECE X magnet	0.341***	0.142	0.177**	0.112	0.0490	0.0833
		(0.113)	(0.0959)	(0.0826)	(0.0998)	(0.0974)	(0.0857)
	Sample size	356	391	458	378	411	458
Native american	ECE	0.0246	−0.0205	0.0252	−0.0361	0.0135	0.00565
		(0.0448)	(0.0255)	(0.0598)	(0.0296)	(0.0276)	(0.0451)
	Magnet middle	0.123	0.168	0.206*	0.0868	0.132	0.195*
		(0.102)	(0.102)	(0.119)	(0.0884)	(0.0965)	(0.109)
	ECE X magnet	0.392***	0.229	0.375**	0.443***	0.198	0.393***
		(0.147)	(0.162)	(0.153)	(0.142)	(0.159)	(0.146)
	Sample size	130	114	142	133	121	142

Note: Each column and student group represents a regression run. We are only reporting the unstandardized coefficient of interest. All models include the following covariates: mother's marital status, mother's education, lunch status, female, internet in home, neighborhood median income, lives with father, and redshirt. The model with all students includes controls for race. Standard errors in parentheses

*** $p < 0.01$

** $p < 0.05$

* $p < 0.1$.

academic success. First, we have Woodcock-Johnson tests administered in kindergarten, which measured pre-reading, pre-writing, and pre-math skills. Second, we have third grade test scores on state standardized tests for both math and reading. While we do have Woodcock-Johnson test scores for all students, third grade test scores do not exist for all students. We did not impute any test score data.

When analyzing the seventh-grade reading test scores, we controlled for third grade reading and math tests and the Woodcock-Johnson Letter Word I.D. and Applied Problems tests at kindergarten entry, depending on the model. We did not include a control for ECE. Fig. 5 plots the effect of attending a magnet school on math test scores (left) and reading test scores (right) for all students and then by subgroup. Tables A.9–A.11 in the appendix contain the full regression results. Attending a magnet middle school boosted state standardized tests, even after controlling for kindergarten and third grade academic performance. Looking at the model with all students, attending a middle school magnet was associated with an increase of 37.6 points for math ($p < 0.001$) and 19.6 points for reading ($p < 0.001$) on the state standardized test. For context, both math and reading OCCT scores were reported on a scale ranging from 400 to 990. Students who scored above a 700 were determined to be proficient in that subject. For our sample, the average math score was 684.1 with a standard deviation of 95.9. The effect of attending a magnet school then would be a 0.39 standard deviation increase. For reading, the average score was 703.2 with a standard deviation of 84.2. A 19.6 increase in the scale score would be equivalent to 0.23 standard deviation increase. This effect varied by race; white students saw the largest boost from magnet schools and Native Americans did not see any. When looking at the effect by lunch status subgroups, the largest boot from magnet schools on test scores came from the paid group.

In addition to analyzing seventh grade state tests, we also examined the effect of magnet school attendance on PSAT scores. We have similar expectations for predicting success on this test. We have one additional concern with the PSAT test results; we have PSAT scores for only 48.5% of our sample. We did not impute missing PSAT test scores because we do not believe the test scores are missing at random. The students that did have a PSAT score were less likely to receive a free or reduced lunch, lived in a neighborhood with higher median income, and were more likely to be white than our overall sample. Students who attended ECE were more likely to have taken the PSAT. A number of factors could influence the lack of a PSAT score. For example, students in lower performing schools might not be encouraged to take it or the student may have left the TPS school district. These issues should be kept in mind when interpreting the results. However, we did find strong, positive effects for attending a high school magnet on PSAT scores. After controlling for 3rd grade and 7th grade test performance, students enrolled in a magnet school performed 35 points higher than students not enrolled ($p < 0.001$). Table A.12 in the appendix contains the full

Table 4
Coefficients (and Standard Errors) of ECE and middle school magnets by free lunch status.***

Students	Variables	Applied to magnet			Accepted to magnet		
		Academic	Lottery	Both	Academic	Lottery	Both
Free	ECE	0.00736	0.00559	0.0138	0.00603	0.0100	0.0197
		(0.0158)	(0.0131)	(0.0208)	(0.0108)	(0.0115)	(0.0153)
	Magnet middle	0.279***	0.435***	0.527***	0.168***	0.346***	0.420***
		(0.0650)	(0.0620)	(0.0553)	(0.0468)	(0.0552)	(0.0532)
	ECE X magnet	0.216***	0.0584	0.0967	0.131**	0.00459	0.0583
		(0.0775)	(0.0740)	(0.0630)	(0.0592)	(0.0665)	(0.0622)
	Sample size	1077	1077	1250	1116	1147	1250
Reduced	ECE	−0.00983	0.00930	0.00179	−0.00118	0.0414	0.0175
		(0.0459)	(0.0394)	(0.0544)	(0.0384)	(0.0466)	(0.0502)
	Magnet middle	0.552***	0.303**	0.613***	0.506***	0.266*	0.570***
		(0.117)	(0.150)	(0.111)	(0.118)	(0.135)	(0.113)
	ECE X magnet	−0.0734	−0.0202	−0.0176	−0.0184	0.0112	0.0216
		(0.144)	(0.176)	(0.137)	(0.144)	(0.164)	(0.138)
	Sample size	149	127	169	150	137	169
Paid	ECE	0.00531	0.0182	0.0487	−0.0452	0.0313	0.00925
		(0.0543)	(0.0235)	(0.0579)	(0.0296)	(0.0270)	(0.0381)
	Magnet middle	0.528***	0.0943*	0.563***	0.562***	0.137*	0.608***
		(0.0763)	(0.0560)	(0.0731)	(0.0688)	(0.0723)	(0.0654)
	ECE X magnet	0.0668	0.0388	0.0389	0.0363	−0.00339	0.00700
		(0.0851)	(0.0859)	(0.0848)	(0.0725)	(0.0878)	(0.0734)
	Sample size	366	183	391	367	213	391

Note: Each column and student group represents a regression run. We are only reporting the unstandardized coefficient of interest. All models include the following covariates: race, mother's marital status, mother's education, female, internet in home, neighborhood median income, lives with father, and redshirt. Standard errors in parentheses.

*** $p < 0.01$
** $p < 0.05$
* $p < 0.1$.

regression results. We did not run any subgroup models due to sample size constraints and concerns over missing data.

Discussion

From an outsider's perspective, what is really needed to sustain the positive effects of ECE over time is high-quality K-12 schools available to students from diverse backgrounds. Whether those schools are traditional schools, magnet schools, or charter schools is a secondary concern. From a student's perspective or a parent's perspective, however, the choice to be made is not whether to enroll in a high-quality school, assuming that can be defined, but whether to enroll in a magnet school, which requires a special application process. Students and parents, in Tulsa and probably in many other jurisdictions as well, have a rough understanding that magnet schools tend to be "better" schools in some sense of that word. Report cards issued by the state of Oklahoma reinforce that conclusion.

Whether the magic that magnet schools work is due to better teachers, better principals, better students, a better reputation, or a better culture is an interesting question that we cannot resolve here. What we can say is that magnet schools, at least in Tulsa, attract better students and produce better outcomes, as measured by standardized test scores, than other schools. Based on evidence from a student survey, conducted in the fall of 2014, we can also say that students at magnet middle schools have a higher sense of "school connectedness" (Resnick et al., 1997) than students at non-magnet schools.

This evidence echoes Reynolds and Ou (2011) finding that magnet schools in Chicago act as important mediators between preschool and educational achievement. An important proviso, however, is that both the preschool and the magnet school must be high-quality. These

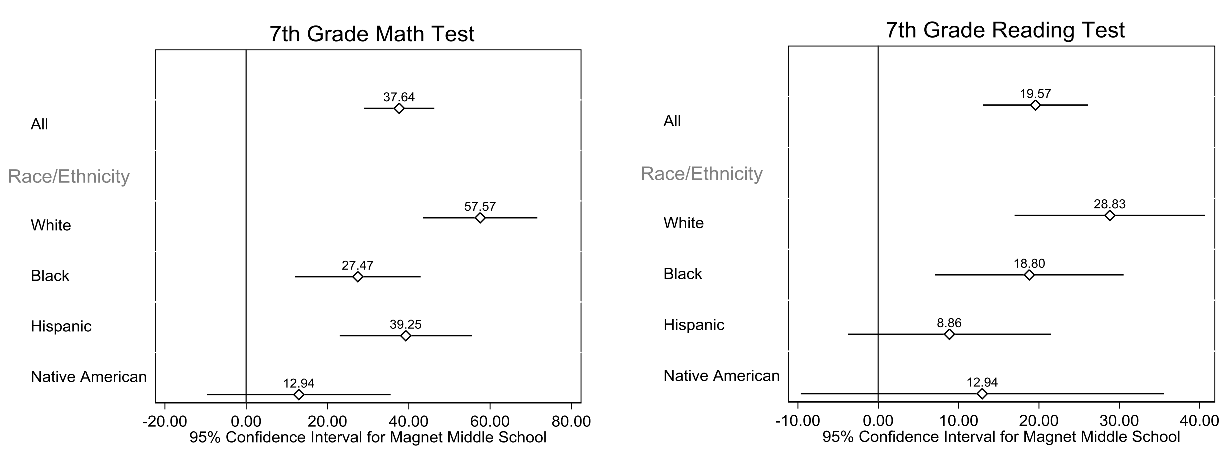

Fig. 5. Seventh Grade State Standardized Tests.
Note: Each coefficient represents the effect of ECE from a different model. Covariates are included in all of the models. For each coefficient, 95% confidence intervals are also included.

conditions seem to be met in Chicago – where the preschool program was staffed by highly-educated teachers and where the magnet schools rewarded superior academic performance at the admissions stage – and in Tulsa – where the preschool program scored relatively high in instructional support, as measured by CLASS (Phillips, Gormley, & Lowenstein, 2009), and where the magnet schools were rated as superior by the Oklahoma Department of Education. There is no reason to believe that a mediocre preschool and a mediocre magnet school would yield such favorable outcomes.

Magnet school admissions policies are also enormously important. New York City has some excellent magnet schools, but few of them actually serve students of color or students from disadvantaged backgrounds. While Latinos constitute 41% of New York City's public school population, they account for only 6% of the enrollment at selective admission high schools; while blacks constitute 26% of the public school population, they account for only 4% of the enrollment at selective admission high schools (Gewertz, 2019). In Chicago, in contrast, outstanding magnet schools have recruited a diverse student body, with substantial representation for students of color. In a school district that is 47% Latino and 37% black, Chicago's eleven elite high schools have a student body that is 34% Latino and 29% black (Gewertz, 2019). The Tulsa Public Schools system seems much more like Chicago's than New York City's Blacks constitute 34.9% of the middle school students in our sample and 26.4% of the magnet middle school students. Latinos constitute 25.3% of the middle school students in our sample and 24.6% of the magnet middle school students. Tulsa promotes racial diversity in its magnet schools through lotteries, which ignore academic achievement altogether, and sometimes through a quadrant system which compares applicants to students in their own geographic area. By locating some of its best schools in high-minority neighborhoods (either black or Latino), Tulsa Public Schools also encourages students of color to apply.

High quality schools have the potential to build on early learning gains by offering thousands of students every year a challenging but stimulating school environment that encourages steady progress towards academic gains. In Tulsa, magnet schools play that role. Students who attended a magnet middle school or high school in Tulsa fared better academically than a comparable set of students who did not attend a magnet school. Although many magnet school attendees benefit from this favorable school environment, some ECE alumni benefit disproportionately because they were more likely to enroll in a magnet school.

Because magnet schools advantage some students (those who get to attend) and disadvantage others (those who do not attend), it is important to take a closer look at how different students fare, especially racial/ethnic minority students and those from low-income households. For minority and disadvantaged students to benefit from magnet schools, they must a) apply; b) be admitted; and c) take advantage of the superior education offered by the magnet school.

For middle school, differences across racial and ethnic groups in the likelihood of attending a magnet school are apparent. Black and Hispanic students who attended an ECE program were more likely to attend a magnet middle school, which was not true of whites or Native Americans. Blacks, Hispanics, and Native Americans all benefited from attending a magnet middle school. However, students of color benefit less from attending a magnet middle school than white students did. Students who were eligible for a free lunch and students who paid for their lunch were more likely to enroll in a magnet middle school if they attended an ECE program. Their reading and math test scores were also improved. Students who paid for their lunch had the biggest test score boost from attending a magnet school; students who received a free lunch saw a comparable boost in reading but a smaller boost in math.

In terms of magnet high schools, attending a magnet middle school was a strong predictor of attendance. Given the well-established features of ECE fadeout (Duncan & Magnuson, 2013), magnet schools may be a way to mitigate the shrinking of ECE effects. Put another way, a high-quality ECE program may propel more students to enlist in high-quality and often competitive magnet schools, which, in turn, could contribute to higher achievement. Magnet schools, by virtue of their higher quality, have the potential to build on early learning gains by offering thousands of students every year a challenging but stimulating school environment that encourages steady progress towards academic gains.

Limitations

We close with a few words of caution. First, ECE participation was not randomly assigned; thus we employed an alternative strategy, propensity score weighting, for mitigating selection effects. This method helps alleviate bias due to systematic differences in non-experimental settings by creating comparable groups to improve causal inference (Dehejia & Wahba, 2006; Stuart, 2010). Nonetheless, there may have been unobserved child or family characteristics that contributed to ECE enrollment that may explain the association between ECE and magnet school attendance/application. Parental motivation is difficult to capture. However, as a sensitivity analysis, we re-ran the middle school regressions with a dummy variable indicating whether or not the child's parents completed the parent survey in August 2006. Completion of the survey, which required a parent to accompany the child to school and to spend a few minutes completing an optional task, could serve as a basic measure of parental motivation. In the overall sample, a child who has a parent that returned a survey was more likely to attend a magnet school. However, the coefficient on ECE remained statistically significant and of the same magnitude.

Results cannot be interpreted outside a large, urban school district. Magnet schools are likely not feasible in small or rural school districts where population size does not warrant such an approach. Also, our findings would probably not apply to school districts where there are no quality differences between magnet and non-magnet schools. We do not expect all magnet schools to be of higher quality than traditional schools.

In addition, we are limited by missing data. The original study sample contained 4033 students, but only 1,84 remained in the Tulsa Public Schools District by middle school. Furthermore, slightly less than half of our sample took the PSAT. There are several potential causes of missing a PSAT score, but we are most concerned when it is not missing at random. For example, students in lower performing schools might not be encouraged to take it or not have the same access to take the test. These issues should be kept in mind when interpreting the results.

Conclusion

In this paper, we examined whether enrollment in a high quality school can help a student who attended an ECE program at age 4 to sustain the educational benefits of that program. In focusing on school quality, we have implicitly embraced what Bailey et al. (2017) have called the “sustaining environments” perspective on how to make early childhood interventions last over time. Efforts to enhance a student's K-12 experience (inside or outside the classroom) would fit that perspective. For example, professional development programs that provide student-specific information on school readiness to kindergarten teachers (Jenkins et al., 2018) and high-quality after-school programs that include trained providers and structured activities (Vandell, Larson, Mahoney, & Watts, 2015) could be strategies that help to sustain ECE benefits over time. A K-12 curriculum that promotes critical thinking skills or other higher-order skills might be even more efficacious (Gormley, 2017b).

We cannot state definitively that a magnet school pathway is the best sustaining environment strategy to sustain the initial benefits that a strong ECE program provides. Nor do we mean to denigrate other competing perspectives, such as the “skill building” hypothesis, which says that ECE programs that target skills that are malleable, fundamental, and would not have developed eventually in the absence of the intervention are less likely to produce fadeout (Bailey et al., 2017). Promising work on how to improve preschool pedagogy has already been conducted (Farran, Meador, Christopher, Nesbitt, & Bilbrey, 2017; Hinton, 2017), and the relative merits of these competing perspectives must be adjudicated through additional research. The present analysis complements this work by demonstrating that magnet schools may help to sustain positive preschool effects. A strong magnet school system, including middle schools and high schools, can provide an opportunity for students who benefited from a high-quality ECE program to augment and sustain their learning gains. School districts that offer such a program might wish to think of magnet schools as a logical extension of their ECE strategy. Though not as closely connected chronologically to pre-K enrollment, magnet middle and high schools may be as important as strategies that focus on the early elementary grades, such as pre-K-3 alignment or deliberate efforts to upgrade elementary school pedagogy, because students are subject to stressors and risks as adolescents that can easily distract them from their studies (Steinberg & Morris, 2001).

We acknowledge that a magnet school system, such as Tulsa's, has the potential to benefit some students at the expense of others. If magnet schools are part of the mix, they may attract the best students or the most highly motivated students, to the detriment of students who wind up attending more traditional schools. Under such circumstances, peer effects at magnet schools may be more positive, while peer effects at more traditional schools may be more negative (Hanushek, Kain, Markman, & Rivkin, 2002). If this occurs, some students will still be left behind. For these reasons, school districts should be open to a range of options for enhancing school quality and the educational experiences of more disadvantaged students. Whatever the specific strategies school districts employ, it is important to provide learning opportunities at every step of the way – elementary school, middle school, and high school – to help students with both weak and strong early childhood experiences to make substantial progress over time.

Funding

This work was supported by the Heising-Simons Foundation [2015-033].

Appendix A. Appendix

Table A.1
Tulsa middle school and high schools.

School name	Magnet?	Lowest grade	Highest grade	OK grade
Carver Ms	Academic	6	8	A
Clinton MS		7	8	F
Edison preparatory MS[a]	Academic	6	8	C
Monroe demonstrations MS	Lottery	6	8	F
Thoreau demonstration academy	Lottery	6	8	B
Traice MS		6	8	F
Central JHS		7	8	F
East central JHS		7	8	F
Hale JHS		7	8	F
McLain 7th		7	7	F
McLain JHS		8	8	F
Memorial JHS		7	8	F
Will Rogers College JHS	Lottery	7	8	F
Webster Middle		6	8	F
Tulsa MET JHS		7	8	F
Booker T. Washington High School	Academic	9	12	A+
Central		9	12	D
East Central		9	12	F
Edison Preparatory High School[a]	Academic	9	12	B+
Hale		9	12	F
McLain		9	12	F
Memorial High School[b]	Academic	9	12	C+
Webster		9	12	D-
Tulsa MET High School		9	12	F
Will Rogers College High	Lottery	9	12	C-

Note: The last column indicates the grade that the school received on the school report card for the 2014–2015 academic year from the Oklahoma Department of Education.
[a] Edison MS & HS have a magnet program but also are community schools.
[b] The Engineering program requires an application process.

Table A.2
Summary of missing data.

	Variable	Non-missing observations	Percent missing
Admin data	Race	1843	0.1
	Lunch status	1841	0.2
	Gender	1844	0.0
	Redshirt	1844	0.0
	Neighborhood Med Income	1844	0.0
Parent data	Marital status	1112	39.7
	Mother's education	997	45.9
	Internet	1113	39.6

(*continued on next page*)

Table A.2 (*continued*)

	Variable	Non-missing observations	Percent missing
Test data	Live with father	1110	39.8
	3rd Grade reading test	1579	14.4
	3rd Grade math test	1597	13.4
	OCCT reading	1685	8.6
	OCCT math	1650	10.5
	PSAT	879	52.3
	Magnet school data	1844	0.0

Table A.3
Attending admission magnet middle school by race (LPM Model).

	(1)	(2)	(3)	(4)	(5)
ECE	All	White	Black	Hispanic	Native Am.
	0.067***	0.037	0.056*	0.096***	0.102*
	(0.020)	(0.042)	(0.030)	(0.036)	(0.052)
Black	−0.006				
	(0.031)				
Hispanic	0.013				
	(0.032)				
Asian/Hawaiian	0.204*				
	(0.106)				
Native american	−0.058				
	(0.036)				
Marital status, married	0.010	−0.060	0.042	0.016	0.000
	(0.030)	(0.066)	(0.050)	(0.052)	(0.061)
Marital status, remarried	0.057	0.112	−0.068	0.090	−0.107
	(0.082)	(0.171)	(0.071)	(0.137)	(0.170)
Marital status, separated	0.057	0.019	0.091	−0.006	0.064
	(0.050)	(0.100)	(0.079)	(0.096)	(0.115)
Marital status, divorced	−0.017	−0.057	−0.009	−0.004	−0.108
	(0.043)	(0.083)	(0.063)	(0.111)	(0.075)
Marital status, widowed	0.013	0.006	−0.007	−0.078	0.098
	(0.071)	(0.198)	(0.094)	(0.154)	(0.188)
Mother's Ed, high school/GED	0.015	0.060	−0.034	0.027	−0.074
	(0.026)	(0.060)	(0.049)	(0.042)	(0.074)
Mother's Ed, some college	0.066**	0.063	0.030	0.138	0.058
	(0.033)	(0.069)	(0.048)	(0.084)	(0.053)
Mother's Ed, college	0.338***	0.317***	0.245**	0.487***	0.380*
	(0.068)	(0.101)	(0.118)	(0.158)	(0.197)
Reduced lunch	0.102**	0.070	0.229**	0.101	0.009
	(0.043)	(0.063)	(0.097)	(0.079)	(0.073)
Paid lunch	0.202***	0.233***	0.099	0.171	0.170*
	(0.042)	(0.068)	(0.072)	(0.119)	(0.091)
Female	0.042**	0.105**	0.021	0.005	0.131**
	(0.019)	(0.043)	(0.029)	(0.034)	(0.059)
Internet access at home	0.054**	0.113***	0.052	−0.059	0.077
	(0.024)	(0.044)	(0.037)	(0.054)	(0.063)
Neighborhood median income 2006 in $10,000	0.020***	0.031**	0.012	−0.013	0.062***
	(0.007)	(0.013)	(0.010)	(0.015)	(0.024)
Lives with biological father	0.047*	0.095*	0.028	0.052	0.090
	(0.028)	(0.057)	(0.043)	(0.052)	(0.063)
Red shirt	−0.001	−0.029	−0.148**	0.283	0.139
	(0.083)	(0.107)	(0.067)	(0.242)	(0.134)
Constant	−0.116***	−0.208***	−0.043	0.008	−0.376***
	(0.043)	(0.079)	(0.056)	(0.075)	(0.097)
Observations	1391	420	503	334	110

Standard errors in parentheses.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

Table A.4
Middle School Admission Magnet Attendance by Lunch Status (LPM Model).

Variables	(1)	(2)	(3)
	Free	Reduced	Paid
ECE	0.064***	0.015	0.085
	(0.019)	(0.077)	(0.064)
Black	0.006	0.195	−0.110
	(0.031)	(0.130)	(0.092)
Hispanic	0.020	0.087	−0.091
	(0.031)	(0.114)	(0.134)
Asian/Hawaiian	0.332*	−0.020	0.177
	(0.170)	(0.246)	(0.159)
Native american	−0.050	−0.066	−0.040
	(0.031)	(0.102)	(0.099)
Marital status, married	0.013	0.125	−0.052
	(0.030)	(0.130)	(0.115)
Marital status, remarried	0.064	0.390	−0.220
	(0.081)	(0.287)	(0.227)
Marital status, separated	0.039	0.234	0.182
	(0.050)	(0.305)	(0.230)
Marital status, divorced	−0.035	0.079	0.083
	(0.040)	(0.189)	(0.143)
Marital status, widowed	−0.026	0.230	0.046
	(0.066)	(0.299)	(0.297)
Mother's education, high school/GED	0.008	0.092	0.104
	(0.027)	(0.106)	(0.159)
Mother's education, some college	0.044	0.263**	0.133
	(0.033)	(0.122)	(0.163)
Mother's education, college	0.305***	0.504**	0.374**
	(0.108)	(0.212)	(0.162)
Female	0.004	0.066	0.178***
	(0.019)	(0.081)	(0.065)
Internet access at home	0.022	0.115	0.147
	(0.023)	(0.089)	(0.094)
Neighborhood median income 2006 in $10,000	0.006	0.040	0.031**
	(0.008)	(0.031)	(0.013)
Lives with biological father	0.040	0.029	0.178*
	(0.030)	(0.103)	(0.093)
Red shirt	0.047	–	−0.059
	(0.094)		(0.130)
Constant	−0.033	−0.378**	−0.203
	(0.044)	(0.188)	(0.186)
Observations	997	133	261

Standard errors in parentheses
*** $p < 0.01$
** $p < 0.05$
* $p < 0.1$.

Table A.5
Attending lottery magnet middle school by race (LPM Model).

Variables	(1)	(2)	(3)	(4)	(5)
	All	White	Black	Hispanic	Native Am.
ECE	0.070***	0.061	0.090**	0.037	−0.022
	(0.025)	(0.047)	(0.038)	(0.050)	(0.079)
Black	−0.010				
	(0.036)				
Hispanic	0.087**				
	(0.038)				
Asian/Hawaiian	−0.051				
	(0.117)				
Native american	0.016				
	(0.049)				
Marital status, married	0.052	0.039	0.072	0.033	0.223**
	(0.042)	(0.078)	(0.067)	(0.073)	(0.105)
Marital status, remarried	0.084	0.187	0.003	0.009	0.105
	(0.095)	(0.156)	(0.199)	(0.173)	(0.306)
Marital status, separated	0.027	0.072	−0.023	0.078	0.011
	(0.058)	(0.108)	(0.081)	(0.154)	(0.146)
Marital status, divorced	−0.025	0.003	−0.031	−0.081	0.019
	(0.051)	(0.099)	(0.076)	(0.145)	(0.138)

(continued on next page)

Table A.5 (*continued*)

Variables	(1)	(2)	(3)	(4)	(5)
	All	White	Black	Hispanic	Native Am.
Marital status, widowed	0.153	−0.111	0.182	0.273	0.200
	(0.117)	(0.188)	(0.145)	(0.255)	(0.262)
Mother's Ed, high school/GED	0.008	0.031	0.014	−0.032	0.244*
	(0.044)	(0.075)	(0.070)	(0.070)	(0.126)
Mother's Ed, some college	0.044	0.091	0.027	0.038	0.162*
	(0.043)	(0.079)	(0.064)	(0.100)	(0.096)
Mother's Ed, college	0.320***	0.323***	0.273**	0.363**	0.275
	(0.079)	(0.115)	(0.139)	(0.167)	(0.266)
Reduced lunch	0.009	−0.022	0.108	0.058	−0.180
	(0.044)	(0.071)	(0.090)	(0.086)	(0.120)
Paid lunch	0.148***	0.168**	0.096	0.165	−0.016
	(0.046)	(0.076)	(0.083)	(0.136)	(0.136)
Female	0.047*	0.114**	0.035	0.039	0.034
	(0.024)	(0.046)	(0.037)	(0.049)	(0.082)
Internet access at home	0.025	0.089*	0.018	−0.048	0.084
	(0.035)	(0.054)	(0.053)	(0.077)	(0.098)
Neighborhood median income 2006 in $10,000	−0.010	−0.003	−0.002	−0.079***	0.044*
	(0.008)	(0.013)	(0.013)	(0.018)	(0.025)
Lives with biological father	0.043	0.062	0.021	0.070	0.079
	(0.037)	(0.059)	(0.056)	(0.078)	(0.108)
Red shirt	−0.068	0.043	0.220***	−0.129	0.072
	(0.083)	(0.116)	(0.075)	(0.273)	(0.270)
Constant	0.089	−0.049	0.067	0.438***	−0.233**
	(0.059)	(0.095)	(0.073)	(0.114)	(0.118)
Observations	1544	428	562	414	125

Standard errors in parentheses.
*** $p < .01$
** $p < .05$
* $p < .1$.

Table A.6
Middle School Lottery Magnet Attendance by Lunch Status (LPM Model).

Variables	(1)	(2)	(3)
	Free	Reduced	Paid
ECE	0.038	0.156**	0.161**
	(0.028)	(0.078)	(0.070)
Black	−0.016	0.123	−0.039
	(0.041)	(0.125)	(0.097)
Hispanic	0.093**	0.231**	0.065
	(0.043)	(0.114)	(0.131)
Asian/Hawaiian	0.053	−0.128	−0.022
	(0.164)	(0.151)	(0.225)
Native american	0.046	−0.002	0.031
	(0.061)	(0.118)	(0.117)
Marital status, married	0.046	0.079	0.112
	(0.047)	(0.130)	(0.113)
Marital status, remarried	0.124	−0.217	0.087
	(0.112)	(0.257)	(0.242)
Marital status, separated	0.018	0.129	0.118
	(0.061)	(0.294)	(0.257)
Marital status, divorced	−0.024	0.028	0.095
	(0.056)	(0.187)	(0.153)
Marital status, widowed	0.154	0.177	−0.134
	(0.128)	(0.246)	(0.242)
Mother's education, high school/GED	0.009	0.066	0.220
	(0.047)	(0.121)	(0.170)
Mother's education, some college	0.026	0.141	0.319**
	(0.047)	(0.127)	(0.155)
Mother's education, college	0.229**	0.160	0.580***
	(0.111)	(0.250)	(0.160)
Female	0.056**	−0.153**	0.111
	(0.027)	(0.075)	(0.071)
Internet access at Home	0.023	0.016	0.029
	(0.039)	(0.090)	(0.094)
Neighborhood median income 2006 in $10,000	−0.034***	−0.035	0.019
	(0.010)	(0.029)	(0.014)
Lives with biological father	0.028	0.001	0.169*

(*continued on next page*)

Table A.6 (*continued*)

Variables	(1)	(2)	(3)
	Free	Reduced	Paid
	(0.040)	(0.100)	(0.090)
Red shirt	−0.164*	0.853***	0.001
	(0.090)	(0.105)	(0.147)
Constant	0.197***	0.118	−0.378**
	(0.069)	(0.209)	(0.184)
Observations			
ECE	1154	138	252

Standard errors in parentheses.
*** $p < 0.01$
** $p < 0.05$
* $p < 0.1$

Table A.7
Application and acceptance to magnet high school.

	Applied			Accepted		
	Academic	Lottery	Both	Academic	Both	Lottery
ECE	0.074***	0.035*	0.096***	0.046***	0.036**	0.077***
	(0.020)	(0.018)	(0.023)	(0.017)	(0.017)	(0.021)
Black	0.017	−0.062***	0.001	−0.024	−0.041*	−0.039
	(0.031)	(0.023)	(0.033)	(0.027)	(0.023)	(0.030)
Hispanic	0.015	0.092***	0.100***	0.007	0.077***	0.069**
	(0.033)	(0.030)	(0.036)	(0.029)	(0.028)	(0.033)
Asian/Hawaiian	0.188*	−0.024	0.159	0.237**	−0.028	0.209**
	(0.102)	(0.075)	(0.098)	(0.101)	(0.075)	(0.097)
Native american	−0.040	−0.034	−0.045	−0.032	−0.024	−0.043
	(0.039)	(0.030)	(0.043)	(0.037)	(0.030)	(0.041)
Marital status, married	−0.003	0.016	0.017	0.008	0.010	0.024
	(0.032)	(0.029)	(0.038)	(0.024)	(0.025)	(0.033)
Marital status, remarried	0.047	0.068	0.088	0.002	0.074	0.066
	(0.086)	(0.072)	(0.083)	(0.063)	(0.061)	(0.070)
Marital status, separated	0.010	−0.024	0.012	0.019	−0.010	0.024
	(0.050)	(0.040)	(0.058)	(0.038)	(0.042)	(0.052)
Marital status, divorced	−0.011	−0.008	−0.013	0.030	−0.008	0.027
	(0.045)	(0.032)	(0.047)	(0.039)	(0.031)	(0.043)
Marital status, widowed	0.001	0.014	0.032	0.013	0.015	0.044
	(0.077)	(0.069)	(0.092)	(0.055)	(0.066)	(0.083)
Mother's education, high school/GED	0.007	0.007	0.010	0.028	0.008	0.027
	(0.031)	(0.032)	(0.039)	(0.023)	(0.028)	(0.033)
Mother's education, some college	0.047	0.024	0.050	0.055*	0.027	0.061*
	(0.036)	(0.034)	(0.044)	(0.028)	(0.031)	(0.037)
Mother's education, college	0.241***	0.047	0.246***	0.247***	0.066	0.259***
	(0.061)	(0.052)	(0.060)	(0.051)	(0.052)	(0.054)
Reduced lunch	0.068*	−0.041	0.037	0.064*	−0.003	0.057
	(0.040)	(0.029)	(0.041)	(0.035)	(0.029)	(0.038)
Paid lunch	0.191***	−0.064**	0.137***	0.156***	−0.039	0.121***
	(0.040)	(0.027)	(0.042)	(0.036)	(0.030)	(0.039)
Female	0.056***	0.051**	0.082***	0.061***	0.065***	0.101***
	(0.020)	(0.019)	(0.023)	(0.017)	(0.017)	(0.021)
Internet access at home	0.090***	−0.012	0.074**	0.059***	−0.000	0.045*
	(0.028)	(0.024)	(0.031)	(0.021)	(0.023)	(0.027)
Neighborhood median income	0.016**	−0.017***	0.005	0.020***	−0.013***	0.011
	(0.007)	(0.005)	(0.007)	(0.006)	(0.005)	(0.007)
Lives with biological father	0.036	0.028	0.061*	0.037*	0.023	0.058**
	(0.026)	(0.023)	(0.031)	(0.021)	(0.021)	(0.027)
Red Shirt	0.066	−0.006	0.041	−0.066	0.001	−0.065
	(0.087)	(0.068)	(0.094)	(0.054)	(0.055)	(0.066)
Constant	−0.079*	0.108***	0.013	−0.113***	0.063*	−0.051
	(0.046)	(0.039)	(0.053)	(0.039)	(0.035)	(0.047)
Observations	1622	1414	1841	1663	1527	1841

Standard errors in parentheses.
*** $p < .01$
** $p < .05$
* $p < .1$

Table A.8
Application and acceptance to magnet high school.***

	Applied to magnet			Accepted to magnet		
	Academic	Lottery	Both	Academic	Both	Lottery
ECE	0.008	−0.000	0.016	0.005	0.010	0.020
	(0.015)	(0.012)	(0.019)	(0.010)	(0.011)	(0.014)
Magnet middle	0.402***	0.362***	0.545***	0.321***	0.294***	0.475***
	(0.047)	(0.050)	(0.042)	(0.040)	(0.045)	(0.041)
ECE X magnet	0.097*	0.060	0.067	0.046	0.018	0.032
	(0.051)	(0.060)	(0.047)	(0.047)	(0.054)	(0.046)
Black	0.013	−0.055***	0.006	−0.025	−0.037*	−0.033
	(0.027)	(0.021)	(0.028)	(0.024)	(0.021)	(0.025)
Hispanic	0.008	0.051**	0.048*	−0.003	0.050**	0.029
	(0.027)	(0.025)	(0.029)	(0.025)	(0.024)	(0.026)
Asian/Hawaiian	0.125	−0.016	0.097	0.188**	−0.008	0.155**
	(0.082)	(0.097)	(0.077)	(0.083)	(0.088)	(0.077)
Native american	−0.041	−0.046	−0.033	−0.031	−0.025	−0.032
	(0.035)	(0.028)	(0.038)	(0.032)	(0.028)	(0.035)
Marital status, married	−0.018	−0.003	−0.016	−0.001	−0.007	−0.003
	(0.028)	(0.024)	(0.031)	(0.024)	(0.023)	(0.030)
Marital status, remarried	0.001	0.014	0.026	−0.031	0.039	0.014
	(0.089)	(0.071)	(0.086)	(0.061)	(0.061)	(0.070)
Marital status, separated	−0.020	−0.042	−0.027	0.001	−0.026	−0.009
	(0.046)	(0.035)	(0.048)	(0.034)	(0.036)	(0.043)
Marital status, divorced	0.001	−0.005	0.003	0.042	0.001	0.041
	(0.039)	(0.029)	(0.041)	(0.035)	(0.029)	(0.037)
Marital status, widowed	−0.053	−0.036	−0.049	−0.025	−0.023	−0.023
	(0.076)	(0.058)	(0.082)	(0.056)	(0.060)	(0.073)
Mother's education, high school/GED	−0.014	0.003	−0.004	0.019	0.010	0.018
	(0.027)	(0.025)	(0.029)	(0.021)	(0.023)	(0.026)
Mother's education, some college	0.007	0.007	0.003	0.029	0.013	0.024
	(0.029)	(0.028)	(0.032)	(0.024)	(0.027)	(0.029)
Mother's education, college	0.081	−0.065	0.049	0.131***	−0.019	0.094**
	(0.050)	(0.056)	(0.047)	(0.043)	(0.053)	(0.045)
Reduced lunch	0.016	−0.057**	−0.016	0.031	−0.008	0.017
	(0.034)	(0.026)	(0.033)	(0.029)	(0.027)	(0.030)
Paid lunch	0.084**	−0.106***	0.021	0.077***	−0.069**	0.023
	(0.034)	(0.028)	(0.035)	(0.030)	(0.029)	(0.031)
Female	0.042**	0.036**	0.049***	0.051***	0.056***	0.073***
	(0.018)	(0.016)	(0.018)	(0.016)	(0.015)	(0.017)
Internet access at home	0.061**	−0.016	0.044	0.038**	−0.008	0.020
	(0.025)	(0.023)	(0.028)	(0.019)	(0.022)	(0.024)
Neighborhood median income	0.011*	−0.009*	0.005	0.017***	−0.008*	0.011*
	(0.006)	(0.005)	(0.006)	(0.006)	(0.005)	(0.006)
Lives with biological father	0.016	0.011	0.027	0.020	0.012	0.030
	(0.024)	(0.021)	(0.028)	(0.022)	(0.020)	(0.026)
Red shirt	0.090	−0.032	0.065	−0.046	0.004	−0.044
	(0.101)	(0.055)	(0.105)	(0.047)	(0.047)	(0.052)
Constant	−0.053	0.070**	−0.001	−0.111***	0.024	−0.075**
	(0.040)	(0.031)	(0.041)	(0.035)	(0.030)	(0.038)
Observations	1592	1387	1810	1633	1497	1810

Standard errors in parentheses.
*** $p < 0.01$
** $p < 0.05$
* $p < 0.1$

Table A.9
Middle school reading state tests.***

	(1)	(2)	(3)	(4)	(5)
	All	White	Black	Hispanic	Native American
Magnet middle school	19.57***	28.83***	18.80***	8.856	12.94
	(3.336)	(6.031)	(5.968)	(6.406)	(11.36)
Reading 3rd test score	0.435***	0.473***	0.370***	0.494***	0.445***
	(0.0252)	(0.0413)	(0.0425)	(0.0434)	(0.0736)
Woodcock johnson test	1.700***	1.279***	1.799**	1.745**	1.977
	(0.379)	(0.487)	(0.750)	(0.739)	(1.278)
Black	−6.357				
	(5.536)				
Hispanic	3.136				
	(5.148)				

(continued on next page)

Table A.9 (*continued*)

	(1)	(2)	(3)	(4)	(5)
	All	White	Black	Hispanic	Native American
Asian/Hawaiian	16.16				
	(11.36)				
Native american	−3.160				
	(5.878)				
Marital status, married	2.319	−0.186	2.307	3.392	11.85
	(5.767)	(11.34)	(8.954)	(9.903)	(14.40)
Marital status, remarried	−17.95	−2.770	−33.59	−23.38	9.408
	(14.02)	(13.57)	(38.32)	(25.39)	(59.86)
Marital status, separated	6.602	13.09	3.792	1.109	18.19
	(9.344)	(17.96)	(14.27)	(13.75)	(23.93)
Marital status, divorced	0.195	5.486	−3.487	−8.017	−3.816
	(9.016)	(13.37)	(15.74)	(17.51)	(20.23)
Marital status, widowed	0.298	16.55	−6.428	21.62	16.07
	(12.37)	(22.46)	(17.68)	(24.19)	(26.68)
Mother's education, high school/GED	1.484	−3.389	1.246	0.385	13.41
	(5.578)	(14.02)	(12.08)	(7.632)	(18.82)
Mother's education, some college	3.769	1.127	3.995	2.343	5.146
	(5.925)	(13.73)	(10.64)	(9.514)	(18.05)
Mother's education, college	3.877	3.828	−2.591	21.67	−6.143
	(8.196)	(14.67)	(17.84)	(19.55)	(24.61)
Reduced lunch	6.498	−5.581	10.50	19.05*	−9.870
	(6.352)	(9.749)	(15.80)	(9.790)	(16.13)
Paid lunch	8.453	11.13	12.92	1.607	−17.29
	(5.547)	(8.231)	(10.24)	(13.92)	(14.76)
Female	9.239***	14.35***	8.176	8.185	16.91
	(3.110)	(5.513)	(5.698)	(5.794)	(10.47)
Internet access at home	6.916	3.897	12.88*	2.796	−9.598
	(4.316)	(7.730)	(7.775)	(9.180)	(14.67)
Neighborhood median income	1.930**	−0.929	4.829**	2.344	7.214**
	(0.915)	(1.248)	(2.070)	(2.355)	(3.165)
Lives with biological father	5.583	4.664	2.897	9.955	18.55
	(5.055)	(8.204)	(9.027)	(10.12)	(14.29)
Red shirt	12.21	25.63	−3.884	3.521	−3.106
	(12.42)	(17.53)	(21.96)	(22.05)	(32.03)
Constant	352.0***	338.4***	381.0***	314.0***	320.7***
	(18.57)	(29.53)	(29.75)	(31.49)	(48.91)
Observations	1549	488	517	396	119

Standard errors in parentheses.
*** $p < 0.01$
** $p < 0.05$
* $p < 0.1$.

Table A.10
Middle school math state tests.***

	(1)	(2)	(3)	(4)	(5)
	All	White	Black	Hispanic	Native American
Magnet Middle School	37.64***	57.57***	27.47***	39.25***	17.04
	(4.401)	(7.145)	(7.849)	(8.257)	(18.29)
Math 3rd Test Score	0.394***	0.343***	0.320***	0.527***	0.363***
	(0.0249)	(0.0448)	(0.0386)	(0.0458)	(0.0878)
Woodcock Johnson Test	2.932***	4.628***	3.162***	1.881**	3.732
	(0.527)	(0.858)	(0.891)	(0.932)	(2.386)
Black	−3.897				
	(5.836)				
Hispanic	1.276				
	(6.361)				
Asian/Hawaiian	33.72**				
	(13.56)				
Native American	−3.919				
	(7.396)				
Marital Status, Married	−2.022	−1.541	7.321	−11.07	−19.78
	(7.019)	(12.38)	(10.26)	(13.54)	(22.36)
Marital Status, Remarried	1.643	5.174	−0.199	−10.18	−2.046
	(14.43)	(21.34)	(40.85)	(24.70)	(57.70)
Marital Status, Separated	0.916	11.80	−3.898	−5.234	−7.637
	(10.19)	(20.32)	(13.92)	(24.42)	(29.26)
Marital Status, Divorced	7.749	4.580	13.19	2.191	−6.379

(*continued on next page*)

Table A.10 (*continued*)

	(1)	(2)	(3)	(4)	(5)
	All	White	Black	Hispanic	Native American
	(9.925)	(14.85)	(13.22)	(26.26)	(27.86)
Marital Status, Widowed	−10.28	−4.651	−10.82	−4.980	0.0257
	(15.58)	(23.25)	(22.75)	(27.49)	(38.78)
Mother's Education, High School/GED	−4.110	−0.0220	−4.891	−2.430	−7.521
	(8.148)	(13.57)	(15.54)	(12.10)	(21.73)
Mother's Education, Some College	2.386	−2.554	11.29	−2.370	−14.83
	(8.893)	(12.78)	(16.18)	(14.82)	(20.49)
Mother's Education, College	6.503	5.226	7.343	12.90	−1.893
	(11.22)	(14.29)	(22.71)	(19.48)	(30.92)
Reduced Lunch	15.54**	23.22**	−2.954	31.88***	−0.182
	(6.622)	(9.885)	(14.02)	(11.65)	(20.19)
Paid Lunch	14.65**	18.61**	11.23	9.832	−2.346
	(6.258)	(9.312)	(12.09)	(18.09)	(21.34)
Female	5.071	6.340	5.588	8.583	−4.424
	(3.914)	(5.994)	(6.858)	(7.264)	(13.65)
Internet Access at Home	4.180	0.967	6.544	2.110	6.185
	(6.118)	(9.244)	(9.331)	(13.50)	(17.64)
Neighborhood median income	3.089**	1.013	5.265**	2.732	6.529
	(1.200)	(1.461)	(2.438)	(3.510)	(4.260)
Lives with Biological Father	10.08*	13.28	8.346	7.372	21.63
	(6.041)	(9.186)	(9.512)	(13.12)	(18.91)
Red Shirt	8.638	−2.351	87.22***	−43.05*	6.427
	(15.96)	(18.97)	(20.79)	(24.89)	(44.50)
Constant	329.6***	337.1***	363.7***	257.5***	357.7***
	(18.85)	(32.37)	(28.42)	(35.46)	(56.45)
Observations	1567	491	521	404	122

Standard errors in parentheses.
*** p < .01
** p < .05
* p < .1

Table A.11
Middle school state tests by Lunch Status.***

Variables	Free	Reduced	Paid	Free	Reduced	Paid
	Reading	Reading	Reading	Math	Math	Math
Magnet Middle School	18.90***	17.30	20.09***	31.38***	39.95***	61.30***
	(4.031)	(12.43)	(7.663)	(5.454)	(11.33)	(9.132)
3rd Grade Test	0.419***	0.586***	0.452***	0.386***	0.462***	0.387***
	(0.0291)	(0.110)	(0.0410)	(0.0300)	(0.0738)	(0.0500)
Woodcock Johnson	1.524***	2.679*	1.402***	2.519***	4.832***	3.780***
	(0.521)	(1.467)	(0.501)	(0.626)	(1.425)	(1.122)
Black	−8.734	27.30	−9.183	1.870	−19.68	−8.557
	(7.238)	(17.28)	(9.036)	(7.968)	(16.84)	(8.785)
Hispanic	−1.173	46.98***	−7.973	4.391	27.45*	−7.468
	(6.647)	(14.31)	(12.48)	(7.992)	(15.01)	(17.63)
Asian/Hawaiian	12.80	22.76	13.65	41.66	37.58	29.85*
	(12.27)	(24.99)	(17.86)	(26.13)	(24.09)	(17.11)
Native American	1.680	22.44	−21.14**	8.761	−0.967	−22.25*
	(7.836)	(17.47)	(8.511)	(9.950)	(16.52)	(12.98)
Marital Status, Married	1.214	7.388	0.249	−3.071	4.338	−4.369
	(6.880)	(17.96)	(13.42)	(8.089)	(17.40)	(17.38)
Marital Status, Remarried	−25.49	36.77	−17.79	11.00	−11.18	−36.22
	(17.61)	(33.68)	(20.25)	(18.52)	(34.24)	(38.82)
Marital Status, Separated	4.294	20.29	11.82	−1.692	37.88	13.15
	(10.46)	(22.68)	(21.62)	(11.18)	(36.23)	(28.23)
Marital Status, Divorced	−2.828	8.964	6.407	9.283	6.001	8.212
	(10.16)	(29.31)	(16.45)	(12.29)	(19.51)	(20.03)
Marital Status, Widowed	−1.745	25.02	−1.515	−11.21	−2.837	14.85
	(14.73)	(26.18)	(22.31)	(17.87)	(38.14)	(32.05)
Mother's Education, High School/GED	−0.131	20.99	−12.06	−4.343	4.217	−27.10
	(6.144)	(16.77)	(20.32)	(8.981)	(17.48)	(27.45)
Mother's Education, Some College	1.208	22.22	−8.365	3.150	−3.467	−21.28
	(6.528)	(19.18)	(19.77)	(9.876)	(20.00)	(27.31)
Mother's Education, College	11.06	32.87	−12.17	17.24	−21.41	−24.46
	(13.70)	(26.35)	(19.45)	(16.29)	(35.09)	(26.62)
Reduced Lunch	8.863**	19.40**	7.555	6.071	0.280	−1.048
	(3.873)	(9.438)	(6.036)	(4.881)	(10.07)	(6.455)

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Table A.11 (*continued*)

Variables	Free	Reduced	Paid	Free	Reduced	Paid
	Reading	Reading	Reading	Math	Math	Math
Paid Lunch	7.102	3.420	4.969	6.199	6.066	−6.578
	(4.946)	(12.79)	(9.607)	(7.433)	(13.03)	(12.23)
Female	4.693***	6.125*	−0.559	3.746*	0.288	2.374
	(1.516)	(3.561)	(1.158)	(2.105)	(4.168)	(1.449)
Internet Access at Home	4.029	13.56	16.86	9.009	18.58	16.95
	(5.310)	(15.87)	(10.33)	(6.999)	(16.65)	(11.89)
Neighborhood median income	15.62	27.43*	9.584	27.92	−36.25**	−23.75
	(15.27)	(15.32)	(22.76)	(19.74)	(16.22)	(25.18)
Constant	361.3***	169.2*	373.7***	334.6***	268.3***	361.3***
	(22.89)	(86.62)	(33.36)	(23.93)	(57.57)	(43.29)
Observations	1037	146	366	1054	146	367

Standard errors in parentheses.
*** $p < 0.01$
** $p < 0.05$
* $p < 0.1$

Table A.12
PSAT Scores.***

	Total score	Total score	Total score
Magnet High School	114.4***	67.09***	35.71***
	(9.426)	(9.222)	(7.846)
3rd Grade Math		0.344***	
		(0.0605)	
3rd Grade Reading		0.418***	
		(0.0779)	
7th Grade Math			0.537***
			(0.0724)
7th Grade Reading			0.711***
			(0.0719)
Black	−77.86***	−43.59***	−40.88***
	(13.68)	(13.90)	(10.86)
Hispanic	−59.85***	−30.72**	−27.56**
	(14.09)	(14.53)	(11.77)
Asian/Hawaiian	22.12	34.29	9.127
	(27.94)	(32.50)	(28.15)
Native American	−60.23***	−49.45***	−33.12**
	(17.36)	(15.46)	(13.93)
Marital Status, Married	4.310	3.588	−2.552
	(13.31)	(12.96)	(9.952)
Marital Status, Remarried	11.49	2.758	2.317
	(35.66)	(27.48)	(25.04)
Marital Status, Separated	3.446	−7.747	−18.37
	(21.86)	(18.91)	(16.87)
Marital Status, Divorced	4.699	2.038	−5.528
	(22.94)	(20.83)	(16.73)
Marital Status, Widowed	−19.44	−13.81	−21.31
	(36.11)	(28.99)	(28.57)
Mother's Education, High School/GED	9.759	1.870	11.80
	(15.26)	(12.57)	(11.05)
Mother's Education, Some College	36.47**	24.07	22.96**
	(15.88)	(15.06)	(11.68)
Mother's Education, College	62.09***	29.16	30.18*
	(20.16)	(20.07)	(16.50)
Reduced Lunch	16.69	10.27	−8.415
	(15.04)	(14.91)	(12.77)
Paid Lunch	51.33***	31.97**	25.04**
	(14.04)	(14.31)	(11.04)
Female	5.412	3.286	−3.194
	(8.600)	(8.358)	(6.922)
Internet Access at Home	5.442	0.909	−2.534
	(12.49)	(11.54)	(8.983)
Neighborhood median income	9.509***	8.821***	6.820***
	(2.298)	(2.470)	(2.100)
Lives with Biological Father	4.717	5.967	−1.681
	(13.24)	(11.37)	(9.189)
Red Shirt	−14.53	−15.66	−22.31
	(31.40)	(36.92)	(27.61)
Constant	779.6***	250.6***	−61.28

(*continued on next page*)

Table A.12 (*continued*)

	Total score	Total score	Total score
	(21.45)	(48.75)	(43.59)
Observations	877	821	877

Standard errors in parentheses.

*** $p < 0.01$

** $p < 0.05$

* $p < 0.1$

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