Identifying the Harm of Manipulable School-Choice Mechanisms*

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Abstract

An important, but underexplored, component of student assignment procedures is heterogeneity in the level of strategic sophistication among students. Our work provides the first direct measure of which students rank schools following their true preference order (sincere students) and which rank schools by manipulating their true preferences (sophisticated students). We present evidence that our proxy for sophistication is capturing systematic differences among students. Our results demonstrate that sophisticated students are assigned to higher performing schools. This implies that manipulable school-choice mechanisms benefit sophisticated students at the expense of sincere students.

Keywords: School choice, student assignment, strategic sophistication, magnet schools

JEL classification: C78, D61, D78, I20

1 Introduction

Building on the earlier literature (Roth, 1982; Roth and Sotomayor, 1992), the seminal work by Abdulkadiroğlu and Sönmez (2003) introduced the gains that may be realized by approaching the assignment of students to public schools as a market design problem.[1] Indeed, following that article and subsequent consultation with economists, the Boston Public Schools replaced their existing school-choice mechanism (hereafter the Boston Mechanism) with the celebrated Deferred Acceptance algorithm of Gale and Shapley (1962). However, the Boston Mechanism continues to be the most widely used school-choice mechanism in practice.

The main objection to the Boston Mechanism is that some students can benefit from strategically misreporting their preferences. Intuitively, the Boston Mechanism first assigns as many students as possible to their first-choice school. After making these assignments, it then assigns as many students as possible to their second choice, and so on. Under the Boston Mechanism, it is risky for a student to rank the schools truthfully if she has a low priority at her most-preferred school. If she is not admitted to it, then it is possible for a school in which she has high priority to be filled by students that ranked that school first. That is, the Boston Mechanism is manipulable. It was precisely this concern that was cited by Boston Public Schools' Superintendent Thomas Payzant:

> A strategyproof algorithm "levels the playing field" by diminishing the harm done to students who do not strategize or do not strategize well... The need to strategize provides an advantage to families who have the time, resources, and knowledge to conduct the necessary research (Payzant, 2005).[2]

We provide the first direct evidence of the extent to which sophisticated students gain at the expense of sincere students in the Boston mechanism. Following the terminology in Pathak and Sönmez (2008), we refer to students who rank schools following their true preference order as "sincere" students. In contrast, students who rank schools by manipulating their true preferences in response to their probability of admission to each school are called "sophisticated" students.[3]

[1] In a similar environment, Balinski and Sönmez (1999) study student assignment to colleges in Turkey.

[2] See the literature on student assignment policies in Boston (Abdulkadiroğlu, Pathak, Roth, and Sönmez, 2005a) and New York City (Abdulkadiroğlu, Pathak, Roth, and Sönmez, 2005b, 2009).

[3] These terms ***do not*** imply that sincere students are unsophisticated or sophisticated students are insincere. In-

While there has been much interest in this question both theoretically and empirically, all empirical papers have faced the same identification problem: the researcher cannot know which students are sincere and which students are sophisticated.

The assignment procedure used by the Wake Country Public School System provides a unique opportunity to identify which students are behaving strategically.[4] In their application procedure, students have a two-week window during which they must log into a website and submit their preferences. A student is free to change her ranking as many times as she wishes. Moreover, upon each visit, a student learns how many students have ranked each school first. Therefore, a sophisticated student benefits from logging into the website multiple times. On the other hand, a student submitting her true preferences needs to only log into the website once. We will present evidence that students' usage of the website is correlated with outcomes in a way that suggests that login behavior reveals one's type. As a result, our classification of sincere and sophisticated students is drawn from the number of logins to the application website.

Specifically, we classify students who log in once as sincere and those who log in more than once as sophisticated. We test a series of hypotheses to demonstrate that our login proxy for sophistication is capturing important, systematic differences among students. Some students who visit the application website multiple times in fact change their rankings near the end of the selection period by removing popular (i.e., overdemanded) schools from the top of their rankings. More generally, we demonstrate that sophisticated students are systematically avoiding popular schools in their submission strategy. As a result, sophisticated students are more likely to receive a magnet assignment but, conditional on receiving a magnet assignment, are less likely to be assigned to a highly popular school.

Of further concern, we find that the likelihood of being a sophisticated student varies as a function of demographic characteristics. A primary goal of a school-choice mechanism is that it is equitable for disadvantaged populations. However, if advantaged populations are more likely to strategically manipulate the assignment procedure, then this undermines the objectives of the school system. Indeed, we find that Asian students are significantly more likely to be sophisticated, while Black students are significantly more likely to be sincere. However, demographic characteristics

stead, they are simply shorthand for whether or not true preferences are submitted. Velez (2015) uses this terminology as well.

[4] The Wake Country Public School System is the 16th largest school system in the United States (WCPSS, 2013).

explain only a small fraction of the variation in the incidence of sophistication, which highlights the importance of our approach for classifying students as sincere or sophisticated.

Once we identify sincere and sophisticated students, we study the educational quality of the schools to which each type of student is assigned. Doing so allows us to ask whether sophistication is undermining the policy objectives of the school system in its magnet school program. That is, we ask whether sophisticated students not only gain admission to magnet schools with a higher probability, but also gain admission to higher quality magnet schools. The results suggest a small but evident advantage of sophistication in that, conditional on receiving a magnet assignment, sophisticated students are assigned to schools with higher test scores and more academically gifted students. Therefore, the advantage that sophisticated students gain at the expense of sincere students supports the move from a manipulable mechanism to a strategyproof mechanism. As evidence of the concern by policymakers regarding this point, after consultation with the authors, the Wake County Public School System moved from the mechanism studied here to a strategyproof mechanism.

1.1 Related Literature

The importance of carefully designing matching mechanisms for school assignment is well known (Pathak, 2011; Abdulkadiroğlu and Sönmez, 2013). Further, a lot of attention has been paid to the drawbacks of the Boston Mechanism, specifically that it is not strategyproof and is not Pareto efficient when true preferences are not reported (Ergin and Sönmez, 2006). Despite this, the Boston Mechanism, and its variants, continues to be widely used in practice, including in school districts such as Cambridge, MA; Charlotte-Mecklenburg, NC; Denver, CO; Miami-Dade, FL; Minneapolis, MN; and Tampa-St. Petersburg, FL. Strikingly, the Seattle school district replaced the Boston Mechanism with a strategyproof mechanism only to switch back in 2011 (Kojima and Ünver, 2014). Drawing on the matching literature, our goal is to identify the harm of assigning students to schools using a manipulable mechanism.

Related to our work, several papers have used school-choice data to analyze manipulations in preference reports. Agarwal and Somaini (2014) find evidence of significant gaming of preference in Cambridge, MA under the Boston Mechanism. The authors use structural estimation to recover cardinal utilities from preference reports that may be strategically manipulated. Using data from

Cambridge, MA, the authors find evidence of strategic manipulations, focusing on priorities based on proximity to a school.[5] Using data from Beijing, China, He (2012) estimates a structural model that explicitly accounts for heterogeneous levels of sophistication: sophisticated students (whose subjective beliefs are correct) and sincere students (whose subjective beliefs are incorrect). He measures strategic behavior with survey responses that parents provided concerning their expected probability of admission into a given school, where strategic behavior implies that one's subjective beliefs equal the empirical distribution from submitted lists.

Finally, Hastings, Kane, and Staiger (2008) (using data from Charlotte-Mecklenburg, North Carolina) and Burgess, Greaves, Vignoles, and Wilson (2014) (using data from England) have similar sets of findings. Both papers find that students prefer a school with good academic performance, a preference that is stronger for higher-socioeconomic-status students. Hastings, Kane, and Staiger (2008) take reported preferences as truthful because they use data from the first year of the assignment procedure, a procedure that they argue was poorly understood and one in which students were advised to report truthfully. Burgess, Greaves, Vignoles, and Wilson (2014) are less concerned with strategic manipulations because some of their data come from districts that use a mechanism that is strategyproof with the exception of truncated lists.

Building on this existing literature, our approach uses data from the Wake Country Public School System, which is described now.

2 Student Assignment in Wake County, NC

We use data from the Wake Country Public School System (WCPSS), which is the 16th largest school system in the United States by enrollment, with 153,300 students enrolled during the 2013-2014 school year (WCPSS, 2013). Student enrollment is growing at a rate of 2.6% per year between the 2006-2007 and 2013-2014 school years. Further, the state of North Carolina is forecasted to be one of the fastest growing states in terms of primary and secondary school enrollment growth over the next decade.[6] There are 170 schools in the system, including 38 magnet schools, which are partially-choice-based assignment schools aimed at "reduc[ing] high concentrations of poverty

[5]Interestingly, the authors' estimates suggest that the welfare of the average student would be lower under the Deferred Acceptance algorithm. One explanation comes from Abdulkadiroğlu, Che, and Yasuda (2011), who show that Deferred Acceptance may be ex-ante Pareto dominated by the Boston Mechanism.

[6]See http://nces.ed.gov/programs/digest/d13/tables/dt13_203.20.asp.

and support[ing] diverse populations."[7]

The school system was formed in 1976 with the voluntary merger of the urban Raleigh City school district with the suburban Wake County school district (Flinspach and Banks, 2005). The school system is diverse in terms of race and ethnicity, with the following racial composition of enrolled students: 6.8% Asian, 24.4% Black, 15.7% Hispanic or Latino, 48.6% White (not Hispanic), and 4.5% other/multiple races (WCPSS, 2013). In 2011, 38.6% of students in WCPSS were eligible to receive subsidized meals as part of the Free and Reduced-Price Lunch program, while 50.3% of students across North Carolina and 48.1% of students across the US were similarly eligible.[8] Diverse geographical areas are encompassed within the school system, including the city of Raleigh, NC (population of 431,746), the town of Cary, NC (population of 151,088), and the surrounding suburban and rural areas.[9]

2.1 The Assignment Algorithm in Wake County

Students in WCPSS are assigned to a base school and can apply for reassignment through the magnet-school application process.[10] Assignment of a student's base school is determined by an optimization algorithm, which (according to WCPSS) "balances proximity to school, building utilization, anticipated growth, and impact of future base attendance areas."[11] The base-school algorithm relies on insights from the operations research literature (Taylor, Vasu, and Causby, 1999). An important part of the assignment process in WCPSS is that students "lose" their assignment to the base school if they are assigned to a magnet school in the application process. As a result, the magnet-application process emphasizes that students should not list a school on their magnet application if they prefer it less than their base school.

Magnet seats are assigned (up to a school's capacity of magnet seats) using students' submitted lists of preferences over schools and students' priority points. The construction of priority points

[7] See http://www.wcpss.net/magnet.

[8] See http://www.ncpublicschools.org/fbs/resources/data.

[9] See http://quickfacts.census.gov/qfd/states/37/3755000.html.

[10] We focus on magnet applications but there are other ways that students can apply to change their assignment. Students can apply to an application school (test-score dependent schools that are known as exam schools in other districts) or can request a transfer to a school other than their base through the calendar transfer application (requesting reassignment to a year-round school from a traditional-calendar school or vice versa) or non-calendar transfer application (requesting reassignment to any other school in the district on the same calendar as their base school). Magnet applications provide the most interesting variation in terms of heterogeneity in sophistication but our future work will study the other application processes as well.

[11] See http://www.wcpss.net/enrollment-proposal/about-the-plan.html.

in WCPSS is based on the district's *Four Pillars*: student achievement, stability ("stay where you start"), proximity, and operational efficiency. Ties among students with the same number of priority points are broken randomly using a lottery number that is not shown to students. For elementary schools, priority points at school s depend on whether the student's sibling will attend school s next year (highest priority), whether the student lives in a high-performing node based on historical test-score data (second highest), and whether the student's base school is overcrowded (third highest).[12] For middle and high schools, priority points depend on siblings (highest priority), magnet pathway (second highest), magnet non-pathway (third highest), high-performing node (fourth highest), and overcrowded base (fifth highest). The second and third highest priority levels for secondary schools are reserved for students who currently hold magnet seats and are applying to the magnet middle or high school that follows their magnet program's pathway/feeder schools (second highest) or are applying to a magnet school that is not on their pathway (third highest).

Given this priority construction, for 90% of magnet seats, the magnet-school assignment algorithm used by WCPSS is known in the literature as the Boston Mechanism (Abdulkadiroğlu and Sönmez, 2003). WCPSS used the Boston Mechanism for the reason that Boston and many other districts used it: it is intuitive, easy to explain, and maximizes the number of students assigned to their reported first choice. The Boston Mechanism considers all students who ranked a school first and assigns the highest-priority students up to its capacity, only considering students who ranked it second if seats remain.[13] As explained in the introduction, the main problem with the Boston Mechanism is that students can receive a more-preferred assignment by manipulating their true ranking of schools. This paper focuses on these manipulations and heterogeneity in understanding how to game the algorithm.

Finally, 10% of magnet seats are assigned through a non-priority-based pure lottery, that is, a lottery that is independent of a student's priority points. The district introduced the 10% lottery to encourage more students to participate in the magnet application process. WCPSS policy dictates that non-priority students will not be assigned to a magnet seat, where non-priority students are those who do not receive points from any of the enumerated priority levels. As a result, many

[12] A node is WCPSS's terminology for a geographic area that is comparable to a large neighborhood.

[13] In partnership with the authors, starting with assignment for the 2015-2016 school year, WCPSS replaced the Boston Mechanism with the Deferred Acceptance algorithm of Gale and Shapley (1962). The present paper considers data prior to the switch and future work will examine how well students appear to understand the fact that the Deferred Acceptance algorithm is not manipulable.

neighborhoods (i.e., those in a non-high-performing node and whose base is not crowded) were excluded from the magnet process before the introduction of the 10% lottery.

2.2 Students' Level of Information

We now describe the application website where students submit their ranking of schools, focusing on how fully informed we should expect students to be during the application process. Rankings are not considered submitted until the selection window closes (i.e., students can change their ranking at any point during the two-week period). Further, the website allows students to rank up to three schools, out of 23 elementary, 11 middle, and 4 high schools. The ability to rank only three schools is another feature of the application process that introduces an important role for strategic behavior. The data contain a record of each time a student's account was used to visit the website, irrespective of whether the student ranked or changed their ranking of schools during the visit.

Figure 1 shows a screenshot of the list of schools available to a given student, along with several other pieces of information. Each school name contains a link to their website. Further, the application website shows the magnet program(s) available at the school, including programs such as Gifted and Talented, International Baccalaureate, Language Immersion, etc. It is these specialized programs that are the "magnet" that attracts students to apply to magnet schools. Students are also shown whether the school operates on a traditional calendar or a year-round calendar and whether or not they would be provided bus transportation if assigned to the school.

It is important to consider what students know about their priority points specifically and probabilities of admission to each school broadly. An important component of the application website is that students are prominently shown the number of "Current 1^{st} Choice Applicants" (as shown in Figure 1). The number of current first-choice applicants updates upon logging into the application website. As a result, a student can log into the application website multiple times to observe the change in relative demand for each school. In fact, we will argue in the next section that the number of times that a student logs in reflects their level of strategic sophistication.[14] In favor of this conjecture, we observe in the data that the application website sees a large number of visits in the final two days of the selection window, many of which are from students who have

[14] In separate work in progress, we consider the process by which student incorporate the number of current first-choice applicants into their decision-making process, that is, whether a model of dynamic best-responding is consistent with the observed data.

previously ranked schools. The majority of those students who change their ranking near the end of the selection window change their rankings in the following way: lowering or removing schools with the highest number of current first-choice applicants. As a result, we argue that some students are logging into the website multiple times in order to manipulate their rankings.

Further, in the process of forming their preferences over schools, students and/or parents visit several schools during the two months leading up to the application selection window, when schools hold magnet tours. These tours provide information intended to assess the fit of a student to the school and also provide information about the number of available seats the school has at a given grade and the number of applicants to the school last year. Given the information provided on the application website concerning current first-choice applicants and information from the school about capacity and historical demand, students have a good sense of the popularity of each school (i.e., the extent to which each school is likely to be oversubscribed or undersubscribed).

Finally, the application website shows at which school a student has sibling priority (in case it was not obvious), which implies that students know whether they are in the top priority level. Students also know which schools follow their pathway in the transition from elementary to middle to high schools. However, beyond sibling and pathway priorities, priority points for a high-performing node and overcrowded base are not readily obvious. A student may have a sense of the level of crowding of their base but this information is likely to be imperfect. Further, the historical performance level of a student's node is neither readily obvious nor readily available to students. Our conversations with WCPSS staff indicate that a student can call the district office and ask which priority points they receive but we have no data on how common this is. Finally, a student's random number that breaks ties among students with the same number of priority points is never made available to her.

In total, the above discussion suggests that students have a very good sense of which schools are popular and a loose sense of where they fall in the priority order. Taken together, these details have important implications for the exercise of identifying sincere and sophisticated students, as we do in the next section, because both knowing how popular a school is and not knowing your exact number of priority points jointly imply that there is a potentially large role for strategic manipulations in this setting.

3 Identifying Sincere and Sophisticated Students

We seek to identify which students are sincere and which are sophisticated, and do so using auxiliary data from the application process. In contrast, the related literature uses structural inference of submitted preferences lists but these techniques do not identify student-level markers of strategic behavior. Specifically, Agarwal and Somaini (2014) and He (2012) do not classify individual students as sincere or sophisticated in their analysis and instead estimate structural models that allow for strategic behavior. These alternative approaches can be used to identify which students find truth-telling to be a best response but do not identify which students are sincere and which are sophisticated, which is our goal.[15]

Our application data come from the website where students log into submit their preference list. We will present evidence that students' usage of the website is correlated with outcomes in a way that suggests that login behavior reveals one's type, sincere or sophisticated. As a result, our classification of sincere and sophisticated students is drawn from the number of logins to the application website. While the results that follow are robust to a number of alternative specifications of the login variable, we identify students who log in once as sincere and those who log in more than once as sophisticated. A student can engage in strategic behavior but log in only once to submit their list and a student can log in multiple times but still submit their true list. However, several pieces of anecdotal evidence, along with empirical results that we will present, convince us that our login proxy for sophistication is capturing important, systematic differences among students.

Before classifying students as sincere or sophisticated, we clean the login data to capture *unique* visits to the application website. Specifically, we construct a rolling hour window around each visit and count all visits within the rolling hour as a single, unique visit.[16] Based on the number of unique

[15] Different approaches have been taken in the existing literature to measure manipulations in school assignment. First, Agarwal and Somaini (2014) use a regression-discontinuity approach to compare students on either side of the radius around a school, where students within the area around a school have priority at that school, while students outside do not. The authors find discontinuities in the probability of ranking a school first at the proximity-priority boundary. However, if preferences are affected by the information that students are given on their proximity-priority schools (i.e., these schools become focal), then discontinuities do not imply manipulations. Second, Calsamiglia and Güell (2014) use an unexpected change in the determination of neighborhood schools in Barcelona, Spain. The authors find that the number of students ranking the new neighborhood school first increased from 9% to 17%. Again though, because students are told which school is their neighborhood school, one must assume that this information does not affect preferences. Third, He (2012) presents evidence that students are strategizing using data from a survey that asks which school is "the best." He demonstrates that students often report a best school that is different from the school they ranked first.

[16] A rolling window implies that three visits on a given day at 9:00PM, 9:59PM, and 10:58PM all count as one unique visit, while two visits at 9:00PM and 10:58PM each count as a separate visit. The results are robust to

visits, students visit the application website an average of 4.61 times (standard deviation = 8.65) during the selection period of two weeks (January 28 through February 11, 2014). The distribution of visits ranges from 1 to 60 visits, with 1, 2, and 4 visits as the 25^{th}, 50^{th}, 75^{th} percentiles, respectively. Using our designation, 60.7% of the applicants are classified as sophisticated. See Figure 2 for the distribution of unique visits, separately for students who were assigned or not assigned to a magnet school.

Next, we compare single-visit students (sincere) and multiple-visit students (sophisticated). First, the demographic characteristics we consider are the student's gender, race, and ethnicity. The data contain self-identified designations for race and ethnicity separately. We interact race with ethnicity to create variables that identify non-Hispanic Asian students, non-Hispanic Black students, non-Hispanic students of other/multiple races, and Hispanic students. The omitted group throughout our analysis contains non-Hispanic White students. For brevity, we refer to non-Hispanic Asian students as Asian students (likewise for other races). Two other characteristics of interest are whether the student is classified as having limited English proficiency (LEP) or as academically gifted (AG). LEP students are identified as speaking a language other than English at home (self-identified) and in need of additional support (self- and staff-identified). Finally, AG students are identified via Cognitive Abilities Test scores that exceed 85%; other factors, including classroom performance/growth, can be part of the AG identification process.

Before presenting summary statistics by sophistication, Table 1 summarizes these student characteristics. Column (1) presents the data for all grade-entry students in WCPSS. All of our analysis will focus grade-entry students because the magnet application process is dramatically different for non-grade-entry students (i.e., students rising into a grade other than kindergarten, sixth grade, or ninth grade).[17] Next, column (2) includes only magnet applicants, while column (3) includes only successful magnet applicants (i.e., students who were assigned to one of their ranked schools). Comparing columns (1) and (2) reveals several differences between the applicant pool and the non-applicant pool. Specifically, magnet applicants, relative to non-applicants, are a lot more likely to be Asian and AG but a lot less likely to be Hispanic and LEP. Smaller differences exist for other characteristics but applicants are also more likely to be female, Black, and other/multiple races

intervals that are shorter or longer than one hour.

[17] For example, non-grade entry students do not get sibling priority. Further, non-grade-entry students make up a small portion of the applicant pool and are dramatically less likely to receive a magnet assignment.

but are less likely to be White.

Comparing columns (2) and (3) indicates that students who submit successful magnet applications are different from unsuccessful applicants. Specifically, successful magnet applicants, relative to unsuccessful applicants, are more likely to be Asian and AG but other differences are smaller or nonexistent. The implications of Table 1 are that the magnet application process is being used, and being successfully used, differentially by different types of students. To understand whether this fact ought to be of concern to policymakers, we now turn to an initial analysis of heterogeneity in strategic sophistication among these students.

After classifying students as sincere or sophisticated, we find in Table 2 that Asian students are significantly more likely to be classified as sophisticated, while Black students and students of other/multiple races are significantly more likely to be classified as sincere.[18] These differences are simply unconditional raw probabilities and should not be taken as causal. But Table 2 does suggest that sincere and sophisticated students differ along some observed dimensions (e.g., race) but not others (e.g., gender).

4 Evidence of Strategic Behavior

To provide evidence in favor of our classification of students as sincere or sophisticated, we test the following hypotheses.

Hypothesis 1. *Sophisticated students will receive a magnet assignment with a higher probability.*

Sophisticated students are more likely to receive a magnet assignment, unless preferences of sincere and sophisticated students are drawn from systematically different distributions in terms of preferences for popular schools. This is the case because sophisticated students are responding to their probability of admission to schools, while sincere students are submitting their true list regardless of admission probabilities. As a result, sophisticated students will be more likely to receive admission.

Hypothesis 2. *Sincere students will be assigned to a more popular (i.e., overdemanded) school, conditional on receiving a magnet assignment.*

[18] While AG students are also more likely to be classified as sincere, they also have more priority points than non-AG students, on average. Students with more priority points have a lower incentive to be sophisticated because often they are guaranteed assignment at their first choice. As emphasized in the text, the analysis that follows controls for priority points and other factors when looking at the differences between sincere and sophisticated students.

If a sincere student receives a magnet assignment, then she is more likely to be assigned to a popular school, where popularity refers to a large demand for the school relative to its capacity. Hypothesis 2 is a direct corollary of Hypothesis 1 because, if sophisticated students are systematically avoiding popular schools in their submission strategy, then sophisticated students will be assigned to less popular schools when assigned.

Hypothesis 3. *Students who have a younger sibling are more likely to be sophisticated.*

Students who have a younger sibling can affect the assignment of their younger sibling because of sibling priority. Specifically, the younger sibling is guaranteed admission to the school if the older sibling is assigned to it. Because of the greater incentive to be sophisticated, we predict that older siblings are more likely to be sophisticated.

Hypothesis 4. *Sincere and sophisticated students will differ in their probabilities of exiting the school system, conditional on not receiving a magnet assignment.*

While we do not have an ex ante hypothesis concerning the direction of the effect, we expect that sincere and sophisticated students will differ in terms of the frequency with which they exit the school system, perhaps to attend a charter or private school. Further, we hypothesize that the difference in the probability of exit will be more pronounced when the student does *not* receive a magnet assignment.

To test these hypotheses, we use data from applications for seats for the 2014-2015 school year. The analysis excludes students whose assignment was the result of the 10% lottery (233 students) or was the result of an administrative assignment (176 students for reasons including special educational needs, etc.). After these exclusions, our main data set consists of 3,790 students who submitted a magnet application, 63.8% of whom received a magnet assignment. Further, when comparing students' assignment outcomes (Hypotheses 1 and 2), we restrict our attention to students who have priority points in an intermediate range, which we refer to as non-guaranteed, priority students. Specifically, we exclude: (1) students with no priority points because WCPSS does not assign students without priority points to magnet seats (except through the 10% lottery) and (2) students whose priority points are high enough that they are guaranteed a seat at the magnet school they ranked first. For example, WCPSS policy guarantees seats to students with sibling priority and, for secondary schools, students who apply to their pathway/feeder school. By using students who have non-zero priority points but who are not guaranteed a seat, we consider those students who have an interesting strategic decision. Finally recall that we focus on entry-grade students, that is, students whose next grade is kindergarten, sixth grade, or ninth grade.

4.1 Probability of Magnet Assignment

Table 3 presents the results of a Probit regression where the dependent variable is equal to 1 if the student received a magnet assignment. Non-guaranteed, priority students are included because these are the students with an interesting strategic decision to make in their rankings. Assignment-related variables are added as controls in column (2). Further, other student characteristics are added in column (3), specifically the student's gender, race/ethnicity, status as having limited English proficiency (LEP), and status as academically gifted (AG). Finally, column (4) adds fixed effects for the zip code of the student's home address. These zip code fixed effects control for unobserved characteristics of the student's neighborhood, which are important because of residential segregation along characteristics such as income.

In support of Hypothesis 1, column (1) shows that sophisticated students are 5.6 percentage points more likely to receive a magnet assignment. When adding controls, the probability-of-assignment advantage for sophisticated students is 6.3, 7.2, and 6.8 percentage points in columns (2) through (4), respectively. The effect size represents a quantitatively large and statistically significant effect of sophistication on magnet assignment. Recalling that 63.8% of students received a magnet assignment, our results imply that sophistication is associated with a 10.7% increase in the likelihood of assignment. This large effect provides strong evidence that our proxy for sophistication is picking up important features of how students behave with respect to the assignment process.

Next, students who ranked two schools in their magnet application are assigned with a higher probability than those who ranked only one, and the effect is about twice as large for those who ranked three schools (out of three slots) in their applications. Note that unreported results find a larger effect of sophistication on magnet assignment when the number of choices variables are omitted. This result suggests that part of the effect of sophistication on magnet assignment is being captured by ranking more choices and, indeed, sophisticated students are significantly less likely to rank one school (t-statistic = 2.16, p-value = 0.03) and are weakly more likely to rank three schools (t-statistic = 1.63, p-value = 0.10). Next, we find an intuitive result that students with higher priority points are more likely to get a magnet assignment and find conflicting results on the level of the school (elementary, middle, or high), depending on whether demographics are included.

The final results in Table 3 concern demographic and other student characteristics that affect magnet assignment. We find a quantitatively small effect of gender but quantitatively large effects of race/ethnicity.[19] Next, students with limited English proficiency are 17.1 percentage points more likely to receive a magnet assignment. We do not have an explanation for this result but we note that there are a small number of LEP identified students included in this regression and thus we avoid saying too much about a very small, specialized group. Finally, students designated as academically gifted are 33.1 percentage points more likely to receive a magnet assignment, which is intuitive because some magnet seats are reserved for academically gifted students.

4.2 Popularity of the Assigned School

As a first pass at testing Hypothesis 2, Table 4 summarizes characteristics of the assigned schools for successful magnet applicants, separately for sincere and sophisticated students. In column (1), First Choice is equal to 1 if the student was assigned to the school that she ranked first on the magnet application, conditional on receiving a magnet assignment. The final two columns involve the popularity of the student's assigned school, conditional on receiving a magnet assignment. In column (2), Popularity is measured by the number of first-choice magnet applications received by the school. In column (3), Popularity Rank is measured by the rank of the popularity variable.

In support of Hypothesis 2, column (1) of Table 4 shows that conditional on receiving a magnet assignment, sophisticated students are 1.4 percentage points less likely to be assigned to the school they ranked first. As in the previous section, only non-guaranteed, priority students are considered. A better test of the hypothesis is whether students are assigned to a more popular school, condi-

[19]The results for race/ethnicity on magnet assignment suggests that Black students have a higher probability of assignment than White students (the omitted group). This is an interesting pattern because magnet schools are intended to attract high socioeconomic groups to schools located in low socioeconomic neighborhoods. We conjecture that Black students are applying to magnet schools that are less popular than those of White students. One possible reason for this difference could be preferences concerning the racial makeup of schools, where Black students may prefer schools with higher percentages of minority students and such schools may be less popular overall. To look for evidence in favor of our conjecture, we include first-choice fixed effects that control for which school a student ranked first. In unreported results, we see a reversal of the pattern for race/ethnicity, suggesting that it is the ranking of schools that drives the disadvantage of White students relative to Black students.

tional on receiving a magnet assignment. Columns (2) and (3) address this issue and show that sophisticated students are assigned to schools that are less popular. Specifically, column (2) shows that sophisticated students are assigned to schools that were ranked first by 12.8 fewer students on average, while column (4) shows that sophisticated students are assigned to schools that are 0.8 slots lower in the ranking of schools.[20]

Looking further, Table 5 reports the results of an OLS regression on the popularity of the student's assigned school, conditional on the student receiving a magnet assignment. As in column (2) of Table 4, popularity is measured by the number of first-choice magnet applications received by the school. Here, we find that sophisticated students are assigned to less popular schools but the standard error of the estimate is large. Further, relative to the mean of the popularity variable of 250.6, the effect is around 1 or 2%, which is quantitatively small. Results using the rank of the popularity variable are similar and thus are omitted.

Next, we look further at the popularity of a student's assigned school, conditional on receiving a magnet assignment, and how popularity changes in the number of visits a student made to the application website. Recall that our sincere/sophisticated classification separates students who visited once versus more than once. However, in unreported results, we find that there are quantitatively large and statistically significant differences in the popularity measure across students who visit the website more than three times.[21] It makes sense that the most frequent visitors are systematically avoiding the most popular schools because of the information on the number of current first-choice applicants discussed earlier that visitors to the application website are shown.

Our conclusion is that we find directional support for Hypothesis 2 that sophisticated students are assigned to less popular schools, conditional on receiving a magnet assignment. We find strong support, in quantitative and statistical terms, when we compare the most sophisticated students (as measured by website visits, i.e., the most frequent visitors) to sincere students. In these cases, sophisticated students are systematically avoiding popular schools and receiving magnet assignments at less popular schools. Consistent with this difference between sincere and sophisticated students, ranking more schools is associated with being assigned to a less popular school.

[20]Separately by school level, the most popular school has a rank of one. As a result, the fact that sophisticated students have a higher average rank implies their assignments are less popular.

[21]In terms of raw differences, the popularity index differs between sincere and sophisticated students by 18.79 (standard error = 6.99); in the full regression (the specification in column (3) of Table 5), the popularity index differs by 17.0 (standard error = 6.14). Both differences are statistically significant.

4.3 Birth Order and Sophistication

According to Hypothesis 3, students who have a younger sibling have a larger incentive to be sophisticated because their assignment confers higher priority to their younger sibling.[22] An ideal test would identify all children in every household in the county but of course our data are limited to students currently attending a WCPSS school. As such, we put students into two groups: the first group contains students that we positively identify as having an older sibling in a WCPSS school, while the second group contains all other students. The group of other students contains four types of students: (1) students that we positively identify as having a younger sibling in a WCPSS school, (2) students who are the oldest child but whose younger siblings have yet to enter WCPSS, (3) students who are the youngest child but whose older siblings have already exited WCPSS (e.g., graduated), and (4) students who do not have any siblings. Types (1) and (2) of those in the other students category are the students that we would like to have as the comparison group in our test but Types (2), (3), and (4) of those in the other students category cannot be distinguished from one another. As a result, we simply ask whether students who we know are the youngest behave in a way that is consistent with differential behavior of oldest and not-oldest children.

Consistent with Hypothesis 3, Table 6 shows that students who we know to be a younger sibling are less likely to be sophisticated than other students. Looking at all students, not-oldest siblings are 4.5 percentage points less likely to be sophisticated. The predicted relative levels of sophistication hold in all three grade levels and the difference increases in grade level. In particular, not-oldest high school students are 10.3 percentage points less likely to be sophisticated than other high school students. The fact that this difference is largest for high school students cuts against an alternative interpretation of these results, specifically that not-oldest students are more familiar with the application website because their older sibling previously used the website. Given that our proxy for sophistication is drawn from students' login intensity, students who are more familiar with the website are less likely to log in multiple times. However, high school students are likely to

[22]We identify siblings as students who reside at the same physical address, including apartment number if present. This approach falsely identifies a very small number of non-sibling students who share an address, possibly because they live in the same residence but are unrelated or related but not siblings. Further, students may live at the same physical address but different specific residences, such as multifamily dwellings that do not report separate unit numbers (e.g., a long-term hotel or homeless shelter). However, we identify siblings following WCPSS's approach when assigning sibling priority and the relevant question in our sibling analysis is whether a student will have sibling priority.

have previous experience with the WCPSS application process, which implies that the decreasing relative level of sophistication of not-oldest students runs counter to this familiarity hypothesis. As a result, we interpret Table 6 as supportive of the hypothesis that oldest children are more likely to be sophisticated because of the incentive imbedded in the sibling priority.[23]

4.4 Exits from the School System

Several papers in the school-choice literature (e.g., Calsamiglia and Güell (2014); He (2012)) point out that it is important to consider students' outside options, specifically, the possibility that students plan to attend a charter or private school if they are unsuccessful in a obtaining seat at their preferred public school. While we do not have an ex ante hypothesis concerning the direction of the effect, we expect that sincere and sophisticated students will differ in terms of the frequency with which they exit the school system. We define an exit by merging the 2013-2014 student-level data, including magnet applications, with 2014-2015 student-level data. Any non-twelfth-grade student who is not matched across the two years is said to have exited, which includes students who enrolled in a charter, private, or home school; students who moved or exited from system for other reasons outside of interest for the current study; and students who are not matched for other reasons including data errors. While we cannot quantify the relative magnitudes of these three sources of exits, we use data on exits from non-magnet-applicants as a baseline for the number of exits that occur generally, then ask how students who participate in the magnet-application process exit differentially from this baseline level.

For this exercise, we use data on whether the student holds a seat in any WCPSS school, which could be their base school, a magnet school, or any other WCPSS school. To think about how many students generally exit the school system in a given year, we look at the transition between the 2013-2014 and 2014-2015 school years and index students by their grade in the latter year. Considering students who did not submit a magnet application, the following percentages exited the school system: 10.7% of the 7,564 non-applicant kindergarteners, 8.7% of the 10,617 non-applicant sixth graders, and 8.8% of the 10,982 non-applicant ninth graders. Note that the interpretation of the 10.7% of exits from rising kindergarteners is that these students registered

[23]We can conduct an alternative test of Hypothesis 3 by restricting the sample to families where we identify multiple children, and compare the oldest identified child to his or her younger siblings. Relative to the results in Table 6, the effects are larger but the standard errors are too (possible because of the restricted sample size).

with the school system but did not in fact attend a WCPSS school in their kindergarten year.

From this baseline level of exits (roughly 11% for primary school students and 9% for secondary school students), Table 7 shows exits by magnet applicants, specifically showing the mean fraction of students who exited the school system from 2013-2014 to 2014-2015.[24] Panel A considers only students who submitted a magnet application but were not assigned to any of their ranked schools. Panel B considers only students who submitted a magnet application and were assigned to one of their ranked schools. Consistent with Hypothesis 4, the results in Table 7 point to large differences in the propensity to exit between sincere and sophisticated students.

Specifically, relative to sincere students, sophisticated students are 5.9 percentage points more likely to exit the school system if their application is unsuccessful. In percentage terms, sophisticated students are 44.4% more likely to exit, an extremely large effect. Looking separately at the grade-entry years to elementary, middle, and high school, the unsuccessful sophisticated applicants are 3.7, 6.0, and 7.4 percentage points more likely to exit, respectively, relative to unsuccessful sincere applicants. In Panel B however, sophisticated students are slightly less likely to exit, conditional on receiving magnet assignment. Given what we can observe in the data, only imperfect interpretations of these results are possible in the sense that we cannot identify which students are exiting to attend a charter or private school and which are exiting for other reasons. However, Table 7 presents strong evidence that our proxy for sophistication is segmenting students in a systematic way that captures important differences in how students approach the magnet application process.

5 Is the Playing Field Level?

When changing from the manipulable mechanism that was used by Boston Public Schools, the discussions focused on "leveling the playing field" for all students (Payzant, 2005). The results presented thus far provide strong evidence that sophisticated students gain at the expense of sincere students, most prominently in that sophisticated students are seven percentage points more likely to receive assignment at a magnet school. However, to further investigate whether the playing field is unlevel in a way that meaningfully undermines the school system's objectives, we look at the

[24] An alternative way to analyze exits is to use a regression analysis of the probability of exit to construct the predicted probability of exit for sincere and sophisticated students, controlling for observed characteristics. These results are very similar to what is shown in Table 7 and are available from the authors upon request.

educational quality of the schools to which sincere and sophisticated students are assigned. For the analysis, we use all students who received a magnet assignment, comparing the assigned schools of sincere and sophisticated students along two dimensions.

First, we use data on School Performance Grade (SPG) scores, which are the underlying scores used to generate A-F letter grades as part of the North Carolina School Report Cards initiative.[25] Second, we use our student-level data to calculate the fraction of each school's student body that is designated as academically gifted (AG). Both measures of the educational quality of schools are drawn from the 2013-2014 school year, prior to the assignment of the students in question. Data on test scores directly, rather than a test-score composite such as SPG, provide similar results but require the exclusion of high school students because elementary and middle school students take end-of-grade tests than are different from those of high school students.

The results using SPG scores and fraction AG as dependent variables are in Table 8. Similar to the earlier regression tables, columns (1) and (4) include the main assignment variables, columns (2) and (5) additionally include demographics and other student characteristics, and columns (3) and (6) additionally include zip code fixed effects. We find that sophisticated students gain assignment to schools that are of higher quality: sophisticated students are assigned to schools with SPG scores that are around one percentage point higher and around one percentage point more AG students. The mean SPG score is 69.6%, while the mean fraction AG is 13.8%. As a result, the effect sizes at the mean in percent terms are around 1% for SPG scores and around 6% for fraction AG. Our interpretation is that sophisticated students are clearly gaining at the expense of sincere students. The fact that the effect sizes are small is reassuring, from an econometric standpoint, given the fact that our proxy for sophistication is simply capturing students' login behavior. From a policy standpoint, the results strongly suggest that sophistication confers an advantage that undermines the objectives of the school system.[26]

[25] School Performance Grades are available at http://www.dpi.state.nc.us/accountability/reporting/ and are required by North Carolina General Assembly § 115C-83.15, passed in 2013. The scores have an 80 percent weight on the school's achievement score (a composite that is primarily a function of end-of-grade test scores) and a 20 percent weight on students' academic growth (calculated using the Education Value Added Assessment System (EVAAS)).

[26] The other results in the table are of independent interest, but many of these echo earlier parts of our paper and the earlier literature. For example, we find that Asian students are assigned to higher quality schools than White students, while the opposite holds for Black students.

6 Conclusions

The majority of choice-based assignment procedures used to match students to seats in public schools are manipulable, in the sense that a student can obtain a more-preferred assignment by reporting preferences over schools that differ from her true preferences. We provide evidence on which students are in fact responding to the manipulability of assignment mechanisms. Our analysis uses a novel set of auxiliary data from the application website where students in the Wake County Public School System submit their rankings of schools. We find meaningfully important differences between students who repeatedly log into the application website, relative to students who log in only once. These data therefore allow us to segment students according to whether they submit their true preferences (sincere students) or whether they rank schools in response to their probability of admission (sophisticated students). Using our classification of sincere and sophisticated students, we find that strategic sophistication allows sophisticated students to gain admission to schools that are of higher quality than the assigned schools of sincere students.

It is important to note that, in partnership with the authors, the Wake County Public School System moved from the mechanism studied here to a strategyproof mechanism for assignment in the 2015-2016 school year. While this implies that the harm done to sincere students no longer applies to this group of students, the majority of school districts continue to use manipulable mechanisms for which our findings pertain. As a result, we recommend that policymakers consider the distributional consequences that are implied by our results when making student assignment decisions.

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School Options Information (click on school name for more information)

MAGNET SCHOOLS	Program Description	Calendar	Sibling Priority	Transportation	Current 1st Choice Applicants
A. B. Combs Magnet Elementary (XC)	Combs Leadership	Traditional		Parent	13
Brentwood Magnet Elementary (EN)	Engineering Magnet	Traditional		Express	4
Brooks Museums Magnet Elementary (MU)	Museums Magnet	Traditional		Parent	12
Bugg Magnet Elementary (CA)	Creative Arts and Science Program	Traditional		Express	13
Conn Magnet Elementary (GC)	Active Learning and Technology	Traditional		Express	3
Fuller Magnet Elementary (GT/AG)	Gifted and Talented/AG Basics Program	Traditional		Neighborhood	14
Green Elementary (LW)	Leadership and World Languages	Traditional		Parent	3
Hodge Road Elementary (DS)	Spanish Dual Language Immersion	Year Round		Parent	1
J. Y. Joyner Magnet Elementary (LA)	Center for Spanish Language/International Baccalaureate Primary Years Programme	Traditional		Parent	4
Jeffreys Grove Elementary (SI)	Spanish Immersion	Traditional		Parent	1
Kingswood Elementary (MT)	Montessori Program grades PK-03; STEM grades 04-05	Traditional		Parent	3
Partnership Elementary (PE)	School of Choice	Modified		Express	1
Stough Elementary (CI)	Chinese Immersion	Traditional		Parent	3
Washington Magnet Elementary (GT)	Gifted and Talented Program	Traditional		Neighborhood	16
Wiley Magnet Elementary (IN)	International Studies	Traditional		Parent	5

Figure 1: Screenshot of the Application Website

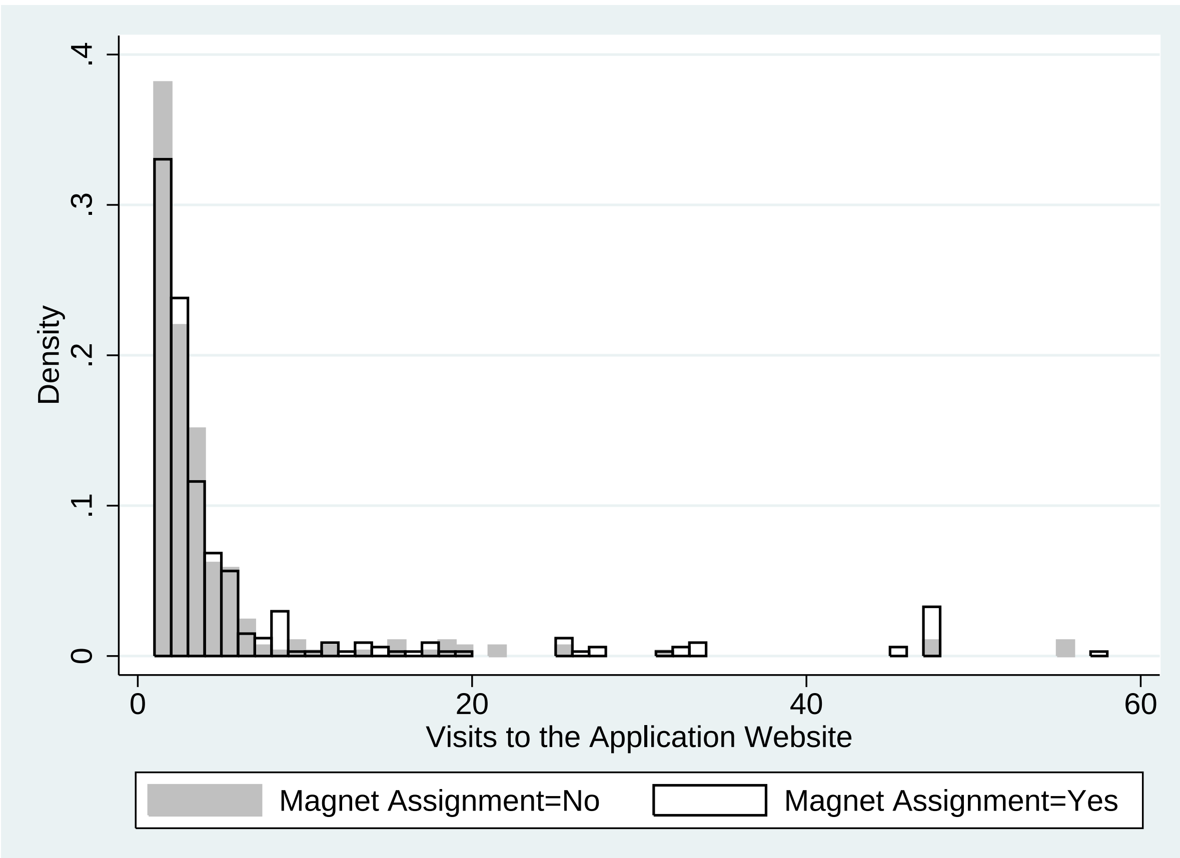

Figure 2: Website Visits by Magnet Assignment

Table 1: Summary Statistics of Student Characteristics

	(1) All Students	(2) Magnet Applicants	(3) Successful Applicants
Female Student	0.485	0.504	0.490
	(0.003)	(0.008)	(0.010)
Asian Student	0.078	0.165	0.192
	(0.001)	(0.006)	(0.008)
Black Student	0.221	0.240	0.235
	(0.002)	(0.007)	(0.009)
Other/Multiple Race	0.041	0.050	0.049
	(0.001)	(0.004)	(0.004)
White Student	0.505	0.476	0.463
	(0.003)	(0.008)	(0.010)
Hispanic Student	0.155	0.070	0.062
	(0.002)	(0.004)	(0.005)
LEP Student	0.120	0.067	0.067
	(0.002)	(0.004)	(0.005)
AG Student	0.190	0.321	0.413
	(0.002)	(0.008)	(0.010)
N	32953	3790	2416

Notes: Shown are the mean fraction of students who are female, Asian, Black, other/multiple races, White, Hispanic, limited English proficient, or academically gifted, respectively. All grade-entry students are included in column (1), all who submitted a magnet application are included in column (2), and all who submitted a magnet application and received assignment at one of their ranked schools are included in column (3). For this and subsequent tables, standard errors are in parentheses.

Table 2: Fraction of Sophisticated Students by Student Characteristics

	(1) Mean	(2) Difference
Male	0.604	
	(0.011)	
Female	0.611	0.007
	(0.011)	(0.016)
Non-Asian	0.589	
	(0.009)	
Asian	0.682	0.093
	(0.019)	(0.021)***
Non-Black	0.618	
	(0.009)	
Black	0.563	-0.055
	(0.017)	(0.019)***
Non-Other/Multi	0.608	
	(0.008)	
Other/Multi	0.546	-0.062
	(0.037)	(0.038)*
Non-White	0.607	
	(0.011)	
White	0.602	-0.006
	(0.012)	(0.016)
Non-Hispanic	0.603	
	(0.008)	
Hispanic	0.626	0.023
	(0.030)	(0.031)
Non-LEP	0.609	
	(0.008)	
LEP	0.587	-0.022
	(0.031)	(0.032)
Non-AG	0.631	
	(0.010)	
AG	0.557	-0.074
	(0.014)	(0.017)***

Notes: All magnet applicants are shown. Column (1) indicates the fraction of students of a given characteristic who are classified as sophisticated. Column (2) indicates the difference between the fraction sophisticated across the two levels of the characteristic. For this and subsequent tables, $*$, $**$, and $***$ denote significance at the 10%, 5%, and 1% level, respectively.

Table 3: Determinants of Receiving a Magnet Assignment

	(1)	(2)	(3)	(4)
Sophisticated Student	0.056	0.063	0.072	0.068
	(0.042)	(0.040)	(0.039)*	(0.037)*
Ranked 2 Schools		0.143	0.155	0.156
		(0.050)***	(0.050)***	(0.046)***
Ranked 3 Schools		0.285	0.241	0.256
		(0.042)***	(0.042)***	(0.039)***
Priority Points		3.424	3.000	3.216
		(0.808)***	(0.800)***	(0.910)***
Middle School		0.042	-0.166	-0.286
		(0.051)	(0.054)***	(0.047)***
High School		0.153	-0.022	-0.025
		(0.044)***	(0.047)	(0.044)
Female Student			0.014	-0.005
			(0.037)	(0.035)
Asian Student			0.037	0.129
			(0.060)	(0.062)**
Black Student			0.287	0.202
			(0.042)***	(0.050)***
Other/Multiple Race			0.149	0.104
			(0.080)*	(0.072)
Hispanic Student			0.129	0.071
			(0.063)**	(0.059)
LEP Student			0.214	0.171
			(0.072)***	(0.075)**
AG Student			0.352	0.331
			(0.053)***	(0.052)***
Zip Code Fixed Effects	No	No	No	Yes
Observations	627	627	604	598
Log Likelihood	-432.098	-400.286	-355.674	-306.694

Notes: Non-guaranteed, priority magnet applicants are shown (i.e., students who have non-zero priority points but who are not guaranteed a seat). The dependent variable in this Probit regression is equal to 1 if the student received a magnet assignment. Marginal effects are shown and, for this and subsequent tables, robust standard errors are in parentheses.

Table 4: Characteristics of Assigned Schools for Sincere and Sophisticated Students

	(1) First Choice	(2) Popularity	(3) Popularity Rank
Sophisticated	0.716	77.233	8.941
	(0.030)	(4.278)	(0.370)
Sincere	0.730	90.028	8.138
	(0.042)	(6.660)	(0.555)
Difference	-0.014	-12.795	0.803
	(0.052)	(7.916)	(0.667)
N	336	328	328

Notes: Non-guaranteed, priority students who received a magnet assignment are shown. In column (1), First Choice is equal to 1 if the student was assigned to the school that she ranked first on the magnet application, conditional on receiving a magnet assignment. The final two columns involve the popularity of the student's assigned school, conditional on receiving a magnet assignment. In column (2), Popularity is measured by the number of first-choice magnet applications received by the school. In column (3), Popularity Rank is measured by the rank of the popularity variable.

Table 5: Determinants of the Popularity of a Student's Assigned School

	(1)	(2)	(3)
Sophisticated Student	-3.959	-2.147	-4.631
	(6.253)	(5.438)	(5.354)
Ranked 2 Schools	-9.838	-13.008	-10.126
	(8.526)	(7.074)*	(7.569)
Ranked 3 Schools	-19.200	-17.622	-19.166
	(6.473)***	(5.688)***	(6.418)***
Priority Points	154.167	86.531	38.800
	(83.330)*	(81.867)	(86.823)
Middle School	79.296	37.587	42.004
	(12.905)***	(9.843)***	(11.527)***
High School	81.145	72.645	72.998
	(3.731)***	(5.013)***	(6.190)***
Female Student		-1.385	-1.644
		(4.989)	(5.249)
Asian Student		6.843	5.981
		(11.927)	(14.039)
Black Student		-6.195	-7.231
		(6.661)	(7.643)
Other/Multiple Race		-16.929	-12.097
		(10.114)*	(11.584)
Hispanic Student		-6.307	-6.446
		(8.133)	(8.878)
LEP Student		-12.536	-15.049
		(8.235)	(8.569)*
AG Student		87.196	90.319
		(17.203)***	(16.870)***
Zip Code Fixed Effects	No	No	Yes
Observations	328	320	320
Adjusted R^2	0.383	0.534	0.555

Notes: Non-guaranteed, priority students who received a magnet assignment are shown. The dependent variable in this OLS regression is the popularity of the student's assigned school, conditional on the student receiving a magnet assignment. Popularity is measured by the number of first-choice magnet applications received by the school.

Table 6: Fraction of Sophisticated Students by Birth Order

	(1) All Levels	(2) Elementary	(3) Middle	(4) High
Not Oldest	0.575	0.668	0.566	0.442
	(0.017)	(0.024)	(0.033)	(0.032)
Other	0.620	0.701	0.623	0.545
	(0.009)	(0.017)	(0.014)	(0.018)
Difference	-0.045	-0.033	-0.058	-0.103
	(0.019)**	(0.030)	(0.036)	(0.036)***
N	3626	1087	1481	1058

Notes: All magnet applicants are shown, along with the mean fraction of students who are classified as sophisticated, depending on the student's siblings who are observed in the data. A student who is identified as having an older sibling is in the "Not Oldest" category. All other students are in the "Other" category, which includes students who are identified to have a younger sibling and students who are identified to not have any sibling.

Table 7: Fraction of Students Who Exit the School System

Panel A: *Unsuccessful Magnet Applicants*

	(1) All Levels	(2) Elementary	(3) Middle	(4) High
Sophisticated	0.192	0.207	0.192	0.156
	(0.013)	(0.021)	(0.021)	(0.029)
Sincere	0.133	0.171	0.132	0.083
	(0.015)	(0.029)	(0.024)	(0.025)
Difference	0.059	0.037	0.060	0.074
	(0.020)***	(0.036)	(0.032)*	(0.038)*
N	1374	540	553	281

Panel B: *Successful Magnet Applicants*

	(1) All Levels	(2) Elementary	(3) Middle	(4) High
Sophisticated	0.078	0.079	0.073	0.084
	(0.007)	(0.013)	(0.011)	(0.014)
Sincere	0.087	0.063	0.067	0.116
	(0.009)	(0.018)	(0.013)	(0.016)
Difference	-0.009	0.016	0.006	-0.033
	(0.011)	(0.022)	(0.017)	(0.021)
N	2416	609	978	829

Notes: All magnet applicants are shown, along with the mean fraction of students who exited the school system from 2013-2014 to 2014-2015. Panel A considers only students who submitted a magnet application but were not assigned to any of their ranked schools. Panel B considers only students who submitted a magnet application and were assigned to one of their ranked schools.

Table 8: Determinants of the Educational Outcomes of a Student's Assigned School

	SPG Score			Fraction AG		
	(1)	(2)	(3)	(4)	(5)	(6)
Sophisticated Student	0.011	0.008	0.007	0.018	0.010	0.008
	(0.003)***	(0.003)**	(0.003)**	(0.005)***	(0.005)**	(0.005)*
Ranked 2 Schools	-0.001	-0.001	0.001	-0.006	-0.009	-0.008
	(0.005)	(0.004)	(0.004)	(0.007)	(0.006)	(0.006)
Ranked 3 Schools	-0.025	-0.018	-0.015	-0.045	-0.028	-0.025
	(0.005)***	(0.005)***	(0.005)***	(0.007)***	(0.006)***	(0.006)***
Priority Points	0.006	0.005	0.004	0.021	0.016	0.015
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
Middle School	-0.038	-0.047	-0.043	0.211	0.154	0.158
	(0.005)***	(0.005)***	(0.005)***	(0.006)***	(0.006)***	(0.006)***
High School	0.033	0.026	0.034	0.179	0.122	0.129
	(0.005)***	(0.005)***	(0.005)***	(0.006)***	(0.007)***	(0.007)***
Female Student		0.012	0.011		0.005	0.007
		(0.003)***	(0.003)***		(0.004)	(0.004)
Asian Student		0.018	0.009		0.049	0.038
		(0.004)***	(0.005)**		(0.005)***	(0.007)***
Black Student		-0.029	-0.010		-0.033	-0.026
		(0.005)***	(0.005)*		(0.007)***	(0.008)***
Other/Multiple Race		-0.009	-0.005		0.003	0.004
		(0.007)	(0.008)		(0.011)	(0.011)
Hispanic Student		-0.010	-0.001		-0.004	-0.001
		(0.008)	(0.008)		(0.009)	(0.009)
LEP Student		-0.014	-0.009		0.003	0.004
		(0.006)**	(0.006)		(0.008)	(0.008)
AG Student		0.026	0.021		0.132	0.128
		(0.004)***	(0.004)***		(0.007)***	(0.007)***
Zip Code Fixed Effects	No	No	Yes	No	No	Yes
Observations	2416	2391	2391	2416	2391	2391
Adjusted R^2	0.191	0.254	0.295	0.485	0.640	0.648

Notes: Students who received a magnet assignment are shown. The dependent variables in these OLS regressions are two measures of the educational outcomes of a student's assigned school, conditional on the student receiving a magnet assignment. Columns (1) and (2) use School Performance Grades (SPG) scores, while columns (3) and (4) use the fraction of academically gifted (AG) students assigned to the school. The performance measures are drawn from the 2013-2014 school year, prior to the assignment of the students in question.