Missing "One-Offs" in High School Choice in New York City*

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1 Overview

School choice plans allow students to access schools beyond their immediate neighborhood and, in many cases, throughout the district. A major goal of these plans is to more broadly distribute educational opportunities by race and family income by de-linking residential location and school assignment. A large and growing literature examines the properties of different school choice assignment mechanisms (see, e.g., Pathak (2011) and Pathak (2016)), and several districts have adopted systems that have superior incentive, efficiency, and fairness properties than previous alternatives (see, e.g., Pathak and Sönmez (2008) and Pathak and Sönmez (2013)). While these reforms are often viewed as a success of market design, the question of whether market-design inspired school assignment systems succeed in more fairly distributing access across racial and income lines remains open.

The extensive literature on the college admissions process identifies two primary mechanisms that produce unequal representation of students by family income at selective colleges. First, and perhaps most important, there is a "pipeline problem": the (average) achievement gap between high school students from wealthy and less wealthy families (and similarly between minority and non-minority students) produces systematic differences in the pool of applicants from each group who are qualified for admission to selective institutions. Second, qualified low-income students disproportionately self-select themselves away from the set of selective colleges. Hoxby and Avery

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(2013) coin the expression "missing one-off" to describe how high-achieving low-income students are typically unusual in their high schools and tend to apply only to the same less-selective schools as their high school peers. In this paper, we use the preferences submitted by high-achieving middle school students in the New York City high school lottery to assess whether the "missing one-off" phenomenon plays an important role in K-12 school assignment.

Previous research on K-12 school choice provides some evidence of self-selection by income, especially at exam schools, which are schools that admit pupils based on competitive admissions tests. Pathak (2013) shows that a large fraction of students who would almost certainly be offered admissions to one of Boston's exam schools do not apply. Corcoran and Baker-Smith (2015) document a clear "feeder-school" phenomenon in enrollment in the nine New York City exam schools: 5% of the middle schools in the city account for more than half of the enrollment at those exam schools. Much of this phenomenon is explained by middle school achievement gaps, for a substantial proportion of the qualified students attend this small set of middle schools.[1] Corcoran and Baker-Smith (2015) find that minority students are about as likely to apply to exam schools as are non-minority students with similar admission test scores, but they identify two other mechanisms that reduces representation of minority students at New York City exam schools. Conditional on application and 8th grade test score, minority students are relatively unlikely to be admitted to exam schools and conditional on admission to an exam school, they are relatively unlikely to enroll. Outside of exam schools, Nathanson, Corcoran, and Baker-Smith (2013) focus on the choices of low-achieving students in NYC. They show that low-achievers tend to choose schools close to home, which are less selective and lower-performing.

This paper proceeds as follows. Section 2 provides background information on the New York City high school lottery and describes the data used in our analysis. Section 3 provides a descriptive analysis of the high school choices, assignments, and subsequent academic achievements of the top decile of New York City middle school students. Section 4 discusses the implications of the main finding – that high-achieving students from low-performing middle schools are less likely to apply and enroll in high-performing high schools and have worse educational outcomes than high-achievers from high-performing middle schools – and describes possible market-design responses that could improve access of these high-achievers to high-performing high schools.

[1] Jencks and Phillips (2011) survey the literature on the black-white achievement gap in K-12. Reardon, Kalogrides, and Shores (2017) report racial/ethnic achievement gaps across MSAs and school districts in the U.S.

2 Background on the Schools and the Data

We focus our investigation on the first four years of New York City's (NYC) High School match. We track four cohorts of students, those who completed 8th grade in the NYC public schools between Spring 2003 and Spring 2006, from middle school through the high school match to initial college enrollment based on a match of names between NYC Department of Education and the National Student Clearinghouse, available for the last three cohorts. Further details on the dataset are in Abdulkadiroglu, Pathak, Schellenberg, and Walters (2017). We focus on high-achieving students, which we define as the top decile of students based on 8th grade score on the statewide math achievement test. Our data excludes students enrolled at NYC's exam schools because these schools have been the focus of other investigations. We are especially interested in high-performing non-exam high schools, which are not as salient as exam schools, and have the same admissions process as all other non-exam high schools. We consider five outcome variables: (1) ever graduated from high school; (2) took the SAT (a necessary step for college admission for most of these students since relatively few students in New York City take the ACT); (3) "College Ready" based on SAT scores, defined as score of at least 500 on the Verbal exam and a score of at least 500 on the Math exam;[2] (4) attended a four-year college any time after graduation; and (5) AP Calculus Test-taking.

We measure the performance of schools using average achievement levels. For middle schools, we partition schools into quartiles based on the average 8th grade math achievement. For high school, we partition schools into quartiles based on the average four-year college going rate. It's worth noting that these measures are not value-added measures and that high-performing schools need not be high value-added schools (Abdulkadiroğlu, Angrist, and Pathak, 2014). However, performance levels are strongly correlated with parent demand, suggesting that high-performing schools are widely perceived to be high-quality schools (Abdulkadiroglu, Pathak, Schellenberg, and Walters, 2017).

3 Analysis and Results

The characteristics of our NYC sample are similar to those in other urban districts. Table 1 shows that nearly two-thirds of the students in the full sample of applicants in the high school match

[2]The College Board identifies scores of 480 on Reading and Writing and 530 on Math as "College Ready." For simplicity, we use threshold scores of 500 on the Verbal and Math tests, excluding the Writing section, which was relatively new when these students were in high school.

receive a subsidized school meal, a measure of poverty. Roughly three-quarters of the applicants are either black or Hispanic. The last column of the table reports characteristics of high-achieving students, as measured by 8th grade math performance. The proportion of Asian students in the top decile of the 8th grade math test is more than three times the proportion of Asian students in the full sample, while the proportion of students living in Queens is about 50% greater among top decile students than in the full sample. By contrast, black, Hispanic, subsidized lunch and students living in the Bronx are significantly less common among high achievers than in the rest of the sample.

For these high achievers, there are pronounced achievement gaps based on the performance levels of their middle school. Figure 1 shows that high-achieving students who are at middle schools with other high-achievers are more likely to graduate, take the SAT, attend a four-year college, be college-ready, and take AP Calculus than high-achievers who are at lower performing middle schools. The relationship between middle school performance and educational outcomes is more pronounced for outcomes beyond college-going. For instance, differences in graduation, SAT test-taking, and four-year college going are less than 10% across middle school performance quartiles. For college-readiness and AP Calculus test-taking, the difference in outcomes across middle school performance is larger. A high-achieving middle school student who is at a middle school with other high-achieving pupils is more than twice as likely to be college-ready than a high-achieving middle school student who is at a middle school where her peers place the middle school in the bottom quartile of performance.

The performance of a high-achieving applicant's high school predicts future outcomes. Figure 2 shows that students attending high schools with higher-achieving peers are more likely to perform better on each academic outcome. Compared to the achievement gap across middle schools in Figure 1, there are larger differences across high school quartiles. Though the results in Figures 1 and 2 may seem superficially predictable, it is notable that there is still such a strong effect of the performance level of the middle school on high school outcomes for high-achieving 8th graders, as these students have demonstrated the ability to perform well at a variety of middle schools.

If high-achieving students in low performing middle schools systematically attend lower-performing high schools, then high school assignment may be an important source of the achievement gaps shown in Figure 1. Figure 3 shows that more than 60% high-achievers who attend the lowest-performing middle schools are assigned to a high school in the bottom 80% of performance. In contrast, only 20% of high-achievers at highest-performing middle schools are assigned to a low-

performing high school. More than half of the high-achievers at the highest-performing middle schools attend the highest-performing high schools.

It is, of course, possible that high schools are less likely to admit students from lower performing middle schools, but we show next that these patterns are driven by self-selection. Figure 4 reports on the performance of the first choice high school of high-achievers. The pattern of choices closely mirrors the pattern of assignment in Figure 3: high-achievers at the lowest-performing middle schools are more likely to rank a low-performing high school, while high-achievers at the highest-performing middle schools predominately rank one of the highest-achieving high schools.

Figure 5 links these patterns of self-selection to the "missing one-of" phenomenon, showing that high-achieving low-income students are relatively isolated in their middle schools. Top decile students attending top quartile high schools have many high-achieving peers: nearly 30 percent of their classmates are also top decile students. By contrast, top decile students attending below average middle schools have averages of 4% (for those at second quartile middle schools) and 2% (for those at lowest quartile middle schools) of classmates who are in the top decile. Given this relative isolation, high-achieving middle school students are unlikely to have many peers who are considering applying to higher-performing high schools.

4 Discussion and Future Work

Our results indicate that employing a K-12 school choice rule with desirable theoretical properties is not sufficient to ensure equitable assignment of students. While the properties of the school-choice rule are clearly important, it is paramount to consider likely differences in the preferences submitted across student groups.

There are two distinct and plausible explanations for the results observed in Table 4, where a relatively small fraction of high-achieving students at lower-performing middle schools apply to the highest-performing high schools. These explanations suggest quite different policy responses. First, students at lower-performing middle schools may have truly different preferences than other applicants with similar academic qualifications. For example, high-achieving students at the lowest-performing middle schools may reside in areas of New York City where it is difficult for them to easily travel to the highest-performing high schools. This geographic isolation combined with a desire for shorter commutes may lead students to forego applications to higher-performing schools. Second, high-achieving students at lower-performing middle schools may not have sufficient information

to determine their true preferences, and in particular, they may not know much about highest-achieving high schools. Related studies suggest that both explanations are important in this context (see, e.g., Hastings and Weinstein (2008) and Hoxby and Turner (2013)).[3] Interestingly, Corcoran and Baker-Smith (2015) found that disadvantaged middle school students are broadly as likely as others to take the entrance exam for exam schools after controlling for 8th grade test scores. This suggests that high-achieving students in New York City, in fact, know about exam schools, and differences may arise for high-performing non-exam schools, which may be less well-known.

The patterns we've documented motivate expanding the scope of school choice market design beyond algorithmic issues to consider ways to influence the choices that families make. It is still an open question whether and which combination of decisions aids, targeted information, and improved guidance at middle schools will influence student choices the most. But, we know of two large-scale randomized controlled trials of informational interventions to help students improve their choices in high school lotteries, one in New York City (Cohodes, Corcoran, Jennings, and Sattin-Bajaj, 2017) and a second in Ghana (Ajayi, Friedman, and Lucas, 2017). These interventions conducted randomization at the school level, then provided information and suggestions about strategies for researching and ranking high schools in group sessions conducted at treatment middle schools. Though neither intervention particularly targeted high-achieving middle school students, the results from these trials should provide valuable evidence in distinguishing between the "preference" and "informational" explanations for the results observed here. More importantly, these randomized trials may identify low-cost approaches to reducing inequality in school assignments and therefore improve the performance of school choice systems in practice.

[3]See also Sattin-Bajaj (2014, 2015) which provides an ethnographic account of challenges faced by immigrant students from navigating the NYC choice process.

Table 1. Descriptive Statistics for NYC 8th graders

	All	2003	2004	2005	2006	High achievers
	(1)	(2)	(3)	(4)	(5)	(6)
Female	0.50	0.50	0.50	0.50	0.49	0.52
Black	0.35	0.36	0.36	0.35	0.34	0.13
Hispanic	0.38	0.37	0.38	0.38	0.40	0.18
Asian	0.12	0.11	0.12	0.12	0.13	0.41
Subsidized lunch	0.65	0.59	0.63	0.71	0.69	0.50
Bronx	0.23	0.23	0.23	0.23	0.23	0.09
Brooklyn	0.33	0.34	0.33	0.32	0.32	0.33
Manhattan	0.12	0.12	0.12	0.12	0.12	0.11
Queens	0.26	0.25	0.26	0.26	0.27	0.39
Staten Island	0.06	0.07	0.07	0.07	0.06	0.07
Grade 8 Math	0.01	0.02	0.02	0.00	-0.02	1.68
SAT	1,376	1,377	1,369	1,386	1,372	1,775
College Ready	0.10	0.10	0.10	0.10	0.11	0.56
HS graduation	0.61	0.57	0.61	0.63	0.62	0.85
4 Year College	0.28	n/a	0.30	0.28	0.26	0.65
Sample sizes: Preferences	269,593	65,838	65,854	67,100	70,801	29,452
SAT	109,079	24,837	27,589	25,638	31,015	21,994
HS Graduation	224,064	53,349	54,434	56,303	59,978	25,650
College	250,575	61,452	61,686	62,751	64,686	26,906

Notes. Dataset described in further detail in Abdulkadiroglu, Pathak, Schellenberg, and Walters (2017). 8th grade Math score in standard deviation units, standardized among all test-takers. SAT is the sum of scores on Math, Reading and Writing sections (with a minimum of 600 and a maximum of 2400). College Ready defined as score of at least 500 on both SAT Math and SAT Verbal. High achievers are top decile students on the 8th grade standardized math assessment.

Figure 1. Achievement Gap by Middle School Performance for High Achievers

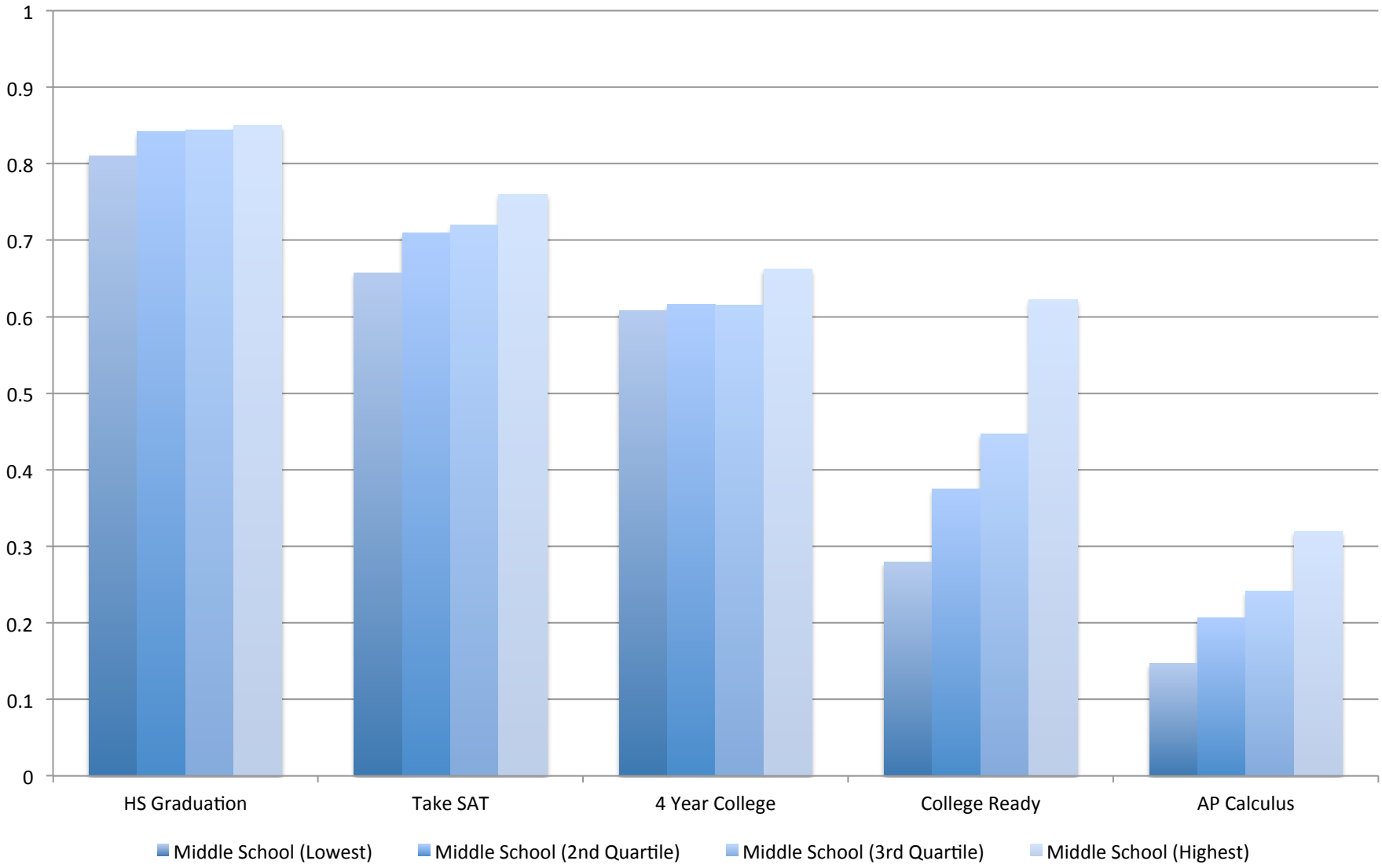


Figure 2. Outcomes by High School Performance for High Achievers

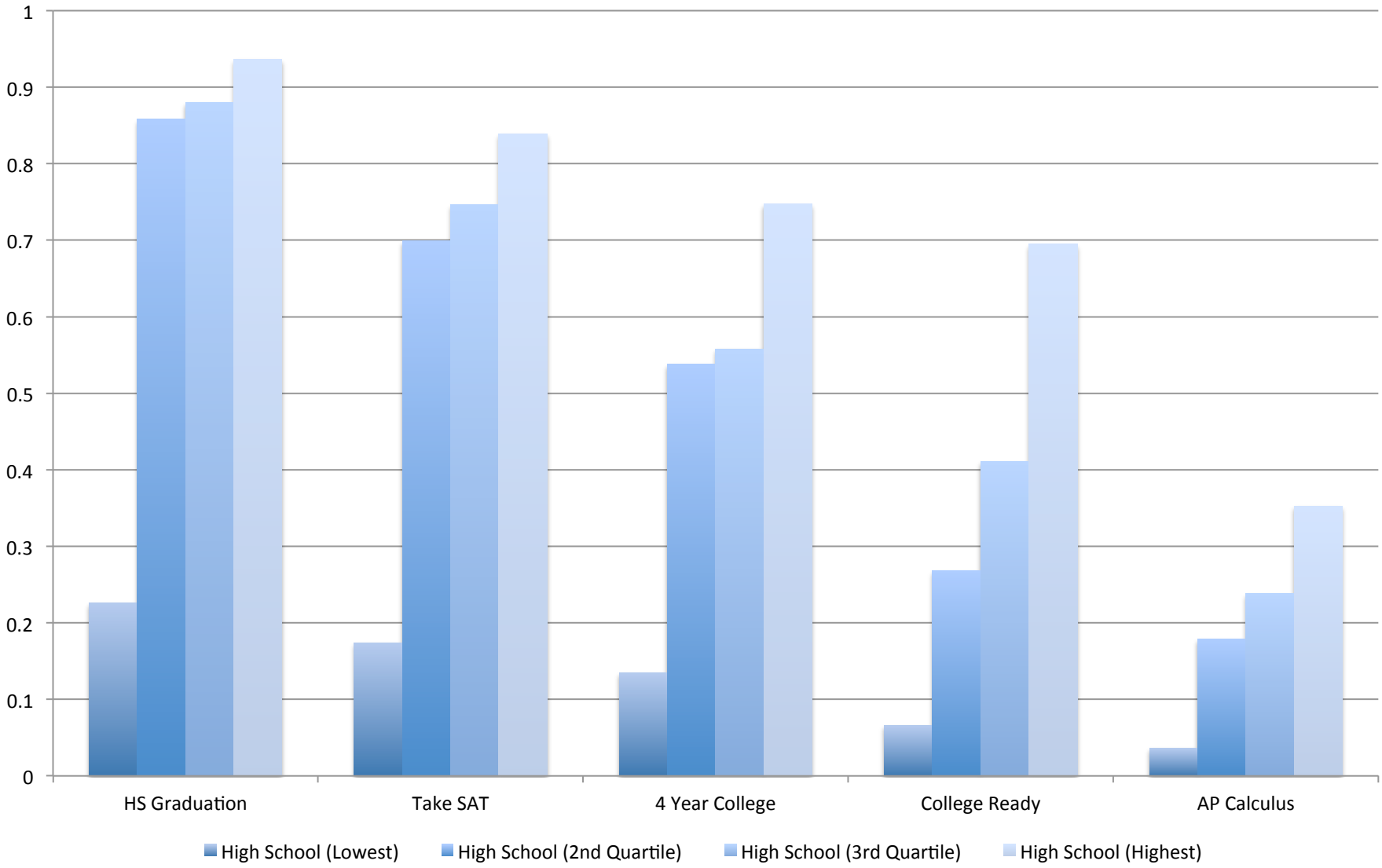


Figure 3. Assigned High School Performance by Middle School Performance for High Achievers

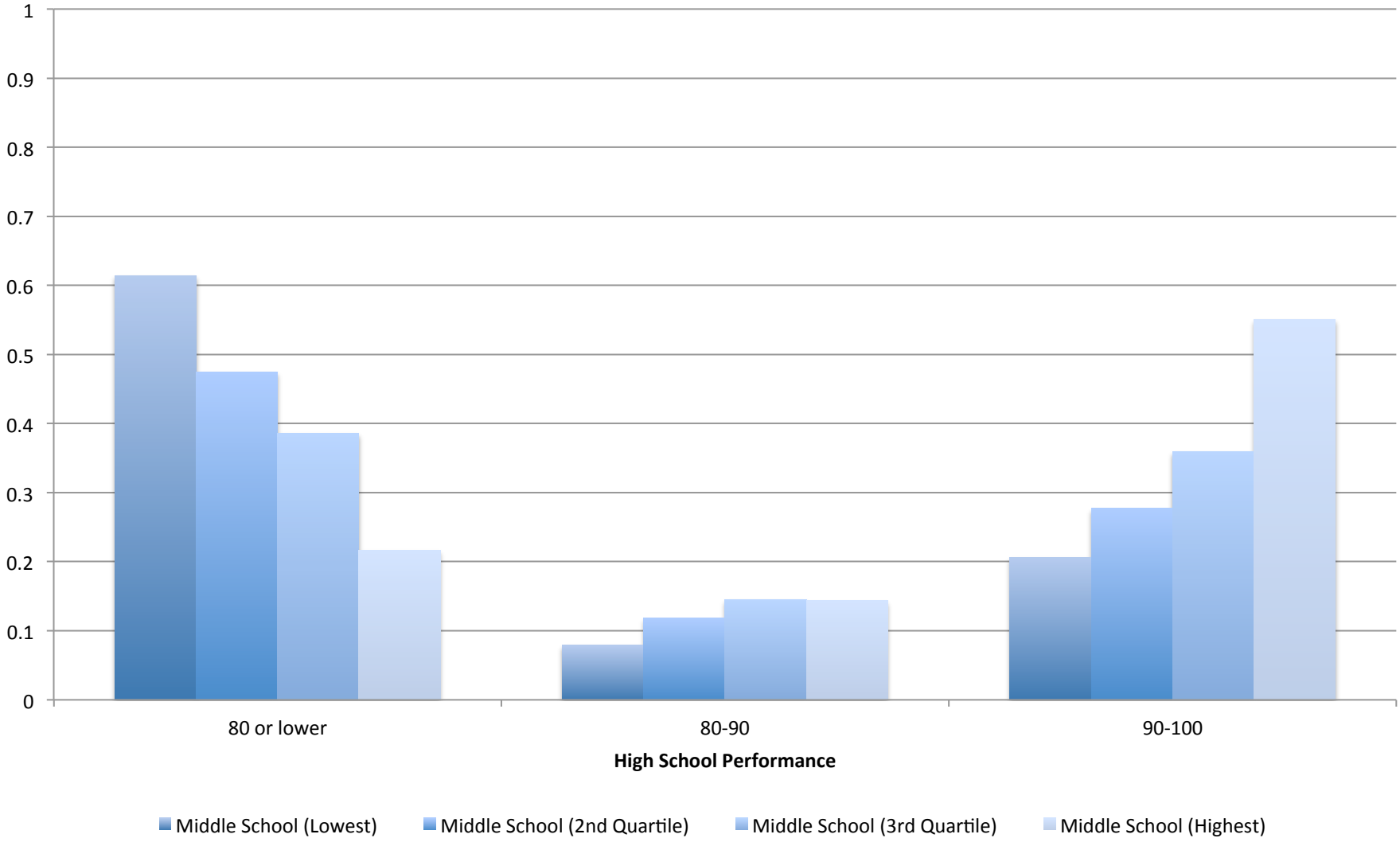


Figure 4. Performance of Top Ranked High School Choice by Middle School Performance for High Achievers

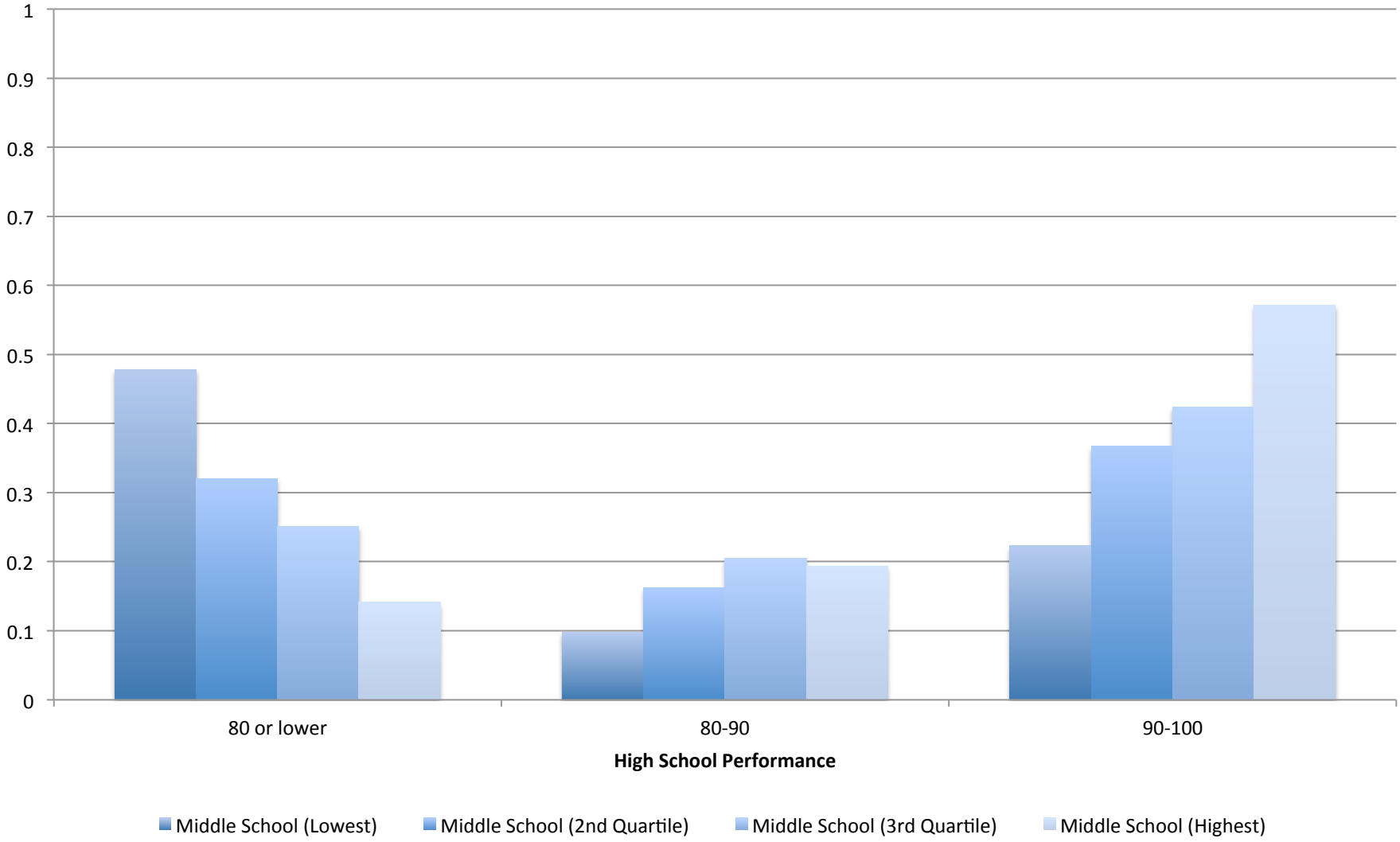
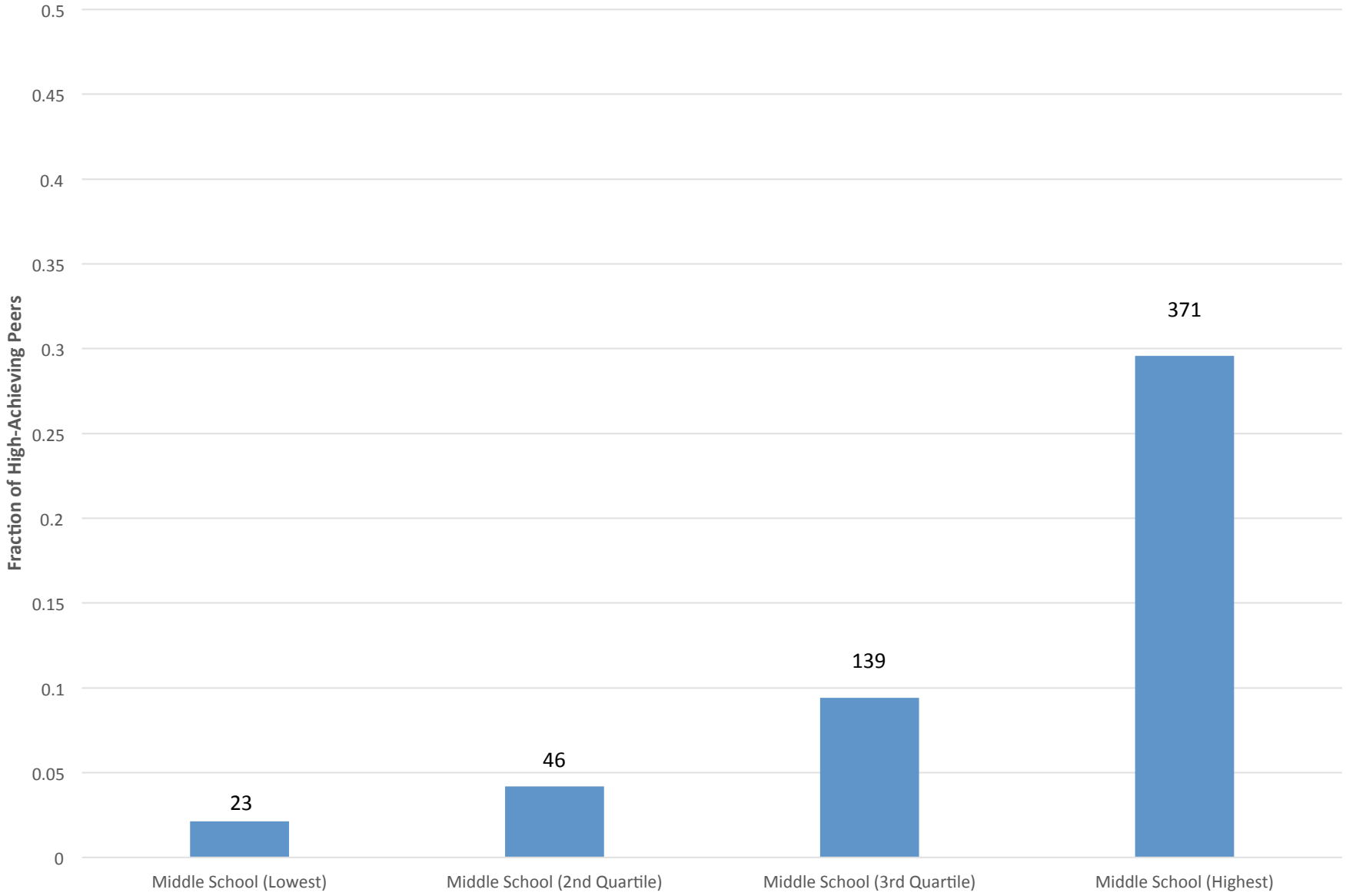


Figure 5. Fraction and Count of High-Achieving Peers
by Middle School Performance for High Achievers



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