Gender and Performance:
Evidence from School Assignment by Randomized Lottery

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School choice programs are intended to improve student achievmement, by allowing for better matches between students and schools. However, it is not clear that academic achievement will improve if parents make school choice decisions over both academic and non-academic school attributes (Justine Hastings *et al.*, 2005a,b). Indeed, many randomized studies of impacts of school choice find little or no effect of school choice on academic outcomes. For example, initial evaluations of randomized voucher experiments in Milwaukee and New York City found modest academic impacts on eligible students (John F. Witte, *et al.* 1995; Daniel P. Mayer *et al.*, 2002).[1] More recently, evaluations of public school choice lotteries in Chicago and Charlotte have found no difference between the average lottery winner and loser in academic outcomes such as test scores (Julie Cullen *et al.*, 2003; Hastings *et al.*, 2005b). When parents are choosing schools for academic and non-academic reasons, school choice may increase utility but not necessarily improve academic outcomes.

There is growing evidence that educational interventions may have heterogeneous treatment effects by gender. Analysis of the Moving To Opportunity demonstration, in which parents were randomly given the opportunity to move to non-poverty neighborhoods, found improvements in educational, mental health, and criminal behavior for females, but negative effects on males (Jeffrey R. Kling and Jeffrey B. Leibman, 2004). Similarly, Michael Anderson (2005) re-analyzed data from three randomized

trials of early childhood education, and found that all of the long-term benefits accrued to girls and not to boys.

We use data from a public school choice program, with school assignment by lottery, to estimate the impacts by race and gender of attending a first-choice school on academic outcomes. Our data come from the Charlotte-Mecklenburg school district (CMS) in North Carolina, which introduced district-wide public school choice in the fall of 2002 after a race-based busing plan was terminated by the courts. The data include student's choices, lottery numbers, school assignments, demographics and academic achievement for the years surrounding implementation of school choice.

We compare outcomes for those making similar choices, whose school assignment was determined solely by lottery number. Overall, there was no gain in academic achievement for those winning the lottery. However, white females did experience significant improvements in test scores when randomized into their first choice school. White females were also more likely to choose academically focused magnets and, among those who won the lottery, reported significant increases in time spent on homework. Our evidence suggests that school choice programs may have heterogeneous treatment effects by gender, which are related to differences in the factors driving parental choices.

I. The CMS Choice Plan

Prior to the fall of 2002, CMS operated under a racial desegregation order for three decades. In September 2001, the district was declared "unitary" by the courts and ordered to dismantle the race-based student assignment. The school board subsequently

voted to approve a district-wide public school choice plan. In the spring of 2002, parents were asked to submit their top three choices of school programs for each child. Each student was assigned a nearby "home school", and was guaranteed admission to this school if she was not admitted to any of her top three choices. Admission to non-guaranteed schools was determined by lottery.

Our analysis focuses on students who whose admission to their first choice school was determined solely by lottery number. Since those listing their home school first were guaranteed admission, we dropped these observations.[2] Remaining students were assigned to priority groups and admission within priority group was determined by a random number. The priority groups were:

Priority 1: Student attended the school in the prior year.

Priority 2: Free-lunch eligible student applying to school where less than half the students were free-lunch eligible.

Priority 3: Student applying to a school within her geographic choice zone.[3]

Slots were first assigned to those in the home school zone listing their home school first. The remaining slots were then assigned by priority group and lottery number.[4] If a school was not filled by those who listed it as a first choice, the lottery process repeated with those listing the school as a second choice, using the same priority groups as above. For most schools, seats were filled by the time the second choices came up.[5]

II. Data

We began with the choice forms submitted by 105,706 students. We dropped students with special needs, those admitted due to siblings, those who listed a guaranteed

school first, and those who belonged to a priority group for which 100% of students in that group were either admitted or denied admission to the chosen school. We were left with 6,931 students in "marginal priority groups", that is, those priority groups within the school/grade choices where admission was determined by random number alone.

We had administrative data on demographics, school attended, absences, suspensions, and grade retention for both the 2001-2002 (baseline) and 2002-2003 school years. North Carolina End of Grade reading scores were available for students in grades 3 through 9 and math scores for students in grades 3 through 8. We standardized the test scores by grade level and year to have mean zero and a standard deviation of one, and averaged the math and reading score to create a composite test score. In addition, the testing data in North Carolina also include student self-reports on the number of hours spent on homework each week.

III. Results

There were substantial differences by race and gender in both baseline academic performance and in the schools chosen, with white females having the highest baseline test scores and choosing more academic-oriented schools. Table 1 describes the characteristics of the randomized group. Overall, these students were less likely to be white than students in the district as a whole (44% white), reflecting the higher fraction of white students who listed their home school first.[6] White students had higher baseline test scores than non-whites, were less likely to receive lunch subsidies, had lower suspension rates, and were assigned to higher-scoring home schools. In addition, white students and white females in particular tended to choose higher scoring schools, were more likely to

choose academic-oriented magnet programs (International Baccalaureate, Learning Immersion), and less likely to choose non-academic magnets.

Table 2 reports the difference in baseline characteristics between lottery winners and losers controlling for lottery fixed effects as a validity check of the randomization. There were no significant differences in baseline characteristics between lottery winners and losers overall. There were some differences that were significant at the 5% level once the data were broken down by gender and race, but the point estimates were small in magnitude, not jointly significant, and did not display any obvious pattern.

Table 3 reports the estimated impact of winning the lottery on the characteristics of the school attended and academic outcomes. Each estimate is from a separate OLS regression that controls for student baseline characteristics (X_i) and choice-grade (lottery) fixed effects (δ_j), based on the following equation:

$$Y_{ij} = X_i\beta + \gamma WonLottery_{ij} + \delta_j + \varepsilon_{ij}$$

The first row of estimates shows that differential attrition of lottery winners was small and insignificant. Among all students, lottery winners were 1.4% less likely leave the district by the fall of 2002 with a standard error of 0.9%. The second through fifth row of estimates show that winning the lottery did have a significant effect on the school that a student attended in the subsequent year. Lottery winners were 52 percentage points more likely to attend their first choice school and attended schools with average test scores about one-tenth of a standard deviation higher. Lottery winners were significantly more likely to attend a non-academic magnet, but this effect was weakest for white females. In contrast, winning the lottery had the largest effect on attending an academic magnet school for white females.

Overall, we find some impacts of winning the lottery on outcomes other than test scores. For example, lottery winners were more likely to report doing more than 3 hours of homework (4.4%, base of 30%), less likely to have 5 or more unexcused absences (3.8%, base of 34%) and less likely to have been retained (1.5%, base of 3.9%). However, there was no impact overall on any of the test score measures.

As reported in columns 2 through 5, the overall impacts mask important differences by gender and race. The results for white females are strikingly different from the other groups. White females experience significant gains in test scores as a result of winning the lottery. If anything, winning the lottery appears to have a negative effect on test scores for all other subgroups.

The differing impacts reflected important differences in choices. White girls seemed to chose slightly better schools than their male counterparts, and were the most likely to choose academically challenging magnets. In addition, the increase in self-reported fraction of students doing more than 3 hours of homework per week is driven completely by the white female subcategory. They experience a roughly 50% increase in homework. These results suggest that white females chose academically focused schools, expended more effort on academics when randomized into those schools, and experienced significant gains in test scores as a result.

In addition, decreases in unexcused absences as a result of winning the lottery are driven by decreases among females. Columns 2 and 4 show that females experienced a roughly 6 percentage point decline in having 5 or more unexcused absences. This result is only significant among non-white females, although the point estimates are the same

across white and non-white females. In contrast, there are no significant effects on any of the outcomes for males.

IV. Conclusion

A number of recent evaluations of educational interventions have reported differing impacts by gender and race. However, without a theory to account for those differing subgroup impacts, such differences could simply be due to chance. When we examine choices made by students in the CMS school choice lottery we find evidence of heterogeneous preferences. Different subgroups of students chose different types of schools: white females were more likely to choose academically rigorous magnets, while non-white students were more likely to choose non-academically focused magnet options. More generally, Hastings *et al.* (2005a) show in a mixed-logit demand framework that preferences over school characteristics vary greatly both across and within race and free-lunch recipient students. Parents face trade-offs between school characteristics such as location, academics, and racial composition. Different parents place different weights on each of these objectives. Giving parents more choices may improve utility, but may little effect on academic achievement overall if parents also have non-academic objectives.

The results presented here seem consistent with this hypothesis. On average there is no significant impact of school choice on student test scores. However, among white females in particular, there were significant gains in test scores as a result of winning the lottery. There is suggestive evidence that this may be a result of both the choices they made and personal effort. White girls were more likely to choose academic magnet

schools, and were the only group that reported significant increases in hours devoted to homework as a result of winning the lottery. Perhaps both the preferences that drive the choice decision and the reaction by the student to their lottery outcome may determine academic outcomes in a school choice setting.

Table 1: Characteristics of Students in Lottery by Gender and Race

	All Students	White Female	White Male	Nonwhite Female	Nonwhite Male
Student Demographics					
White	34.8%	100.0%	100.0%	0.0%	0.0%
Female	50.1%	100.0%	0.0%	100.0%	0.0%
Free or Reduced Lunch	39.4%	9.2%	8.8%	58.6%	52.4%
Student's Baseline Performance					
Test Score	-0.122	0.473	0.371	-0.318	-0.444
Absent > 18 days	12.4%	9.7%	9.8%	13.2%	14.5%
Suspended	15.2%	3.2%	9.7%	14.6%	25.1%
Choice School Characteristics					
Average Test Scores	0.045	0.264	0.199	-0.051	-0.056
Academic Magnet	9.9%	16.1%	12.7%	8.5%	6.7%
Non-Academic Magnet	45.8%	24.9%	32.0%	54.7%	55.2%
Home School Characteristics					
Average Test Scores	-0.224	0.013	-0.012	-0.356	-0.331
N	6739	1114	1233	2265	2127

Table 2: Difference in Baseline Characteristics between Lottery Winners and Losers

Variable	All Students	White Female	White Male	Nonwhite Female	Nonwhite Male
Student's Baseline					
Test Score	0.010	-0.003	-0.018	0.085*	-0.054
	(0.026)	(0.047)	(0.067)	(0.037)	(0.055)
Absent > 18 Days	-0.011	0.024	-0.013	-0.002	-0.034*
	(0.010)	(0.021)	(0.022)	(0.022)	(0.014)
Suspended	-0.010	-0.005	-0.012	-0.010	-0.021
	(0.009)	(0.012)	(0.020)	(0.017)	(0.018)
Home School Characteristics					
Average Test Scores	0.019	0.044*	0.041*	0.032	-0.012
	(0.012)	(0.020)	(0.020)	(0.020)	(0.016)

Notes: The differences are regression estimates controlling for lottery fixed effects. Standard errors adjust for clustering by first choice school. Significance indicated by * ($p<.05$), ** ($p<.01$) and *** ($p<.001$).

Table 3: Impact of Winning the School Choice Lottery

Student Outcome	All Students	White Female	White Male	Nonwhite Female	Nonwhite Male
Attrition					
Not in District, Fall 2002	-0.014	-0.023	-0.038	-0.015	-0.003
	(0.009)	(0.022)	(0.027)	(0.014)	(0.012)
Characteristics of School Attended					
First Choice School	0.521***	0.452***	0.534***	0.512***	0.577***
	(0.036)	(0.048)	(0.038)	(0.047)	(0.050)
Average Test Scores	0.099***	0.108**	0.075	0.114***	0.106**
	(0.026)	(0.036)	(0.039)	(0.030)	(0.035)
Academic Magnet	0.020	0.079	0.013	0.014	0.016
	(0.020)	(0.044)	(0.021)	(0.023)	(0.019)
Non-Academic Magnet	0.211***	0.119*	0.181***	0.243***	0.240***
	(0.042)	(0.051)	(0.049)	(0.048)	(0.055)
Student Performance					
Test Score	-0.012	0.151***	-0.044	-0.053*	-0.042
	(0.020)	(0.037)	(0.047)	(0.026)	(0.032)
> 3 hrs. Homework /Week	0.044*	0.173***	-0.021	0.002	0.041
	(0.021)	(0.041)	(0.059)	(0.028)	(0.024)
Unexcused absence > 5 days	-0.038*	-0.059	-0.008	-0.058*	-0.027
	(0.019)	(0.032)	(0.046)	(0.023)	(0.030)
Suspended	-0.020	-0.016	0.013	-0.029	-0.036
	(0.011)	(0.016)	(0.019)	(0.021)	(0.027)
Retained	-0.015*	-0.010	-0.017	-0.007	-0.017
	(0.006)	(0.011)	(0.013)	(0.009)	(0.012)

Note: Each entry is from a separate OLS regression of the given outcome on lottery outcomes. Regressions included lottery fixed effects, baseline characteristics (race, gender, free lunch, ESL status, absences, suspensions, and retentions). The regressions for student test scores and homework also controlled for baseline test score. Standard errors adjust for clustering at the first choice school level. Significance indicated by * ($p<.05$), ** ($p<.01$) and *** ($p<.001$).

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Footnotes

[1] Subsequent analyses of those programs accounting for attrition found no impacts (Cecilia E. Rouse, 1998; Alan B. Krueger and Pei Zhu, 2002).

[*2] See Hastings *et al.* (2005a) for a detailed description of the student choice data.

[3] The county was split into four geographic Choice Zones. A student could chose any school, however bussing would only be provided within the student's Choice Zone.

[4] The random number was assigned using a computer algorithm that we verified with CMS programmers. Parents do not know their lottery numbers at the time of submitting their choices. Once any sibling was admitted to a school, other siblings could choose to attend the school. We dropped those who were admitted to a school because of a sibling preference.

[5] See Hastings *et al.* (2005a) for a discussion of potential strategy in school choices.

[6] See Hastings *et al.* (2005a) for a detailed discussion of student choices.