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ABSTRACT

The career magnet high school programs of the New York City (NYC) public school system were evaluated in an experimental study. The experimental design compared the ninth-grade performance of students randomly selected for magnet schools with those who "lost the lottery." It included 91 pools of students: 3,272 with average reading scores and 986 with scores in the bottom 16% or who had not taken the reading test. The career magnet programs in NYC are of two types: one dedicated to career magnet education and the other placed within comprehensive high schools as schools-within-a-school. The self-contained schools encouraged students to enroll in high school and helped students earn more graduation credits. The programs within comprehensive schools raised students' reading scores. Programs with hands-on computer work encouraged attendance and programs with strong placement efforts encouraged poor readers to stay in school. (Seventeen tables, 4 references, and 3 appendices are included. The appendices discuss using the experimental results to estimate the impact of career magnets on students and the program administrator survey; a sample page from the directory of NYC public schools is provided.) (NLA)

THE EFFECTIVENESS OF NEW YORK CITY'S CAREER MAGNET SCHOOLS: AN EVALUATION OF NINTH GRADE PERFORMANCE USING AN EXPERIMENTAL DESIGN

Robert L. Crain
Amy L. Heebner
Yiu-Pong Si

Assisted by

Will J. Jordan
David R. Kiefer

Teachers College, Columbia University

National Center for Research in Vocational Education
University of California at Berkeley
1995 University Avenue, Suite 375
Berkeley, CA 94704

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PREFACE

This is a report on an experimental design analysis of the effects of New York City's career magnet high school programs—locally called "Educational Option" programs—on the ninth graders who would not normally have been admitted, but who were admitted by lottery and entered the programs in the Fall of 1988. It is likely that additional experimental design studies will be done to measure the performance of these students in the tenth and eleventh grades. If these studies are done, the report of the effect on tenth-grade performance, along with a large ethnographic study of students and staff, will be available in the Summer of 1992, and a large final report, including all the material from the two preceding reports and adding eleventh-grade outcomes, will be available at the end of 1992.

EXECUTIVE SUMMARY

This report evaluates the career magnet high school programs of the New York City public school system. These schools are important for four reasons. First, they represent an important new approach to secondary education, combining career preparation with traditional college preparatory programs so that students interested in career opportunities need not make the hard choice between preparing for college and preparing for an entry-level job after high school graduation. Second, the New York City project is an important research site because it is not a small experiment: Of all the magnet programs in New York City, the career magnets are the most extensive, with 133 programs educating nearly a third of all the public school students in New York City. Third, the New York City project has made a serious commitment to equal opportunity, requiring schools to accept students of all reading levels and admitting one-half of the students to the program through random assignment. Finally, because of the use of random assignment, the project provides an opportunity for an evaluation based on a rigorous randomized experimental design, the only certain methodology for determining whether students who attend these schools benefit from doing so.

In this report, the statistical evaluation of student outcomes is limited to the ninth-grade performance of one cohort of students. Within the next twelve months, it may be possible to present supplemental data on these same students as they go through their sophomore and junior years of high school. For now, we present an experimental design which compares the ninth-grade performance of those students who were randomly admitted to the career magnet schools with those who "lost the lottery" and were not offered seats in these schools. For technical reasons which are explained in the report, this research design evaluates with great accuracy the impact of most career magnets on the majority of students admitted by lottery, although some programs and some students are excluded. The design limits us to evaluating the impact of the more popular programs on those students whose academic records would not normally be strong enough to gain admission to a selective magnet school. This is discussed in detail in the section entitled, "The Analysis of the Experiment," and in Appendix 1.

The conclusion of our analysis is that students who ordinarily would not be admitted to the career magnets benefit from being offered seats because (1) they are less likely to drop out of high school in the transition point between middle school and high

school; (2) they show a gain in reading scores; and (3) they earn more credits toward graduation. The last two results hold only for readers with average reading performance. Students with below-average reading scores also benefit from the program in that they are more likely to pass the advanced mathematics test required for the New York State Regents diploma. However, these below-average readers also are more likely to be absent from school than are students attending comprehensive high schools. These impacts are substantial in magnitude and are statistically significant.

The New York City school system is heavily minority, with a large immigrant population. Thus, the results of this study probably have application for many other central city school systems today.

The career magnets are only one of several types of magnet high school programs in New York City, where most high school students attend magnet programs of one kind or another. Only about three-eighths of the students entering high school in 1988 attended comprehensive programs, although in most cities these are the most common form of education. About a third attended career magnet schools, a tenth attended vocational schools, and the remainder a variety of highly selective schools. The application process in New York City is designed to maximize the number of applications to magnet schools. Every student is required to fill out an application, if only to check a box indicating that they want to attend their local comprehensive high school. Eighty-two percent of eighth graders state a preference for some sort of magnet school.

Some of New York City's magnet schools are highly selective, but the typical career magnet school accepts about half of all the students who apply to the school as their first priority. White-collar careers, especially business and computers, are much more popular with New York City eighth graders than are blue-collar training programs.

The career magnet programs in New York City are both in buildings dedicated entirely to career magnet education and in comprehensive high schools as schools-within-a-school. We analyzed these two types of programs and found their effects to be quite different. This is important because the education planners reading this report may be considering choosing one of these two types to construct in their communities. The self-contained career magnet schools are particularly strong in encouraging middle school students to enroll in high school, especially if they are students with low reading scores,

and also in helping students earn more credits toward graduation. On the other hand, the career magnet programs located within comprehensive schools are particularly effective in raising reading scores.

We found that those career magnet schools which most isolated their students—by offering them separate classes or separate sections of academic classes taken by other students in the same school—were more effective in persuading eighth graders to enter high school rather than dropping out, and in raising reading scores. This may be because the programs which separate their students from other students in the same school are the ones with the strongest commitment to a career focus; however, it may also be that separating students creates a tracking effect which allows for educational improvement merely by separating the career magnet students, who have somewhat better middle school performance, from other students in their comprehensive school, whose middle school performance was weaker.

We also found that programs that provided more hands-on computer work encouraged attendance among students with average reading scores, and programs with strong placement efforts encouraged students with poor reading scores to stay in school.

ACKNOWLEDGEMENTS

This report owes a large debt to many people and many institutions. Our greatest debt is to the students and educators whom we interviewed; without them this report would not exist. We wish to next thank the New York City Board of Education for permitting us to do this study. In particular, we want to thank Robert Tobias, Judith Torres, John Schoener, William Wiechen, Richard Gampert, and Arnold Simmel, all of the Office of Research, Evaluation, and Assessment, for providing the data and giving us much needed advice. We owe a great debt to Robert Klein of the New York City Board of Education and Jack Cassiday of the Educational Testing Service, who gave us much of their time teaching us the ins-and-outs of the high school admission process and the computer program which carried out the random assignment.

We would like to thank our colleagues at Teachers College, Michael Timpane and Thomas Bailey, and at the Manpower Development Research Corporation, Edward Pauly, George Cave, and David Long, for their helpful comments on a briefing on this report.

A thank-you also goes to Sue Berryman, who not only served as the director of the Institute on Education and the Economy, where this project was located, but whose careful critical reading greatly improved the report.

Finally, we would like to thank Laura Gomez for providing the project with much technical, artistic, and emotional support.

INTRODUCTION

Robert L. Crain and Amy Heebner

In the last decade, New York City has expanded its magnet high school programs greatly, mostly by developing a large number of career-oriented programs. Known locally as "Educational Option" programs, we will refer to them as career magnet programs. These programs are career oriented in the sense that they advertise themselves as preparing students for a particular career, ranging from law to fine arts to secretarial work. However, they are not vocational schools because they also prepare students for college, and attract many students for that reason. This is important because given the American emphasis upon higher education, it would be extremely difficult to recruit students to a career school at the beginning of high school if that meant giving up the option of attending college later. (This is especially true for African American students who have long seen higher education as their best chance for upward mobility.)

Career magnet programs are either schools-within-a-school in comprehensive high schools (nearly every high school in New York City has a career magnet program) or else they are located in eight schools dedicated entirely to these programs. In most cases, the career magnet program receives no additional funds from the school board (a few have federal or foundation grants), causing it to reallocate dollars within its regular budget to pay for the special equipment the program requires. The only exception is "redesign" funds, which are available when a school is deemed to be such a failure that it is closed and reopened with a new name and a new staff; these schools receive a supplemental appropriation for the first five years of their new life. Sometimes these redesigned schools become dedicated career magnet buildings, and these are the only career magnet programs which receive extra funding.

When career magnets were first designed, they were intended to be like most magnet schools in America—selective. However, the New York City Schools have stressed more than any other *de facto* segregated school district in the country the importance of providing equal opportunity to students. All students are now required to apply to high school, using a form which makes it as easy to apply to a magnet school as it is to apply to stay in one's home school. Schools are permitted to select only one-half of their students, the other half being assigned randomly. Both the school-selected and the

randomly selected group include students with low as well as high reading performance, one-sixth being taken from students with reading scores in the top sixth of all students, one-sixth from the bottom reading group, and the remainder from the large middle group of readers.

The reason why this evaluation has been done is because the random selection program provides us with the opportunity to make a full-blown experimental design study evaluating the effectiveness of the career magnet schools. There have been very few research opportunities wherein students were assigned randomly to a school, with a second group randomly excluded from the school so as to permit a strict comparison of the effect of that school on the students. Certainly there has been no case where this has been done on a large scale. The random selection process in New York City provides us with the opportunity to evaluate several thousand students randomly assigned to over sixty different magnet programs.

The Impact of Career Magnets

Traditionally, vocational schools and other career-oriented schools have been evaluated by asking, "Do these schools accomplish their primary goal: Training workers so they can be successful in the careers for which they have been prepared?" This approach can be misleadingly narrow. For example, the finding that vocationally trained workers often go to work in a field other than the one in which they are trained is typically seen as negative evidence about the value of vocational education. This narrow evaluation criterion misses a major point. It ignores the fact that a career-oriented high school is first and foremost a high school, a place where adolescents are brought together and educated and socialized to become adults. So stated, it is obvious that the career magnet schools' goals are essentially no different from those of the comprehensive school and that those goals are multiple and different for every student. Indeed, if we held to the traditional evaluation criteria of vocational schools as succeeding or failing based on their ability to place students in their trained fields with high salaries, we would be equally obligated to evaluate comprehensive schools solely on the college grades of their graduates and the quality of the colleges they attend.

This evaluation uses the standard criteria for secondary school educational evaluation, which is, what is the impact of these particular programs on school dropout rates, on absenteeism, on improvements in reading and mathematics, on the difficulty level of the curriculum, and on the rate at which the student progresses toward graduation.

Proponents of the career magnet high school argue that these high schools are superior to conventional comprehensive high schools for two main reasons. First, students are more highly motivated because they can see the connection between what they are learning in school and their adult life. The payoff in an adult career makes attending school worthwhile and makes sense out of what might be otherwise irrelevant learning. Second, the school's "theme" (the term is from Hill [1990]) creates an identity for the school which gives faculty a meaningful purpose in education, motivates them to hold students to higher standards, and helps the school develop an integrated and coherent educational philosophy.

This is especially important in urban centers where working class and immigrant adolescents no longer go to work at age fifteen, but know they are most likely not going to go on to a four-year college. To many of these students, the traditional curriculum often seems irrelevant, and many of the educators serving these adolescents agree that the curriculum is excessively academic, as if it needed only to suit the middle class students who once were the sole recipients of secondary education.

Career magnets are an effort to improve the quality of high school education by making the school more clearly dual purpose; by meeting career needs as well as academic ones, it makes the school's education more relevant and, hence, encourages students to learn more in their academic classes because they are spending part of their day learning material relevant to a possible career future. All of this leads proponents of career magnets to argue that students will learn more academic material, reflected in higher achievement test scores; they will be less likely to drop out of school; and they will be willing to take more classes and invest more in learning. At the same time, proponents argue that the school itself will be driven to set higher standards for its students and invest more in teaching, since the school now has two client constituencies concerned about the quality of its graduates: the college admission officers, who are the traditional clients of academic high schools, and employers.

Proponents of career magnets find themselves in philosophical agreement with the advocates of apprenticeship (Hamilton, 1990) and the critics of modern society who argue that the industrialized countries, especially the United States, have created a prolonged period of adolescence which is harmful to young people and to society. The career magnet, they argue, is a way to connect young people to adulthood rather than to insulate them in a protective ghetto whose boundaries are defined by age.

This report is entirely based on statistical analysis, combining data provided by the board of education with a survey of program administrators. This analysis is reported in the section entitled, "What Schools Do Students Choose?" which describes the application process and gives data on the number of students applying to career magnets and the number admitted, and in the section entitled, "The Analysis of the Experiment," which presents the analysis of the experimental design and shows the impact of career magnets on students and the differences in impact of different types of career magnets.

Although this study shows that career magnets have an impact on students, the experimental design cannot completely explain *why* they have this impact. For this reason, the second part of our research is ethnographic, based on interviews with 132 students, teachers, and administrators. These interviews give us an understanding of why career magnets were effective in many respects and ineffective in others. This part of the study will be reported in our second report to be completed in the Summer of 1992.

WHAT SCHOOLS DO STUDENTS CHOOSE?

Robert L. Crain and Yiu-Pong Si

Eighth graders in New York City are confronted with what to the outsider looks like a bewildering array of information about their high school choices. An analysis of their choices, however, suggests that the system is relatively successful in providing students with the opportunity to choose their school. A surprisingly large number choose to attend some school other than their local comprehensive high school.

The application process begins in the Fall of the eighth grade, when all students are required to complete an application for high school. In it, they are given a checklist of the eight most prestigious programs in New York City,[1] and then given space to write in eight other choices, either selective academic, vocational, or career magnet programs. Students are told that listing a program first (we will refer to this as their first priority choice) increases their chance of being admitted.[2] Students are given copies of their applications for review twice during the next three months.

In January, Educational Testing Service in Princeton randomly selects students for admission to career magnet programs from the electronic file of student applications. The computer program they use assigns a four-digit number to every student who has applied to a particular program. The first digit of the number is the priority level of the students' choice—"1" if this program is the student's first choice—and the remaining three digits are random. Students with the lowest random numbers are offered seats. Thus, a student who applied to eight career magnets would receive eight different numbers, one for each program.

Each program states the number of openings it has. These are then allocated as follows: two-thirds to average readers and one-sixth each to above-average and below-average readers. One-half of those seats are allocated for random selection; thus, if the school has twenty-four openings for below-average readers, the students with the twelve

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[1] These are Bronx High School of Science, Brooklyn Technical High School, Stuyvesant High School, and the five performing arts programs at Fiorello LaGuardia High School of the Performing Arts.

[2] The reason why the eight most prestigious schools are listed separately on the application is so that students will not have to use up their first choice and other priority choices if they want to apply to some of these schools.

lowest random numbers are offered seats. In many cases, these will all be students who made this school their first priority choice, since the number "1" entered in the first place of the four-digit number automatically makes all first priority choices lower than all second or higher priority choices. Second choices will be able to enter only if there are fewer first priority choices than there are vacancies in the school for randomly selected students. A waiting list is also selected in case there are more than the expected number of refusals by randomly selected students.

Once the randomly selected students have been removed from the file, the remaining applications are sent to the school, which selects (again with a quota of above, below, and on-level readers) those students they wish to have. The list of names randomly selected are sent by Educational Testing Service to the central board. Similarly, the school returns the list of applicants to the central board, checking off the students it selected and others for a waiting list. The two lists are co-mingled and students are notified that they have been offered places. After students have accepted or rejected places and students are selected from the two waiting lists as needed, a final list of students who have accepted offers is sent to the school. Those students whose reading scores are in the top two percent receive special treatment: automatic acceptance into their first choice school, whenever possible.

Note that the student does not know whether he or she was randomly or school selected, and the school is not told which names on the list are randomly selected or which ones were selected by the school. It would be possible, of course, for the school to keep their own private record of all the students that they had selected in order to be able to distinguish school-selected from randomly selected students, but we doubt that any school does this, since it would require badly overworked guidance counselors to do a good deal of work for no particular purpose. Thus, the process is kept anonymous with both the student and school probably unaware of who is randomly selected and who is not.

What Programs Do Students Prefer?

Table 1 shows that eighth graders in public school expressed a wide range of preferences. Here we analyze the student choices among the eight highly selective programs, or their first write-in choice if they selected none of the highly selective school

programs. We present data only for students who are *not* in the top two percent of reading scores. Table 1 divides students' first choices into ten types of schools—comprehensive schools; schools for students wanting special teaching such as bilingual schools, alternative schools, or special education schools; and eight different kinds of magnet schools. As the table shows, a quarter of the students in New York City gave as their first choice one of the three highly selective academic high schools, and seven percent chose LaGuardia School for the Arts. An additional nine percent chose a slightly less prestigious selective academic or arts program. Together, these four choices make up forty-one percent of students' first choices. Twenty-three percent of the students chose a career magnet school. The eight freestanding magnet schools received almost as many first choices as the one hundred or so programs located in comprehensive schools around the city or the small number of career magnet programs located in vocational schools. Finally, ten percent of students chose a vocational school. Eight percent of all students chose a program specializing in bilingual education, special education, or alternative education. Only eighteen percent of all students chose their neighborhood comprehensive schools.

Table 1

Attractiveness of Different Types of Programs

Types of Programs	**Percent Who Selected as Their First Choice**
Comprehensive Schools	18%
Alternative/Special/Bilingual	8%
Vocational	10%
Highly Selective Arts *	7%
Other Arts Programs	2%
Highly Selective Academic **	25%
Other Academic	7%
Career Magnets in Vocational Schools	1%
Career Magnets in Comprehensive Schools	12%
Career Magnets in Career Magnet Schools	10%
Total (N = 46,688)	*100%*

Note: * = the five programs at Fiorello H. LaGuardia High School of the Arts
** = Bronx High School of Science, Brooklyn Technical High School, and Stuyvesant High School

Another way to look at the school choices is to say that fifty percent of all New York City eighth graders want to attend a traditional academic high school—eighteen percent their local comprehensive high school where typically only a small amount of their school work will be vocational training and thirty-two percent in a selective school. The large number of choices in these areas are partly the result of New York City having perhaps the most prestigious academic and arts schools in the country—Bronx High School of Science and LaGuardia High School, star of the popular 1980s television show *Fame*, may be the best known schools in America.

Within these broad categories, students can select schools that specialize in particular academic areas such as science or literature. They can also choose among a wide variety of career preparation programs in schools with names such as the High School of Fashion, Aviation High School, and, in a city with a huge mass transportation system, East New York High School of Transit Technology, otherwise known as "Transit Tech."

About a third of all students elected career training in either a career magnet program or a vocational program; they chose computers (10%), health (7%), and business (6%) most often. Less than a tenth of all students elect a program which trains them for a blue-collar craft. Table 2 gives a detailed breakdown of the first choices of eighth grade students among all the magnet programs. The table is based on the 38,217 eighth graders who chose a magnet school; 46,688 application forms were filled out, but the remainder elected to attend their neighborhood comprehensive schools.

It is not easy to use this data to decide how many students are attracted to a particular field. In some cases, a student may choose a particular career program simply to avoid the rough climate of their neighborhood school. Many white and some minority students will have no interest in a school with too many opposite-race students. It is also unclear how many students are making choices based on the prestige of the school rather than its career specialty. For all these reasons, it is difficult without detailed study to predict from this data what preferences students in another city, without such unique New York City factors as LaGuardia High, a very large mass transit system, and with more or fewer desegregated schools, would have.[3] It does seem clear from Table 2 and the other

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[3] We would nevertheless recommend that any city planning a magnet high school program make the investment in studying the New York City data, which is quite complete and extremely valuable as "market research." Of course, it is not easy to conclude from this what students' true preferences are, for the reasons

data presented in this section that vocational programs would rarely have the attractiveness of career-magnet programs which offer white-collar career training and a chance to attend college.

Table 2

In 1988, Students Who Selected Magnet Programs Chose the Following Fields of Study

Fields of Study (Number of Programs)	Percent Choosing Each Type of Program
Academics	
General Academics (18)	25.0%
Science (10)	11.0%
Writing (3)	.5%
Literature (1)	.0%
Language (1)	.1%
International Studies (3)	.3%
Subtotal	*37%*
White-Collar Careers	
Computers (22)	10.0%
Business (22)	6.0%
Medicine (7)	3.0%
Health (14)	4.0%
Veterinary Science(2)	.5%
Law (12)	4.0%
Engineering (9)	2.0%
Fashion (2)	1.0%
Communication(2)	.6%
Government (1)	.2%
Teaching (1)	.1%
Secretarial (7)	2.0%
Subtotal	*33%*
Athletics (3)	1.0%
Subtotal	*1.0%*

(continued on next page)

stated above and also because the students must choose only from what is offered and accessible, and the New York subway system does not connect every home to every possible school.

Table 2
(continued)

Arts	
General Performing Arts (3)	0.6%
Fine Arts (6)	3.0%
Visual/Graphic Arts (7)	0.7%
Music—Instrumental (7)	2.0%
Music—Vocal (4)	2.0%
Drama (5)	1.0%
Dance (4)	2.0%
Subtotal	*11.0%*
Blue-Collar Careers	
Agriculture/Fishing (2)	0.2%
Automotive (7)	2.0%
Aviation (3)	2.0%
Machinery (4)	0.0%
Drafting (5)	0.7%
Cosmetology (7)	0.9%
Foods (1)	0.1%
Building Maintenance (9)	1.0%
Mass Transit (1)	0.3%
Exploratory Vocational (5)	2.0%
Subtotal	*9.0%*
Alternative/Special/Bilingual	9.0%
Subtotal	*9.0%*
Total (N=38,217)	*100.0%*

Note: Students who chose to attend their neighborhood comprehensive high school are omitted from this table.

How Many Students Get Into Magnet Schools?

Because of the large number of career magnet programs in New York City, these programs are less selective than the other types of college-preparatory magnet schools. Table 3 shows the chance of being admitted into one's first-choice program. The chance of being accepted into the city's most exclusive schools is quite small, since these schools

have an extremely large number of applicants.[4] The other selective academic programs take only one of four applicants who made these schools their first choice. Career magnet programs in total magnet buildings are slightly less selective, taking three of every eight applicants; however, the career magnet programs located in comprehensive schools, which are the majority of the programs, take over half of their applicants. Application and acceptance rates vary widely from one career magnet program to another. A criminal justice program in a comprehensive school had 2,813 applicants for seventy-four openings. The secretarial and word processing program at another school had 2,351 applications for 101 seats, while a shorthand program at a third school was unable to fill its thirty seats.

Table 3
Likelihood of Obtaining First Choice Selection,
By Types of Programs

Types of Programs	Chance of Being Accepted To Their First Choice
Highly Selective Arts *	2%
Highly Selective Academic **	6%
Other Academic	26%
Other Arts Programs	24%
Career Magnets in Career Magnet Schools	37%
Career Magnets in Comprehensive Schools	58%
Career Magnets in Vocational Schools	87%
Vocational	45%
Bilingual	58%
Special Education	48%

Note: * = the five programs at Fiorello H. LaGuardia High School of the Arts
** = Bronx High School of Science, Brooklyn Technical High School, and Stuyvesant High School

Students seem aware that they are not likely to get into their first choice programs and among students who apply to magnet programs, the median number of program choices is between five and six. The result is that three-quarters of all students who apply to magnet schools wind up accepting an offer from one. The results of the application process appear in Table 4, which shows that only thirty-eight percent of all students said

[4] While this data makes Bronx High School of Science and its sister schools seem more selective than Harvard College, bear in mind that Harvard has an application fee.

they would be attending comprehensive schools in the Fall—eighteen percent initially chose to and twenty percent were either not admitted to any magnets or changed their mind after being admitted. Meanwhile, thirty-six percent planned to attend a career magnet school. Of every twenty students entering high school, eight will go to comprehensive schools; seven to career magnets; two to vocational schools; two others to selective arts or academic schools; and one to an alternative, bilingual, or special education program.

Table 4

Only a Minority of New York City's Entering Ninth Graders Were Planning to Attend Comprehensive High Schools

Types of Programs	Percent Planning to Attend
Comprehensive	38%
Alternative/Bilingual/Special	5%
Vocational	10%
Highly Selective Arts *	1%
Other Arts Programs	2%
Highly Selective Academic**	2%
Other Academic	5%
Career Magnets in Vocational Schools	1%
Career Magnets in Comprehensive Schools	29%
Career Magnets in Career Magnet Schools	6%
Total (N=46,688)	99%

Note: * = the five programs at Fiorello H. LaGuardia High School of the Arts
** = Bronx High School of Science, Brooklyn Technical High School, and Stuyvesant High School

Since it is school board policy to require most programs to accept students from all reading levels, we should expect students with high, average, and low reading scores to be more or less equally distributed among the various types of schools listed in Table 4, except of course for the highly selective schools. However, there is a slight bias against both the high and low readers and in favor of the average readers because of two peculiarities in the allocation of seats. First, the students whose scores put them in the top two percent of the distribution are given automatic acceptance into virtually any school. Even so, these students' admissions are counted as part of the allocation for above-average

students, meaning that students whose scores place them in the above-average category, but not in the top two percent, have a lower chance of admission than do students in the average range. Second, about one-fifth of all students do not have reading scores. These students must be allocated to a reading group; the only reasonable assumption is the one presently used, which allocates them to the below-average group. However, this more than doubles the size of the low group, effectively halving the chances of any one member of the group being offered admission to a career magnet.

Although these sources of bias seem obvious, their impact is with one exception small. Table 5 shows the distribution of students from each of the three reading levels in the different types of schools and programs. (The distribution of students whose reading scores are in the top two percent of reading scores is not shown.)

Table 5
Distribution of Ninth Graders by Reading Level into Different Types of Schools

Types of Programs	Percent Planning to Attend		
	Reading Level		
	Above Average		Below
Comprehensive	37%	38%	39%
Alternative/Bilingual/Special	0%	2%	13%
Vocational	7%	13%	6%
Highly Selective Arts *	3%	1%	0%
Other Arts Programs	2%	3%	1%
Highly Selective Academic **	15%	1%	0%
Other Academic	10%	5%	3%
Career Magnets in Vocational Schools	1%	2%	1%
Career Magnets in Comprehensive Schools	20%	29%	33%
Career Magnets in Career Magnet Schools	6%	6%	3%
Total (N=46,688)	*101%*	*100%*	*99%*

Note: * = the five programs at Fiorello H. LaGuardia High School of the Arts
** = Bronx High School of Science, Brooklyn Technical High School, and Stuyvesant High School

The one case where bias is apparent is the small number of students with low or missing scores in the total magnet schools. Only three percent of these students were going to attend these schools, although six percent of the other two reading groups were going to magnet schools. Another peculiarity in the distribution which might reflect bias in admission is that only twenty percent of the students in the high reading group were entering the career magnets in the comprehensive schools. However, this may not be because of the bias that the reading level distribution formula seems to contain; it may be because these students have less interest in these programs. A large fraction of the high reading group is white, and most of the career magnets are located in comprehensive schools with large minority populations.

Surprisingly, thirty-three percent of the students with low or missing reading scores are in career magnet programs in comprehensive schools. The school board regulations require that the random assignment process select enough low readers to make up eight percent of the total program enrollment and requires the school to also select a minimum of eight percent. The high number of students with low reading scores implies that these programs are selecting more low readers than they are required to take. (For example, the head of a cosmetology magnet told us she preferred to take students with weak academic skills.) It should be noted that many students with low or missing scores may be good students; many are immigrant students whose nonverbal performance would be much better than their reading scores, others may have reading difficulties but be well-disciplined and cooperative, and others may be excellent readers whose scores are simply missing.

If bias is a problem, the most popular career magnets should have a shortage of both below-average and above-average readers. We do not have a measure of program popularity. We do know that the total magnet schools are generally more popular than the career magnets in comprehensive schools; students with low or missing scores are underrepresented there, but students with high reading scores are not. In a future report, we will try to examine whether students from these two groups are less likely to attend the most popular comprehensive school career magnet programs.

THE ANALYSIS OF THE EXPERIMENT

Robert L. Crain and Yiu-Pong Si

In this section, the results of the statistical analysis of student outcome data are presented. The statistically significant differences in educational outcomes between the students who were and were not randomly accepted into the career magnet schools are shown. This data is then used to estimate the effects of attending a career magnet school. Afterwards, the results of separate experimental design analyses of programs with different curriculum features are displayed in order to explain why and how career magnets are effective. The principal finding is that students of average reading performance who would not have been accepted by the career magnet admission committees benefit from having the opportunity to attend these programs.

The Necessary Conditions for an Experimental Design

The random selection process in New York City fulfills the conditions of a standard experiment such as is done in social or medical research or in many sophisticated evaluations of social programs.

There are three necessary conditions for a randomized experiment. First, there must be an identifiable pool of students, all of whom have exactly the same opportunity to be randomly selected for admission to the program. Second, there must be a random selection process which selects some of the students and leaves some behind. Third, the group that is selected must receive an educational treatment which is different from that received by the students who are not selected. Let us demonstrate how these three conditions are met in the case of the career magnet admission process.

First, what group of students constitutes a pool whose members have equal probabilities of being selected? We should note that we are studying the impact of high school programs on ninth graders, and many ninth graders in New York City are in junior high schools, unaffected by career magnets. Consequently, we must limit our study to those students who attended middle schools, which do not have ninth grades.[5] The answer

[5] Junior high school students are given the opportunity to apply to high school at the end of eighth grade, and many do; but if they are not admitted to the school of their choice they frequently choose to stay in

is the group of students who applied to a particular program, have the same reading level, and applied to the program with the same priority choice. We cannot compare students who are at different reading levels because the probability of selection is a function of the number of vacancies and the number of applicants at each reading level, and, therefore, will be different for each reading level. Similarly, the students who applied to a particular program as their first choice have a higher probability of being selected than those who applied to it as their second choice, and, therefore, those groups could not be combined. Finally, the number of applications and the number of vacancies in any two programs will differ so that applicants to differing programs have different probabilities of winning the lottery, and comparisons across programs are not appropriate.

The second condition is that the students in the pool must be randomly divided into "treatment" and "comparison" groups. This condition is met by the Educational Testing Service random number allocation. However, many pools of students do not meet the condition of having both randomly accepted (lottery winners) and randomly rejected (lottery losers) students. For example, the students who used their second choice to apply to a very popular program would not make up an experimental pool because none of them would be randomly offered seats—all seats being taken by first-choice applicants. We would have no comparison of treated students to nontreated students. Conversely, the students who chose an unpopular program as their first choice would not create an experiment because none of them would have been randomly rejected. These groups of students are excluded from the analysis.

For simplicity, we will use the terms "lottery winners" and "lottery losers" to refer to treatment and comparison students, although New York City does not refer to the random assignment process as a "lottery."

The final condition, that the randomly accepted students receive an educational treatment which is different from those who are randomly rejected, is met in an unusual way. In fact, not every student who is randomly offered a seat will accept it—some will choose to go back to their comprehensive school or go to some other school. At the same time, not every student who is randomly rejected will return to his or her comprehensive

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junior high, where they are given a second chance to apply to high school during the ninth grade. Thus, a study of the ninth grade outcomes of junior high school lottery winners and losers would essentially be a study of the difference between attending a high school and attending a junior high school, rather than a study comparing career magnets to comprehensive high school programs.

school; that is, some will be randomly accepted into their second-choice schools and others will be selected by one of the schools they applied to. However, a student who is randomly offered a seat in his first- or second-choice program is considerably more likely to accept and attend a career magnet school than a student who is not randomly offered his first or second choice.[6]

This means that the experiment will allow us to compare one group of students, the lottery winners, most of whom have been educated in career magnet schools, to a comparison group of students, the lottery losers, most of whom have not been educated in career magnet schools. If career magnet schools are effective, this beneficial effect is likely to be large enough to pull up the average performance of all the students in the randomly selected group, even when those randomly selected students who did not attend a career magnet school are included. This means that the results of our analysis will underestimate the magnitude of the effect, and, hence, underestimate the likelihood of a result being statistically significant. The size of the underestimate is discussed in the "Summary of Outcome Tables" section.

Table 6 shows the difference in schools attended by the lottery winners and lottery losers in our sample. As we would expect, the lottery winners are much more likely to attend career magnet programs than are the lottery losers. Lottery losers do go to career magnet programs thirty percent of the time, either by winning the lottery for one of their other choices or, more often, by being selected by a school; an additional four percent attend selective magnets; and eight percent attend vocational schools. In contrast, eighty percent of those who won the lottery went to a career magnet, two percent went to selective schools, and three percent went to vocational schools.

In order to carry out the study, we had to identify all of the separate pools of students which constituted valid experimental designs. We had a large number of potential experimental pools; specifically, we might have had as many as 3,192 separate pools (three reading levels times eight priority choices times 133 programs). In fact, the majority of these pools either had no applicants in them or did not meet the other conditions required of

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[6] This is not true in every pool. There were a few pools in which a large number of lottery losers received offers from career magnet schools. We did not include these pools in the study, since these programs had too few random rejects who did not receive a magnet school education, and, hence, did not meet this third condition.

an experiment—for example, in all the pools of students' third or higher choice levels, very few students were admitted randomly, and, therefore, there could be no comparison of randomly accepted and randomly rejected students.

Table 6
Final Destinations of Lottery Winners and Losers

Final Destination	Lottery Winners	Lottery Losers
Career Magnet Schools	35.4	8.8
Career Magnet Programs in Comprehensive or Vocational Schools	45.0	21.2
Subtotal	*80.4%*	*30.0%*
Selective Academic or Art Schools		
Subtotal	*2.1%*	*4.1%*
Vocational Schools	2.7	8.3
Comprehensive Schools	14.3	57.0
Subtotal	*17.0%*	*65.3%*
Total	*99.5%*	*99.4%*
(N)	(1304)	(3734)

It is important to note that it is possible for the same student to be analyzed as part of two different experiments. They only had to choose a career magnet where some but not all students were randomly admitted as their first choice, and then choose as their second choice a less popular school, where all first choice students were offered seats and the lottery had to reach into the second choices to get enough students to fill the school's random quota. Students who appear in two experiments are given .5 weights in each so that they will not be counted as if they were twice as important as other students. We found that only first-choice and second-choice pools ever provided a sufficient number of applicants who had been randomly accepted, a sufficient number who had been randomly rejected, and, meeting the third condition, a sufficient number of randomly rejected students who did not attend a career magnet school. Our rule was that a pool could be used as an experiment only if it had at least four randomly accepted students and at least four

randomly rejected students, and if a majority of its randomly rejected students did not accept a seat in a career magnet school or other selective school program.

The experiment included ninety-one pools of students: 3,272 students with average reading scores in forty-four different school programs and 986 students whose reading tests put them in the bottom sixteen percent or who had not taken the required reading test in forty-seven school programs.

All of the usable pools were of students whose reading levels were average or below average. We were unable to construct a legitimate experimental design for the top reading group. We do not know why we were unable to do this; there are certain complicating factors for above-average students: (1) a very large number of these students applied to the highly selective academic and arts schools; and (2) students in the top two percent of reading were automatically given their first choice and excluded from the lottery. It is not clear why these two factors should make a difference, but they may have resulted in some bias being introduced into the data. We were unable to divide the above-average students into genuinely random experimental treatment and comparison groups and, therefore, discarded this reading level.

Because the number of lottery winners and lottery losers differs for each pool, we cannot combine the different pools in the analysis. Pools were kept separate either by using the pool as a second independent variable in an analysis of variance or by using multiple regression in which data is aggregated to the pool level (i.e., each data point in the regression is a pool, rather than an individual student).

Is the Experiment Unbiased?

The randomness of our experimental design is tested in Table 7, which shows the results of an analysis of variance measuring the effect of being a lottery winner on eighth grade performance. Since the students were randomly selected after they had completed the eighth grade, there should be no difference between those randomly selected and those randomly rejected. The data is presented separately for all the program experiments combined, for those located only in total magnet schools, and for those located only in comprehensive high schools. Within each category, we present the results separately for

students with average reading scores and those with below-average or missing reading scores. Each cell shows the relationship (in this case a standardized regression coefficient, beta) between being a lottery "winner" and one of the pretest variables, computed by an analysis of variance in which the particular "pool" that the student is in is controlled.

Table 7

Lottery Winners and Lottery Losers are Not Significantly Different on Eighth Grade Performance

Relationship Between Winning the Lottery and Pretests (Betas)

Eighth Grade Performance	All Career Magnets (Wtd. N=4,258)		Freestanding Magnets (Wtd. N=2,254)		Magnets in Comprehensive Schools (Wtd. N=2,004)	
	Reading Levels					
	Average Wtd. N=3,272	Low Wtd. N=986	Average Wtd. N =1,864	Low Wtd. N=390	Average Wtd. N=1,408	Low Wtd. N=596
Reading (STD)	.03	.02	.02	-.06	.02	.01
Reading (DRP)	.00	-.01	.01	.01	-.03	-.01
Mathematics (STD)	.00	-.03	.01	-.01	-.02	-.04
Mathematics (MAT)	.00	.02	.01	.08	-.03	-.02
Grades	.00	.02	.02	.08	-.03	-.02
Absence (Biofile)	-.01	.06	-.02	.09	.01	.04
Absence (Application)	.00	.07	-.01	.07	.02	.06

Note: No statistically significant relationships.

The betas (whose magnitudes are very close to the values of simple correlation coefficients run on the same data) are generally quite small—the median value is .02—and there are no statistically significant differences on the seven pretest variables (i.e., the Degrees of Reading Power test; a second standardized reading test; the Metropolitan math test; a second standardized math test; the composite of the student's grades in English, math, and social studies; and their eighth grade absenteeism, reported in two different ways) in any cell of the table. The median probability of the measured difference is .56. Not only is the probability far removed from the .05 required for statistical significance, it is almost exactly .50, which would be the probability if the effects were generated by a random number generator. There is a slight tendency, not statistically significant, for lottery winners with low reading scores to have higher absenteeism in middle school. Thus, the experiment is biased slightly against the magnet schools, and, because of this, in part of our analysis of ninth grade outcomes we will control on eighth grade absenteeism. However, since these betas are not statistically significant, we have no reason to believe that our experimental data is not genuinely random.

Ninth Grade Outcomes

This evaluation uses the available official data on the ninth-grade performance of the students. We measured the impact of career magnets on seven measures of ninth-grade performance. The first four rows of Table 8 show (row 1) the percentage of lottery winners and lottery losers who continued in school by entering high school after the eighth grade; (row 2) the percentage changing high school in the ninth grade; (row 3) the percentage dropping out of high school; and (row 4) the percentage passing the advanced Regents mathematics test. Row 5 shows the increase between eighth grade and ninth grade in mean number of days absent; row 6 shows mean reading test performance; and row 7 shows the number of credits earned toward graduation in the ninth grade. The last three measures—absenteeism, reading, and credits earned—are all statistically adjusted to remove differences in eighth-grade performance, thus reducing the amount of random error variance in those measures and removing much of the small bias in absenteeism rates observed in Table 7. The percentages and means in Table 8 are taken from an analysis of

variance, which removes any difference between the winners and losers resulting from differences in the number and quality of students applying to the different programs.[7]

Table 8
Effect of Career Magnets
on Ninth Grade Student Outcomes:
Analysis of Variance of All Career Magnet Programs

Outcomes	Students with "Average" Reading Scores (Wtd. N=3,272)			Students with "Below" or "Missing" Reading Scores (Wtd. N=986)		
	Losers	Winners	Diff. (W-L)	Losers	Winners	Diff. (W-L)
% Entering H.S.	86.00	89.00	+3.00**	77.00	83.00	+6.00*
% Changing H.S.	15.00	14.00	-1.00	20.00	19.00	-1.00
% Dropping H.S.	1.00	1.00	0.00	3.00	4.00	+1.00
% Passing Regents Math Test	7.00	7.00	0.00	3.00	6.00	+3.00**
Increase in Days Absent Since Eighth Grade	0.98	0.96	-0.20	0.62	1.75	+1.13**
Gain in DRP Reading Scores Since Eighth Grade	3.19	4.61	+1.40**	4.35	3.04	-1.31
Credits Earned Net of Pretests	3.88	4.18	+.30**	3.75	3.49	-0.26

Note: * = significant $p < .10$ (2-tailed)
** = significant $p < .05$ (2-tailed)

[7] This "standardization" of the data—using both treatment and pool as independent variables in the analysis of variance—is necessary because while each pool is an unbiased experiment, a simple combination of all pools together is not. If one program is very popular, then most of its applicants will lose the lottery. Because of this, these applicants will make up a larger fraction of all lottery losers and a smaller fraction of all lottery winners. If the applicants for this program have unusually good (or bad) academic records, their underrepresentation among lottery losers will make the entire group of career magnet programs appear ineffective (or effective).

Table 8 shows six significant posttest differences at the end of one year of career magnet schooling; five of these are positive effects, but one indicates a negative effect. It also gives the reader a measure of the magnitude of the effect of career magnets. For example, it shows that students with average reading scores who win admission to career magnet programs are three percent less likely to quit their education between middle and high school than are students with the same reading ability who lose the lottery. Additionally, it shows that the difference is six percent among students with low reading scores. All the measures in this and later tables are actually underestimates of the effect of attending career magnet programs. The differences between lottery winners and lottery losers are diluted because twenty-one percent of lottery winners do not enter a magnet school and thirty percent of lottery losers do enter one, mostly by being selected by a school admissions committee. This means the effect of winning the lottery is considerably smaller than the true effect of attending a magnet program, and, furthermore, that the estimates resulting from the experiment apply only to a certain class of students. In Appendix A, we analyze this issue and draw two conclusions:

1. The effect of attending a career magnet is determined in this experiment only for those students whose school record in middle school was not strong enough to gain them admission to a career magnet program without the lottery.

2. The effect of being admitted to a career magnet school on that group of students is approximately twice as large as the overall differences between all lottery winners and all lottery losers shown in Table 8 and other tables in this report.

The figures in the text and tables do not correct for this underestimation unless a correction is specifically mentioned.

Table 8 shows that students who were randomly offered seats in career magnets are less likely to drop out at the end of middle school: Only eleven percent of lottery winners with average reading scores did not appear in high school the following year, compared to fourteen percent of those who were not offered seats. Similarly, among students with low or missing reading scores, only seventeen percent of lottery winners do not enroll in high school, compared to twenty-three percent of lottery losers. Since the table percentages include data on students whose academic records would have qualified them for admission without a lottery, and the effect for other students is underestimated, a reasonable guess is that the dropout rate for students with average reading scores who were not qualified for

admission dropped by a fourth, from around twenty-two percent to around sixteen percent, if they won the lottery. Similarly, a reasonable estimate for students with low reading ability and inadequate academic records is that winning the lottery lowered their dropout rate from around thirty-six to around twenty-four percent. In both cases, the difference between the percentages, six percent and twelve percent, are about twice the measured difference shown in Table 8.[8]

The estimates may be biased. They suggest that being offered career magnet seats has a large effect on the dropout rate. These estimates probably exaggerate the effect slightly. Not all of the students who do not enroll in high school are dropouts. Some have moved from the city, some have enrolled in private schools, and some have moved with their family over the summer to a neighborhood where there is a junior high school which they attended instead of going to high school.

Once students with average reading scores arrive in the career magnet program, they begin experiencing two important benefits. First, they show a sizable improvement in their reading scores. The same reading test battery is administered in the Spring of both the eighth and ninth grades, and standard scores (with a standard deviation of ten) are recorded for both years. Students who did not win the lottery show an increase between eighth and ninth grade of over three points, about one-third of a standard deviation. In contrast, lottery winners show a gain of over four and one-half points, fifty percent greater. If we correct for the underestimation inherent in the experimental design, we conclude that the students in the career magnets gain over twice as much in reading as do similar students in comprehensive programs! See Appendix I for this analysis.

The school district also records the number of courses passed which carry credit toward graduation; the mean is 4.05 for all students, with a standard deviation of 2.0. The students with average reading scores who are offered seats take and pass 4.18 courses carrying credit toward graduation—significantly more than the 3.88 credits earned by the

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[8] One might wonder if we could not have removed the students with academic records strong enough to gain admission without a lottery from the experiment. The reason we could not have is because the lottery is conducted before the schools select the students they want, and, therefore, they do not make a selection from the lottery winners. We could identify the school-selected students from the lottery losers, but we could not decide which ones among the lottery winners would have been selected had there been no lottery.

lottery losers. The credits earned are adjusted for pretest differences in grades and absences.[9]

Unfortunately, the students with low reading scores do not benefit as much from random admission to the career magnet programs. The worst news is that lottery winners with low or missing reading scores have significantly more high school absences than those who did not receive random admission to the career magnets.[10] The result is not as negative as it appears, since some of this higher absenteeism rate can be attributed to the presumably lower attendance by the students who were encouraged to stay in school by winning a career magnet lottery.

The students with low reading scores do not show any improvement in either reading scores or graduation credits earned. In both cases, lottery winners do less well than students who were not offered seats, but the differences are not statistically significant. Note that we have only 986 students with low reading scores, some of whom are dropouts and, hence, have no reading posttests, so a fairly large slowdown in reading improvement does not reach statistical significance. We estimate that students entering career magnet programs with low reading scores show only one-half the gains of similar students who attended comprehensive programs.

Table 8 shows the impact of all career magnets taken together; the two following tables separate the effects of the career magnet schools from the effect of magnet programs located within comprehensive or vocational schools. Most of the career magnets in our study are schools-within-a-school, located in a comprehensive school (and in a few cases, in a vocational school). Some, however, are in freestanding magnet schools, where the whole building is devoted to a single career magnet program or to a group of career magnet programs. There is good reason to expect student outcomes to be different for the career

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[9] The technique used was to standardize middle school grades and middle school attendance, take the mean, restandardize it, and subtract it from the standardized number of credits earned. The result is a measure of the degree of over- or underperformance in credits earned compared to expectations based on middle school performance, expressed in standard deviations of credits earned; this is then destandardized and added to the mean number of credits earned, so as to give us an estimate of the number of credits which lottery winners and lottery losers would earn in the ninth grade if they came in with identical middle school records. Since their middle school records are not very different, the adjustment is not a large one.

[10] Because the number of days absent is a highly skewed variable, we converted the difference between middle school and high school absences to natural log (absences +1). After performing all calculations, we took the antilogarithms to estimate the change in the number of absences.

magnets in comprehensive schools than those in dedicated magnet buildings. The freestanding magnet has the advantage of having its own principal and not having to conform to schoolwide comprehensive school policies or compete with the school's comprehensive program for resources or students. The freestanding magnet school can more easily develop a program with a strong career focus because its larger size affords the economies of scale needed to purchase expensive equipment or create an extensive internship program.

Table 9 shows the result of being accepted randomly into one of the programs in the freestanding magnet schools, and Table 10 shows the outcomes for magnet programs located within comprehensive and vocational schools. The outcomes differ in some interesting ways.

While middle-school students who are admitted to either type of program are more likely to enroll in high school, the effect of career magnet admission on not enrolling is much stronger for the freestanding magnets. This is probably because they are larger and better known. The effect of receiving admission to a total magnet school program is especially strong for students in the low reading group; this group probably has fewer sources of information and, therefore, would be most influenced by the general popularity of a program.

Students in total magnet schools seem to take a more advanced curriculum. Those with low or missing reading scores are much more likely to take the advanced Regents mathematics exam than are similar students not in magnet schools, and those with average reading scores earn more credits toward graduation.

Students with average reading scores in magnet programs in comprehensive schools show a large improvement in reading compared to similar students who are not in a career magnet program. There is also a positive gain in the total magnet schools, but it is not statistically significant. Here we have a statistical dilemma: On the one hand, the lack of a statistically significant effect for total magnet schools means we cannot assume that total magnet schools increase reading performance. At the same time, the difference between the effects on reading growth on admission to a total magnet school program and admission to a magnet program in a comprehensive school is also not significant. That means we cannot assume that the effect of admission to a total magnet school program is

not equal to the effect of admission to a career program in a comprehensive school. In other words, the confidence interval surrounding +0.91, the estimated effect of admission to a program in a total magnet school, includes both 0 and +2.06, the effect of admission to a program in a comprehensive school. The most we can say about this is that there is reason to believe that admission to any career magnet program, whether in a total magnet school or a comprehensive school, is beneficial to reading growth, but there is not the same level of confidence in the results for total magnet programs as there is for programs in comprehensive schools.

Table 9

Effect of Career Magnets on Ninth Grade Student Outcomes: Analysis of Variance of Programs in Total Career Magnet Schools

Outcomes	Students with "Average" Reading Scores (Wtd. N=1,864)			Students with "Below" or "Missing" Reading Scores (Wtd. N=390)		
	Losers	Winners	Diff. (W-L)	Losers	Winners	Diff. (W-L)
% Entering H.S.	89.00	91.00	+2.00	77.00	90.00	+13.00**
% Changing H.S.	13.00	13.00	0.00	16.00	17.00	+1.00
% Dropping H.S.	1.00	1.00	0.00	1.00	4.00	+3.00
% Passing Regents Math Test	7.00	9.00	2.00	4.00	9.00	+5.00*
Increase in Days Absent Since Eighth Grade	0.86	1.16	+0.30	0.58	1.92	+1.34*
Gain in DRP Reading Scores Since Eighth Grade	3.50	4.41	+0.91	4.06	4.59	+0.53
Credits Earned Net of Pretests	4.10	4.66	+0.56**	3.84	3.70	-0.14

Note: * = significant $p < .10$ (2-tailed)
** = significant $p < .05$ (2-tailed)

Table 10

Effect of Career Magnets on Ninth Grade Student Outcomes: Analysis of Variance of Programs in Comprehensive and Vocational Schools

Outcomes	Students with "Average" Reading Scores (Wtd. N=1,408)			Students with "Below" or "Missing" Reading Scores (Wtd. N=596)		
	Losers	Winners	Diff. (W-L)	Losers	Winners	Diff. (W-L)
% Entering H.S.	85.00	89.00	+4.00*	79.00	80.00	+1.00
% Changing H.S.	17.00	14.00	-3.00	19.00	20.00	+1.00
% Dropping H.S.	1.00	1.00	0.00	4.00	5.00	+1.00
% Passing Regents Math Test	8.00	6.00	-2.00	3.00	4.00	+1.00
Increase in Days Absent Since Eighth Grade	1.20	0.79	-0.41	0.65	1.67	+1.02**
Gain in DRP Reading Scores Since Eighth Grade	2.68	4.74	+2.06**	4.56	2.00	-2.56
Credits Earned Net of Pretests	3.60	3.60	0.00	3.68	3.34	-0.34

Note: * = significant $p < .10$ (2-tailed)
** = significant $p < .05$ (2-tailed)

Both average and low readers, and both magnet program students and comprehensive students, are absent more in high school than they had been in middle school, but the increase is greatest for students with low or missing reading scores in career magnets. Some of this high absence can be explained by the fact that students who would have dropped out of school stay in order to attend the career magnets; these are no doubt students whose absence rate was always higher than other students. Furthermore, we think that absence rate is also affected by school factors, and the ethnographic study

indicated that some of the career magnets are more demanding and less tolerant of weak or unmotivated students.

In summary, we can safely conclude that the career magnet programs attract potential dropouts to high school, enable them to improve their reading scores, and give them a more difficult curriculum and more course credits. We can also safely conclude that students with low reading performance are both helped and harmed. They are more likely to make the transition from middle school to high school, but their absence rates go up. More of them pass an advanced math test, but many fall further behind in reading.

Discussion of Outcomes

Many of the effects of career magnet programs should be considered large (correcting for the underestimate of impacts). Adjusting for the underestimation discussed above, we would estimate that low readers who applied to, but were not accepted by the total magnets, are two to four times more likely to drop out or disappear from the New York City public school system between eighth and ninth grades than are those who did receive offers. In total magnets, a low reader is two to four times as likely to pass Regents math than he would be if he were in a comprehensive school. Average readers in magnet schools (whether total magnet or in schools-within-schools) increase their reading skills at a rate at least half again faster (perhaps twice as fast) than they would in regular schools. The average readers in total magnets earn one-fourth more course credits than the average student in regular schools. This considerably increases their chances of getting a high school diploma, since lack of credits is a main reason for students to drop out.

The negative effects on low readers are also educationally significant. The gap in reading ability between poor and average readers narrows during the ninth grade in comprehensive schools; in the career magnets it widens. At the end of ninth grade, a gap has begun to appear between the number of graduation credits earned by average readers and the number earned by low readers; this gap is greater in career magnet schools.

Which Magnet Programs Are Effective?
Why Are Career Magnets Effective?

There are significant differences among the career magnets in their effectiveness. Table 11 presents the significance level of the interaction terms in the three preceding tables. When the interaction term is significant, it means the difference in outcomes for lottery winners and losers is significantly greater for some programs than for others. The outcomes which are most likely to show significant interactions are those where the program policies have the most direct effect—the number of courses completed, which reflects school policy about advisement and grading, and the dropout rate, which in part reflects school policy about recordkeeping.

The variation among programs invites us to make a small "effective schools" study from our data. Since each program is a separate experiment, we can select groups of programs which have a common feature and examine their effects on student outcomes, much as we analyzed total magnets and magnets in comprehensive schools separately. We gathered the data with a telephone survey to each program administrator, asking a series of closed-format questions to gain information about each school's curriculum, resources, and teaching ideology. We obtained data on eighty-five programs. Unfortunately, we later found that many of these did not have the proper number of applicants to yield an experimental design. Even so, we had twenty-five programs where we had an experiment for average readers as well as survey data, and thirty programs where we had experimental results and survey data for students with low or missing reading scores.

The telephone survey we conducted (see Appendix II) attempted to answer seven questions:

- To what extent does the program attempt to establish its special theme by isolating its students into classes separate from the rest of the school?
- How much special equipment, including computers, do students use?
- To what extent does the program attempt to integrate career-oriented and academic learning?
- How much independent study does each student do?

- How often do students work in teams?
- How much employment placement does the program do?
- How supportive is the program director of random admissions?

Table 11

Variation in Impact Among Career Magnet Programs

Outcomes	Students with "Average" Reading Scores (Wtd. N=1,408)			Students with "Below" or "Missing Reading Scores (Wtd. N=596)		
	All Career Mags	Total Mags	Comp Mags	All Career Mags	Total Mags	Comp Mags
% Entering H.S.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
% Changing H.S.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
% Dropping H.S.	.01	.03	.08	n.s.	.01	n.s.
% Passing Regents Math Test	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Increase in Days Absent Since Eighth Grade	.03	n.s.	.04	n.s.	n.s.	n.s.
Gain in DRP Reading Scores Since Eighth Grade	n.s.	n.s.	n.s.	.03	n.s.	.04
Credits Earned Net of Pretests	.01	.01	n.s.	.06	n.s.	.05

(Significance of the lottery winner times program name interaction term in the analyses of variance)

After coding the data, we correlated each response with the various outcome measures for students with average middle school reading scores and students with low or missing reading scores. Since we assumed that our units of analysis were programs, rather than individual students, we had only fifty-five degrees of freedom, requiring very high correlation coefficients for statistical significance. Nevertheless, there are five findings (which will be highlighted as they are discussed) which help us interpret the analysis of the experiment.

It seems to us that these five are consistent with the idea that career magnets work because of their career focus. The findings seem to indicate that those programs which take their career commitment most seriously are the ones who show the strongest educational outcomes. We think that a career-focused program will be one which isolates its students from the regular curriculum and from students who do not share the program's career focus; which provides students with the special teaching and equipment which career training requires; and which provides placement services for graduates. From the analysis that follows, there seems to be modest evidence that programs with strong career focuses show the greatest outcomes.

1. **If keeping students separate from the rest of the school is an indication of the program being committed to a career focus, then a program with a strong career focus encourages middle school students with low or missing reading scores to attend high school.**

In Table 12, we show the percentage of middle school students entering high school separately for programs where the administrator reported that their students took most of their classes separated from the other students in the school. In the leftmost three of the six columns of data, we show the results for all students in the experiment, repeated from Table 8. This data shows that lottery winners are more likely to show up for high school than are lottery losers. The first row is for average readers and shows lottery winners three percent more likely to enroll in high school, while the second row is for students with low or missing middle school scores and shows lottery winners to be six percent more likely to enroll.

Table 12
Effect of Career Magnet Programs Which Provide Many Separate Classes For Magnet Students Only

% Entering High Schools Independent Variable: Number of Separate Classes

Dependent Variable	Reading Level	All Students (N=5,038)			Number of Separate Classes for Magnet Students		
		Win (a)	Lose (b)	Diff. (a-b)	"Many" Diff. (c)	"Few" Diff.(d)	Diff. (c-d) Stat. Sig.?
% Entering High Schools	Average	89	86	+3**	+0.30 (10)	+2.52 (15)	no
	Below or Missing	83	77	+6*	+19.43 (12)	-8.68 (18)	**

Note: s.d. = 39
* = $p < .05$ one-tailed
** = $p < .05$ two-tailed

In the fourth column of the table, we present the difference between lottery winners and losers, the same figure given in the third column, but only for the programs which kept its students isolated from the rest of the school. We had ten such programs with data on the high school enrollment of average readers, and twelve with data on the enrollment of low readers. In the fifth column, we give the difference between the high school entrance rates for lottery winners and losers again, this time among the students who applied to programs where students were not educated separately. The sixth column gives the statistical significance of the difference between columns four and five (i.e., the significance of the size of the impact on high school enrollment of programs which isolate students compared to the impact of programs which do not isolate students). The interesting news is the extraordinarily high increase in high school enrollment of low readers who won the lottery among applicants to programs which had many separate classes; the difference is nineteen percent, compared to an overall difference among all experiments of six percent. In contrast, students who won lotteries after applying to

programs which did not have a high emphasis on separate classes do not show a strong drive to stay in school; the difference is negative, meaning the lottery winners are less likely to enroll in high school than the lottery losers! The data for average readers shows no pattern. The last column of the table shows that the difference between the experimental results for programs with high and low numbers of separate classes is not statistically significant, while the difference in the effect of the two programs on low readers is statistically significant. There surely is a more-than-normal amount of random error in the results for low readers, but the pattern of results is far too strong to be discounted entirely.

We do not believe that middle school students are aware of whether a program has separate classes for its students, but we think that programs which do have separate classes are programs which have a self-conscious desire to establish a distinctive program, either because they want to train students for a particular set of careers or for some other reason. We think that programs which do that will impress students—especially students who do not read well and who probably are not interested in a conventional academic program. Students who search out programs with clear identities or career focuses may often be students with real misgivings about going to high school; for these students, winning or losing the lottery seems to often mean the difference between going to high school and dropping out or leaving the New York City public schools.

2. **If keeping students separate from the rest of the school is an indication of the program being committed to a career focus, then a program with a strong career commitment may be more successful in educating students with average reading scores.**

The evidence for this finding is in Tables 13 and 14. The formats of the two tables are identical to Table 12; however, Table 13 is based on a different question, this time asking not whether there are specialized classes which only magnet students take, but whether in schools which do not have a separate curriculum for their students, the courses offered to all students (presumably general academic classes) have special sections made up only of magnet students.

Table 13

Effect of Career Magnet Programs Which Provide Many Special Sections of Classes Reserved Only for Magnet Students

Gain in DRP Reading Scores Since Eighth Grade

Independent Variable: Number of Special Sections

Dependent Variable	Reading Level	All Students (N=5,038)			Number of Special Sections of Classes for Magnet Students		
		Win (a)	Lose (b)	Diff. (a-b)	"Many" diff. (c)	"Few" Diff. (d)	Diff. (c-d) Stat. Sig.?
Gain in DRP Reading Scores Since Eighth Grade	Average	4.61	3.19	+1.42**	+1.66 (10)	-2.26 (7)	**
	Below or Missing	3.04	4.35	-1.31	+1.56 (8)	-5.64 (8)	no

Note: s.d. = 10.68
* = $p < .05$ one-tailed
** = $p < .05$ two-tailed

In the analysis of the experiment, we learned that students with average reading scores in career magnet programs showed more improvement in reading than did similar students in comprehensive schools. Table 13 shows that this is only true where the program isolates its students into separate course sections.

The programs with more separate course sections have lottery-winning average readers who improve their scores by 1.66 more points than do similar students who did not win the lottery. If we correct for the underestimation in the experimental analysis, this implies that these students in these ten programs are improving their reading at over twice the rate of students in comprehensive schools.

We assume that when the magnet students are kept together in separate sections of a course, it is likely that more work will be given them, that the pace of work might be faster, or that a more highly motivated teacher may volunteer for that section of the class. This may be because the class is half filled with hand-picked students who are desirable because of their good attendance and good grades in middle school. It may also be because the program, being committed to producing a unique product with its student body, is striving harder, with teachers who are working harder and demanding more from the class. Last, but certainly not least, it may be that in programs where there is a strong commitment to a "theme" or career, the lottery winners are more motivated. This effect would then be magnified further, since the concentration of motivated magnet students in a single class may create a more favorable classroom climate.

The data in the fifth column of Table 13 shows that lottery winners with average test scores who enter magnet programs which have few separate sections of courses show no increase in the rate of improvement in reading—in fact, they lag behind students in comprehensive schools. Since the data is based on only seven programs, this large negative effect, which is statistically significantly different from the positive effect for programs which have separate sections, is not statistically significantly different from zero. In other words, we know that the students in schools with few separate sections have lower reading improvement than students in magnets with separate sections, but we do not know that they actually do worse than students in comprehensive schools. One not-implausible hypothesis: If students are in a special program with a specific career focus, but take their academic classes with comprehensive school students and teachers who are not associated with their program, they may feel that these are the unimportant classes in their schedule, and will do less work than their classmates from the comprehensive program. They may be putting their efforts into the special career-specific classes, which may not place great emphasis on teaching the kind of reading skills which are measured by reading tests. We should also note that students in programs which have their students take different courses than those offered the other students in the school do not show high reading gains. (This table, correlating reading gains with the question analyzed in Table 12, is not shown.) We do not wish to speculate on this finding, since it is not based on strong data and next year's study will give us stronger answers to this question.

The data for students with below-average reading scores is not statistically significant, despite the very large negative effect on reading for students in programs which

do not have separate sections of academic classes, and the positive effect for programs which do have separate sections. Because the results are not statistically significant, we believe it is wise not to attempt to interpret them beyond noting that they agree with the pattern for average readers.

Table 14 looks at the use of specialized classes—those designed for and offered to only the students in the career magnet. Whereas the last two questions asked about isolating students from other students in the school by placing them in different classrooms, this question asks whether they are taught different subjects.

Table 14 shows the relationship between having special courses taught only to students in the magnet program and the number of course credits earned during the ninth grade, and shows a complicated set of results. Nearly all career magnets have some special courses which only magnet students may take—it would be difficult to establish a claim to a career focus without at least a few special classes—but some have more than others. In Table 14, we compare programs which have over eight career-specific one-semester classes in four years with programs which have fewer than eight. The average readers in the nine career magnet programs which have fewer special courses do not earn the normal amount of course credits. The difference between these programs and the sixteen programs which have more separate courses is statistically significant using a one-tailed test.

This is another example of the general pattern shown in the two preceding tables, that magnet programs which isolate themselves from the rest of their school have more success educating their average readers. We are uncertain of the process which causes this to happen. Our ethnographic work suggests the possibility that students who have special classes will be motivated to take (or pass) more courses because they will feel that their education is special or likely to increase their career chances. Conversely, those who do not have special classes after having been admitted into a supposedly special program may be intolerant of "the same old stuff." A third possibility is that the career magnet which offers more career-specific courses may have an accelerated curriculum, making sure that its students earn enough credits as freshmen to allow them to take the specialized classes that their program requires in later years.

Table 14
Effect of Career Magnet Programs Which Provide Special Classes for Magnet Students Only

Credits Earned Toward Graduation Net of Background

Independent Variable: Use of More Career-Specific Classes

Dependent Variable	Reading Level	All Students (N=5,038)			Use of Special Classes for Magnet Students		
		Win (a)	Lose (b)	Diff. (a-b)	"More" Diff. (c)	"Less" Diff. (d)	Diff. (c-d) Stat. Sig.?
Credits Earned Net of Background	Average	4.18	3.88	+.30**	+0.10 (16)	-0.62 (9)	*
	Below or Missing	3.49	3.75	-.26	-0.98 (15)	+0.82 (10)	*

Note: s.d. = 2.06
* = $p < .05$ one-tailed
** = $p < .05$ two-tailed

The complication in Table 14 is that the effects of having special courses is very nearly statistically significant for students with low or missing reading scores, but in the opposite direction ($p < .05$ in a one-tailed test, but a one-tailed test is inappropriate here); here, the low-reading ninth graders who do have special classes are the ones who do not obtain normal amounts of course credit. Again, with this data limited to only one grade, we must be cautious, but this result seems to agree with the third conclusion below.

3. **If keeping students separate from the rest of the school is an indication of the program being committed to a career identity, then there is some evidence here that a program with a strong career commitment may be less successful in educating students with low reading scores.**

Table 15 looks at the increase in absenteeism in the ninth grade compared to the student's absenteeism in middle school in programs which do and do not have many special classes for magnet students. For average readers, whose increase in absenteeism is not significantly higher, being isolated from the rest of the school in career-specific classes is of no consequence. For below-average readers, whose absenteeism goes up more in magnet programs than it does in comprehensive schools, increasing absenteeism seems to occur only in programs with more career-specific classes.

Table 15
Effect of Career Magnet Programs Which Provide Special Classes for Magnet Students Only

Increase in Absenteeism

Independent Variable:
Use of More Career-Specific Classes

Dependent Variable	Reading Level	All Students (N=5,038)			Use of Special Classes for Magnet Students		
		Win (a)	Lose (b)	Diff. (a-b)	"More" Diff. (c)	"Less" Diff. (d)	Diff. (c-d) Stat. Sig.?
Increase in No. of Days Absent Since Eighth Grade	Average	0.96	0.98	-0.02	+0.25 (16)	-0.26 (9)	no
	Below or Missing	1.75	0.62	+1.13**	+2.10 (17)	-0.01 (12)	**

Note: s.d. = 5.89
* = $p < .05$ one-tailed
** = $p < .05$ two-tailed

This result seems surprising because it is separate classes which attract students with low reading scores to career magnets. One possibility is that programs with many career-specific classes set too many demands on weaker students or believe that weak students are unable to perform at the level that the career requires, and this becomes a self-fulfilling prophecy.

4. **If providing hands-on computer experience is an indication of the program being committed to a career identity, then a program with a strong career commitment may be more successful in motivating students to attend school.**

One question to the program heads concerned the amount of computer usage. Table 16 shows that for students with average reading scores, the presence of computer labs dramatically reduces absenteeism. We suspect that part of this is because computers are a symbol of career focus; students understand that computers are part of the world of work awaiting them and respond favorably to them for that reason. We also think that keyboard work is an opportunity to use motor skills, a tension release from the academic work of the rest of the day and often a chance for students who do not do well in traditional academic studies to show off a talent. It is somewhat surprising, and very worrisome, that this same pattern does not appear among readers who have low or missing reading scores. It may be that students of limited English proficiency find word processing, the most common initial training on the computer for ninth graders, too difficult.

5. **If providing more placement services is an indication of program commitment to a career focus, then programs with a strong career commitment may have lower dropout rates.**

Table 16

Effect of Career Magnet Programs Which Provide Computer Laboratories

Increase in Absenteeism

Independent Variable: Use of Computer Labs

Dependent Variable	Reading Level	All Students (N=5,038)			Use of Computer Labs		
		Win (a)	Lose (b)	Diff. (a-b)	"More" Diff. (c)	"Less" Diff. (d)	Diff. (c-d) Stat. Sig.?
Increase in Number of Days Absent Since Eighth Grade	Average	0.96	0.98	-0.02	-0.59 (11)	+1.15 (10)	*
	Below or Missing	1.75	0.62	+1.13**	+1.26 (15)	+1.41 (9)	no

Note: s.d. = 5.89
* = $p < .05$ one-tailed
** = $p < .05$ two-tailed

Table 17 shows that students with low reading skills respond favorably to the presence of placement programs for graduates. The high dropout rate for low readers in programs without placement programs suggests that the particularly difficult settings for poor readers are the programs which are more academic and less vocational in focus.

Table 17

Effect of Career Magnet Programs Which Provide More Job Placement Activities for Magnet Students

% Dropping Out of High School During the Ninth Grade

Independent Variable: Job Placement Activities Scale

Dependent Variable	Reading Level	All Students (N=5,038)			Provision of Job Placement Activities for Magnet Students		
		Win (a)	Lose (b)	Diff. (a-b)	"More" Diff. (c)	"Less" Diff. (d)	Diff. (c-d) Stat. Sig.?
% High School Dropout	Average	1	1	0	+1.59 (6)	+0.39 (9)	no
	Below or Missing	4	3	+1	-1.81 (19)	+4.30 (10)	*

Note: s.d. = 13
* = $p < .05$ one-tailed
** = $p < .05$ two-tailed

Summary

There are real differences among programs, and these differences affect their performance. In general the tables all support the view that any devices which serve to increase the program's emphasis on its career focus will motivate students who are able to keep up with the higher work demands, but perhaps alienate those with less preparation. Unfortunately, most of the evidence is based on measures of the degree to which the program isolates career-magnet students from the rest of the school. These tables are subject to a second interpretation: It may be that the effectiveness of isolating students into special classes reserved for magnet students is not an indication that a stronger career focus pays off, but only that isolating the students makes the higher performance level of the school-selected half of the career magnet program's student body have a stronger effect. Segregating "good" students enables teachers to pace material faster, leads to less time lost in classroom management, and enables students to benefit from informal peer-tutoring. If research on career magnets is continued next year, it may be possible to test this competing argument.[11] For now, we can only note that there is negative evidence on each side of the issue. On the one hand, this hypothesis essentially argues that segregating good readers into "high track" classrooms will improve their performance; however, there has been a great deal of research on the effects of tracking on reading test scores which has not supported this proposition. On the other hand, we would expect that if the correct explanation is that isolated programs have a stronger career focus, then a number of questions about career focus in the program administrator's questionnaire should correlate with student educational outcomes. We have found only two questions which do so; most of them do not.

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[11] It is possible that future statistical analyses will be helpful in settling this issue. The present data set excludes all students who were attending junior high school in the ninth grade and would perhaps enter a career magnet school in the tenth grade. If future work is done on tenth grade outcomes, these students will be included, markedly increasing our sample size and probably increasing the number of statistically significant findings in the data. With a larger sample, the pattern of relationships among the findings may become clearer and there will be opportunity for multivariate analysis to test this and other hypotheses suggested by this data.

CONCLUSIONS

Robert L. Crain

Are Career Magnets a Good Idea?

We have demonstrated in this report that the present set of career magnets in New York City benefit the students who want to attend them and who would normally be turned away by school admission committees. In the analysis of the experimental design, we found that at least during the ninth grade, the career magnets encouraged students to stay in school, raised reading scores, provided opportunities for more students to pass the advanced math tests, and gave students more credits toward graduation. The one drawback we discovered is the high absenteeism of students with poor reading scores in these programs.

Even so, this is not the same as saying that American education would be better if more career magnets were built. Addressing that question requires us to be precise about the assumptions we are willing to make about some indeterminable factors. Let us reword the question as follows:

> Would it be a good idea if other big cities with populations like New York City's created a collection of career magnet schools with lottery admission?

The answer to this question is almost certainly yes. The theory is that providing students with education which is relevant to their future careers is effective in motivating them to stay in school, see their schoolwork as important, and become more serious in thinking about and planning for their futures. The lottery winners are presumably more motivated in class by the clear sense of purpose and the hope of future career prospects. Keeping the magnet students together in a small program contributes to a good classroom climate and allows positive peer influences to work.

Of course, the theory is only theory; however, the positive results from the randomized experimental outcomes for the ninth graders who entered in the Fall of 1988 are important because they have little chance of being biased.

There is one caveat, though. The experiment clearly shows in an unbiased manner that students who are offered admission to a career magnet program through random

assignment benefit. This does not unequivocally imply, however, that the overall educational performance of all New York City students has improved as a result of the introduction of career magnets. The gains for students in the career magnets may have come at the expense of the students remaining in the comprehensive schools. Because they are allowed to select half their enrollment, the career magnets are getting more than their share of the better students.[12] In the jargon of the school choice literature, the career magnets are "creaming" the comprehensive schools of their better students, leaving the comprehensive schools with a weaker student body. Just as the students in the career magnets are probably benefiting from the positive influence of a better-than-average group of peers, the lottery losers back in comprehensive schools may be being harmed by going to school with students with poorer-than-average records. We have no way to estimate the size of this peer context effect, but some prior research argues that it is strong.[13] If peer context effects are powerful, the gains experienced by the lottery winners in the career magnets are offset, leaving the total New York City school population in the same place where it began. This study cannot test this hypothesis.

We have noted three reasons why we think the lottery winners benefit from the school curriculum and programs rather than just from being part of a better student body. First, some of the gains such as the higher rates of passing the Regents math exam and higher number of course credits earned seem to be outcomes which are mostly affected by school programming and advising practices. Another outcome, not dropping out, occurred before entering high school and cannot have been affected by contact with the high school student body (although it could have been affected by a program reputation based entirely on the quality of the student body). Third, we found the experimental design effects on student outcomes to be stronger in programs where resources were put into the career focus of the program (computers and placement). Program size is probably not related to selectivity, and the programs which offer students more keyboarding and postsecondary job placement are probably not those with the highest student body reading level. Thus, we are persuaded that there is a "career" effect here, and that the results cannot be entirely explained as merely the benefit of a positive school environment created by selecting good

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[12] The career magnet is able to select students within each reading level on the basis of grades and attendance records, which are probably as good or better than reading scores in predicting high school performance.

[13] The best known study is, of course, the original "Coleman Report" (Coleman et al., 1966); there has been much debate about this issue.

students. We will be able to draw a more conclusive answer in some more complex analyses planned for the tenth and eleventh grade experimental design data.

Can the Career Magnets be Modified so that They Will Better Serve the Needs of Students with the Lowest Reading Scores?

Not all the news from the career magnet programs is good, however. There is some evidence that the career magnets are not doing a good job of educating their academically weak students. We only have experimental data for the ninth grade, so it is important to wait until data for later years is made available. Earlier ethnographic work by Mitchell, Russell, and Benson (1989) and the telephone survey of program administrators all support the experimental results.

It is important not to exaggerate the problem. Our evidence is that absenteeism is up for the students with low reading scores, but they are more likely to be in high school than lottery losers of similar reading levels, so we know that some lottery losers with a predisposition to miss schools do not show up as absent because they have dropped out. Lottery winners with low reading scores are also more likely to have passed the advanced math exam. The bad news is that they are not showing the same benefits in reading scores and credits earned as average readers. The educators in the career magnets are themselves divided on how to deal with weak students; many feel that the career magnets are being harmed by their presence, and that it is not possible for them to meet their program goals with these students. At the same time, many other teachers believe it is possible for the career magnets to solve the problem by developing stronger remedial services. (It is important to remember that career magnet programs do not get a larger budget than do comprehensive schools, thus, they generally feel that they need to spend whatever uncommitted funds they have on providing special resources for their career focus.)

It seems likely that educational opportunities for low-achieving students can be improved, but this is a complex issue. There is considerable opposition among teachers and administrators to the decision to admit weak students to the career magnets, and many administrators told us that random assignment had damaged their programs. We do not know whether they are right or not, but they are trained educators who have first-hand

experience. If they are right, then it may be that improving education for low readers can only be done at the expense of the quality of the program for other students. On the other hand, we know that certain types of efforts are successful with students with low and missing reading scores. For example, programs with strong employment placement programs seem to have good "holding power," apparently reducing dropouts among low readers. There is no obvious reason why placement efforts could not be adopted in more schools, and this effort would presumably be something that would not trade off the quality of other students' education in order to help low readers. (It might reduce the quality of others' education, however, if funds were moved from the existing program to fund placement efforts.) Future research on these schools will show whether the effects of placement efforts hold up in the later years of high school, and perhaps will identify other "exportable" school efforts which seem effective for low readers without harming other students.

One lesson for other school districts lies in the difference between the older and younger magnet programs in their reaction to randomly assigned students. The older programs were established before random assignment, and have been less accepting of randomly assigned students. The new programs, which never had the experience of having a totally selected student body, have been more accepting. This suggests that other communities will have less resistance to the lottery system if they commit themselves to random assignment at the very beginning of the planning process.

The Implications of this Report for the Debate about Choice

This report has been completed at a time when the nation's educators and political leaders are concerned about the role of choice in the reform of American schools. The advocates of a voucher system hold that its adoption would greatly improve American education. Readers may conclude that the educational performance of New York City's career magnets is evidence that they are correct. This may or may not be true, depending upon how the argument is framed and precisely what school choice proposal is under consideration. It is, therefore, worthwhile for us to point out where we think this evaluation does and does not relate to the current school choice debate.

Advocates of choice make an argument which, at the risk of oversimplification, may be boiled down to four points:

1. Students should be offered the opportunity to choose between competing schools.

2. This should include private as well as public schools in order to break the "public school monopoly."

3. Schools will improve because of the positive rewards and negative sanctions which having to compete for students in a free market imposes.

4. Students will benefit from the opportunity to customize their education, attending schools whose special focus corresponds to their interests.

The opponents of choice usually make the following four arguments:

1. It is wrong to use public funds to subsidize private schools, especially religious schools.

2. Even within the public schools, a magnet program will tend to subsidize white and higher status students by providing them with more opportunities for magnet schooling. In addition, the poor and minority students will be less likely to take advantage of choice because they will have less information and less time with which to apply to a choice program.

3. The removal of many middle-class students from the regular schools into both public and private magnet schools will reduce citizen and elite support for regular schools.

4. Choice will lead to race and class segregation.

The most important point to make about our study is that it is of a highly unusual magnet school system. While students are offered choice, their choice is very highly restricted in order to prevent segregation of students by ability and in order to minimize segregation of students on the basis of race or class. Thus, perhaps the most important contribution that a study of the New York City career magnets can make to the choice debate is to point out that some of the problems which opponents of choice are concerned with can be to at least some degree solved. In New York City, there is less segregation by

race and class than would occur in a more conventional choice system for several reasons: First, the number of magnet schools is quite large, providing seats for more than just a small elite of the student body. Second, the application system makes it easier for students with less skill in English, less knowledge of the system, or fewer parental resources to apply to magnet schools. Third, the requirements that the school must take students of all reading levels and the use of the lottery minimize bias introduced by school selection.

While we are confident that the magnet lottery system has on the whole reduced segregation based on class, ethnicity, and reading scores, there is still considerable segregation of students. Even if all comprehensive schools were eliminated and every school became a magnet, there would still be a good deal of race and class segregation because students would be inclined to attend school in their own neighborhood. Such a system would have a good deal less segregation, however, than a network of neighborhood-based comprehensive schools. At least some students in low income or minority neighborhoods would choose to attend school in more affluent and white neighborhoods, and would have a chance of admission because of random assignment.

This report says nothing about the value of having public and private schools compete with each other, since this particular choice plan involves only public schools. The New York City system is to some degree motivated by competition with private schools since private school students are permitted to apply to the career magnets and are allowed to participate in the lottery. We have no way of knowing, however, whether this factor improved the quality of the career magnets.

It is also not possible to determine to what extent the improved education in the career magnet schools is the result of their having to compete for students. Some magnets may have felt a need to keep their enrollments high in order to avoid having to have some of their teachers reassigned to other programs. If so, their teachers may have been more concerned about program quality than they were before they were placed in a magnet program. However, we have no way of proving or disproving this. We do note that many of the presumed positive incentives of a pure choice plan are irrelevant here. We do not believe that any schools have chosen to drastically expand their enrollments because of increased numbers of applications and, had they done so, the existing staff would not have shared in any financial profit. Thus, the system does not have the same kind of financial reward that a market provides, and we see little evidence that teachers and principals were

motivated by a growth-for-growth's-sake intent. At the same time, we did note teachers and principals taking great pride in the achievements of their programs, and we think that the idea of having schools with different and, hence, competing identities may be beneficial in New York City.

Critics of choice point to the many plans around the nation in which low income and minority students and students with less home support miss out on opportunities to attend magnet schools. New York City demonstrates that at the high school level it is possible to create a choice system in which four-fifths of all the students in an urban area will choose a magnet program. At the same time, it is important to note that one-fifth chose to remain in their neighborhood schools, and these students should be studied before any conclusions are drawn. Some of these are no doubt white students assigned to neighborhood high schools with large white enrollments who would prefer those schools to schools further from home, especially when those schools are likely to have more minorities in them. Many people told us that race of school student body was a major factor in determining the number of applications for schools.

In short, the New York City evidence seems to indicate that it is possible to construct a public high school choice system which eliminates some of the worst excesses of an unfettered choice system, reducing while not eliminating race and class segregation. However, it does not tell us whether it would be possible to reduce race and class segregation with a choice system at the elementary school level where students will be less willing to travel outside of their neighborhood or whether this can be done in a choice system developed in private schools where issues of race and class segregation may be more severe. Finally, the fact that New York City's career magnets seem to provide an effective secondary school education in some respects does not tell us whether the entire group of high school students in New York City, including those who are academically strong enough to be selected by magnet programs and those who are left behind in comprehensive schools, have experienced a net benefit. We have no way of measuring effects on all the students in New York City.

Recommendations

This study reports on outcomes for only one year of high school; thus, it is inappropriate to draw recommendations from these preliminary findings.

If the statistical evaluations of the tenth and eleventh grades replicate these results, they will necessarily raise a number of specific issues which will be of interest to the New York City schools and to other districts. If, for example, those studies also show that students in career magnet programs do have higher achievement and lower dropout rates, then the question of whether to create more career magnets in New York City or in other cities will naturally arise. If the future analysis shows randomly assigned students benefiting from career magnets, as this report shows, then some other school districts may be interested in adapting New York City's system of soliciting applications from students and randomly selecting those who will attend. Other districts will also be interested in studying the wide range of career options which New York City has developed. However, it should be noted that a system like New York City's is politically quite controversial, and many districts may not be interested in attempting to create a system as committed to equal opportunity.

Recommendations for New York City

There is one finding which is relevant only to New York City. We found that students with different levels of reading performance do not have equal probabilities of being selected in the admission process. The board rules specify that the career magnet schools should offer sixteen percent of their seats to students with above-average reading scores, sixty-eight percent to students with average scores, and sixteen percent to students with below-average scores. Presumably, this reflects the distribution of reading scores in New York City schools, so that the system should be unbiased. In fact, two peculiarities force a bias into this system. First, the students whose scores put them in the top two percent of the distribution are given automatic acceptance into virtually any school. These students' admissions are counted as part of the allocation for above-average students in spite of this, meaning that students whose scores place them in the above-average category, but not in the top two percent, have a lower chance of admission than do students in the average range. Second, about one-fifth of all students do not have reading scores. These students must be allocated to a reading group; the only reasonable assumption is the one

presently used—the below-average group. However, this more than doubles the size of the low group, effectively halving the chances of any one member of the group being offered admission to a career magnet.

The effect of these two factors is to give career magnet programs in freestanding career magnet schools few students from the low-reading group. Presumably, the most popular career magnet programs in comprehensive schools also have few low readers. At the same time, the career magnets in comprehensive schools have fewer above-average readers than expected.[14]

If one wished to give each reading group an equal chance of being selected, one could alter the rule to replace the 16-68-16 formula with percentages based on the actual number of students in each category, perhaps using the mean of the two preceding years for estimation purposes. Doing this would give the members of each group equal odds of being selected, but would considerably increase the number of below-average students and perhaps slightly increase the number of above-average students in career magnets. Doing this would have both positive and negative consequences. On the positive side,

- The original intent of the plan would be implemented, giving New York City the most egalitarian plan in the nation.
- The "dumping" of an excess of students with low and missing scores into the comprehensive high schools and the less popular career magnet and vocational programs would be prevented.
- Students with low or missing scores, by being admitted into career magnets more often, will enroll in high school more often (assuming that future experimental studies continue to show this educational outcome).
- We do not know, and cannot know, how much the success of the comprehensive schools is affected by the present distribution of reading performances, but it may be that the performance of students in the comprehensive schools will improve.

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14 We caution the reader that we have not yet made a detailed study of the effect of these selection biases; data for other years, or data including junior high school graduates, may be different.

- The principals of the comprehensive schools will strongly support this change, and tension between the comprehensive schools and the career magnet programs should be reduced.

At the same time, there are clear drawbacks to making this change:

- We do not know, and probably cannot know, how much the success of the career magnets depends upon having the present distribution of reading performances, but it is possible that the performance of the career magnets will decline.

- Students with low or missing reading scores, aside from their low dropout rates, are not being well-served by the career magnets; increasing the number admitted may not give them a better education than they are receiving in the comprehensive schools.

- Career magnet principals will strongly oppose this change.

An alternative solution would be to obtain reading scores for all or virtually all students. This could be done by using a brief test that could be given to students who lack reading scores when they receive their school-choice application. The effect of this solution would be to preserve the current 16-68-16 formula; to push some students now in the lowest category into the other categories; and to reduce the opposition of career magnets that would be expected if other solutions are used.

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APPENDIX I:

USING THE EXPERIMENTAL RESULTS TO ESTIMATE THE IMPACT OF CAREER MAGNETS ON STUDENTS

We have seen that a randomly selected group of students who were offered admission to career magnet schools had generally better educational outcomes in the ninth grade than did another randomly selected group of students who were not offered admission by the lottery process. Since the two groups were identical (disregarding sampling error) except that one group was more likely to attend a career magnet school, it follows that the higher outcomes of the one group must have been caused by the career magnet schools. So much is obvious. There are two less obvious questions, however: (1) "How large is the effect of the career magnet program on the average student?" and (2) "To what population of students can these results be generalized?"

In order to make the experimental design work, it was necessary to compare everyone who was randomly admitted to career magnets to everyone who was randomly passed over. If every student who had won the lottery had attended a career magnet school, and every student who lost the lottery had attended a comprehensive school, then the difference in educational outcomes between the lottery winners and losers would be exactly equal to the difference in the school effect of attending a career magnet rather than a comprehensive school. Unfortunately, in comparing lottery winners to lottery losers we are not just comparing students who were in career magnets to students who were not because some "lottery winners" chose not to attend career magnets, and many "lottery losers" found other ways to gain entrance to career magnets or other selective schools. This means that the experimental design will in all probability underestimate the effect of the career magnets. The task of this appendix is to estimate the size of this underestimation. We can do that by writing an algebraic equation which decomposes the difference between the experimental "treatment group" (the lottery winners) and the "control group" (the lottery losers) into the school effects of the different kinds of schools the students in the experiment attended.

In order to understand the process of using the overall difference between the performance of lottery winners and lottery losers to estimate the effect of career magnets on students, it is helpful to consider the reverse of the process: If you knew what the effect of

career magnets (and other types of special schools) were on students, how would you compute the overall difference between all lottery winners and all lottery losers? We will carry out the backwards analysis with a hypothetical example. Imagine that the lottery consisted of only twenty-two students who applied to a single career magnet school, and who could also apply to two other schools, a selective school without a lottery and a comprehensive school. Imagine that eleven of the twenty-two students won the lottery, but only eight went to the career magnet, one choosing to go to the selective school, and two to the comprehensive school. Then imagine that we wanted to compute the difference in book reading between lottery winners and lottery losers, and that we knew for each student (A) what school the student would have attended had they lost the lottery instead of winning it, or won the lottery instead of losing it, and (B) exactly how many books each student read and how many they would have read if they had gone to either of the two other schools. (Since the lottery selects students randomly, we can assume that for every lottery winner there is a lottery loser with similar interests and aptitudes.) If we knew all this information, we would of course know whether students who won the lottery read more books than those who lost the lottery.

Figure A.1 shows graphically the outcome of this hypothetical lottery, and shows that the eleven lottery winners read thirty-six books while the eleven lottery losers read only twenty-nine, and that this is because the students who got into the career magnet schools through the lottery read more books than those who lost the lottery and went to the comprehensive school. The overall higher number of books read by lottery winners is entirely due to the higher book reading of the four lottery winners in the fifth row of the figure. The book reading of the other seven lottery winners does not increase the difference in books read by lottery winners over lottery losers, and, in one case—the selective academic school student who would have gone to a career magnet had she won the lottery—a lottery loser's high rate of book reading reduces the difference between lottery winners and lottery losers.

This example makes three points:

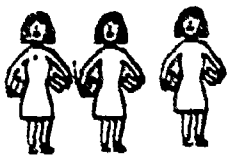
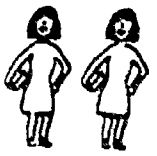
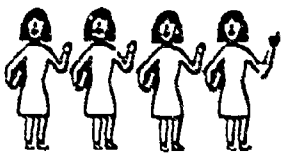
1. The overall difference between all lottery winners and all lottery losers is likely to be considerably smaller than the difference in performance between career magnet students and comprehensive school students.

Figure A.1

A Hypothetical Bookreading Experiment

Assumption: There are only three schools, a selective school called *Humanities*, a career magnet called *Computing*, and a comprehensive school called *Zachary Taylor*. Since a lottery is a random sample, it should be possible to find among the lottery losers a group of students who are identical for any group of lottery winners (except for sampling error). Students at *Humanities* are assigned the most books (5), *Computing* slightly fewer (4), *Taylor* fewest (2), but some types of students read fewer of the assigned books than others, so there is variation according to both the type of school and the type of student.

The Outcome of the Lottery to Enter Computing:

Winners	Losers	
 (4 books each)	 (4 books each)	These students have academic records strong enough to enter computing, so it doesn't matter whether they win the lottery or not. They will still enroll there and read all the books assigned at Computing.
 (5 books)	 (5 books)	These students want to attend Humanities and have records strong enough to be admitted; whether they win the lottery or not, they will go to Humanities and read all the books assigned.
 (5 books)	 (4 books)	These students have records strong enough for Humanities, but not for Computing. Computing is their first choice, Humanities their backup. If they lose the lottery, they will go to Humanities. This group is not quite as studious as the two groups above; at either school they will read only most of the books assigned.
 (2 books each)	 (2 books each)	These students applied to Computing, but then decided to go to Taylor. Those in this group who won the lottery still decided to go to Taylor. Whether they won the lottery or not will not affect their bookreading.
 (3 books each)	 (1 book each)	These students do not have strong enough records to be admitted to Computing, but if they are admitted randomly, they will go. They are not very studious, but they will read more at Computing than at Taylor.
Winners read 36 books.	Losers read 29 books.	Which of the five groups of students contribute to making this difference?

2. The difference between the performance of all lottery winners and all lottery losers is the result of their impact of career magnets on only one kind of student—the kind represented by those in row five of the figure, who are students whose credentials were too weak to earn admission to career magnet schools.

3. The overall difference between lottery winners and lottery losers is affected by several factors—including the impact on students of the selective schools (represented by Humanities High in the figure) and the impact of being placed in one's second-choice career magnet school instead of one's first choice (which is assumed to be zero in Figure A.1).

In order to carry out the process of estimating the impact of the career magnet on student performance, we must reverse the process. Knowing how many students are in each type of program and the overall difference in the performance of lottery winners and lottery losers, we divide students into subgroups and estimate the difference between lottery winners and losers for each subgroup. In the real experiment there are seven subgroups, not five as shown in the hypothetical figure. They are constructed from Table A.1, which is a reproduction of Table 6, and are shown in Table A.2.

Table A.1

Final Destinations of Lottery Winners and Losers

Final Destination	Lottery Winners	Lottery Losers
Career Magnet Schools	35.4	8.8
Career Magnet Programs in Comprehensive or Vocational Schools	45.0	21.2
Subtotal	*80.4%*	*30.0%*
Selective Academic or Art Schools		
Subtotal	*2.1%*	*4.1%*
Vocational Schools	2.7	8.3
Comprehensive Schools	14.3	57.0
Subtotal	*17.0%*	*65.3%*
Total	*99.5%*	*99.4%*
(N)	(1,304)	(3,734)

Table A.1 allows us to divide the population of career magnet applicants into the seven separate subgroups in Table A.2, based upon whether they won or lost their lottery and what schools they attended. We do this in order to see which of these seven subgroups received differing treatments as a result of winning or losing the lottery (i.e., went to different types of schools) and, thus, contribute to the difference in student outcomes which the experiment found. The point of this exercise is to identify subgroups of students who in fact wound up going to the same types of schools whether they won the lottery or not, since these students cannot possibly have different outcomes as a result of winning the lottery, and, hence, are only "dead weight" in the experiment.[1] The subgroup code numbers refer to rows in Table A.2.

- **Subgroup 1:**

  First, note that thirty percent of the lottery losers enrolled in a career magnet. Most of these were selected by a program, with only a few winning another lottery. Since the lottery losers are a random sample of all applicants, and the lottery winners are also a random sample of all applicants, it follows that among the lottery wi rs are a statistically identical group of students (making up thirty percent of all lottery winners) who, had they lost the lottery, would still have enrolled in a career magnet school (although not necessarily the same one). This thirty percent are presumably students with good grades and attendance records. Let us refer to this thirty percent as *certain career magnet students*.

- **Subgroups 2, 4, and 6:**

  Note also that among the lottery winners, 2.1%, 2.7%, and 14.3% chose to attend selective vocational schools, academic or art schools, and comprehensive schools, respectively. These same types of students are represented in the lottery loser group, and surely would have made the same decision to attend these schools, since not offering them a choice that they would have turned down could not possibly change their decision. Let us call these three groups *vocational*, *certain selective*, and *comprehensive students*.

Together, these four groups make up a total of forty-nine percent of all lottery winners and, of course, make up forty-nine percent of all lottery losers as well (ignoring sampling error) since both groups are random samples from the same population. The type

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[1] We shall see that this statement is a slight exaggeration.

of school these forty-nine percent attend is unaffected by the lottery because they would have made exactly the same decision as to type of school whether they won the lottery or lost it. The remaining fifty-one percent were affected by the outcome of the lottery: winning or losing the lottery caused them to change the type of school they enrolled in.

- **Subgroup 3:**
  Note in Table A.1 that whereas only 2.1% of lottery winners attended selective academic or art schools, 4.1% of lottery losers did this. Apparently the extra 2.0% (4.1-2.1) of lottery losers in selective schools are there only because they lost the lottery: The selective schools were their back-up choices. Since the lottery winners are identical within sampling error to lottery losers, this implies that 2.0% of lottery winners were offered seats in selective schools, but turned them down after winning the lottery. In other words, there is a group of lottery losers and a matched group of lottery winners, making up 2.0% of each group, who would attend a career magnet if they won the lottery and would attend a selective school if they lost the lottery. Let us call this group *changing selective students*.

- **Subgroup 5:**
  Similarly, we see that whereas 8.3% of lottery losers attended vocational schools, only 2.7% of lottery winners did so. This implies that 5.6% (8.3-2.7) of lottery losers would have preferred the career magnet program they applied to over the vocational school which accepted them. Thus, we have identified a subgroup, making up 5.6% of both lottery winners and lottery losers, who would choose a career magnet if they won the lottery and a vocational school if they lost the lottery. Let us call this subgroup *changing vocational students*.

- **Subgroup 7:**
  Since fifty-seven percent of lottery losers are attending comprehensive schools, but only 14.3% of lottery winners are attending comprehensive schools, it follows that 42.7% of the lottery winners would have wound up in comprehensive schools had they not won the lottery, and these 42.7% must be statistically identical to a subgroup of the same size of lottery losers who are in comprehensive schools. Let us call this group *changing comprehensive students*; it is this group whom we are most interested in because the experiment is designed to compare the educational

outcomes of the members of this subgroup who won the lottery and went to career magnets to those who lost the lottery and went to comprehensive schools.

Taken together, these seven subgroups make up one-hundred percent of the lottery winners and one-hundred percent of the lottery losers.

Table A.2

Separation of School Effects On Experimental Students

Group Name	If Lottery Lost		If Lottery Won		%
	School Attended	Imp	School Attended	Imp	
1. certain c.m.	career magnet	a	career magnet	b	30.0
2. certain sel.	selective	u	selective	u	2.1
3. changing sel.	selective	v	career magnet	c	2.0
4. certain voc.	vocational	w	vocational	w	2.7
5. changing voc.	vocational	x	career magnet	d	5.6
6. certain comp.	comprehensive	y	comprehensive	y	14.3
7. changing comp.	comprehensive	z	career magnet	e	42.7

We list for each group in Table A.2 a coefficient ("imp") which measures the impact of the type of school they attended on some unspecified outcome, a, b, . . . e for each subgroup which experienced career magnet education and u . . . z for those who experienced some other type of schooling. Since each subgroup is made up of different students, it is possible that the impact of a career magnet would be different for each subgroup.

The impact of a school may be different for different types of students; a career magnet may have effect "e" on a student who would have gone to a comprehensive school if they had not won the lottery, and an effect "d" on a more vocationally oriented student who would have entered a vocational school if he had not won the lottery. We also assume

that in some rows of the table, the lottery outcome would make no difference in a student's educational outcome. For example, the same school effect coefficient, "y," appears in both the third and fifth column of the sixth row. For a student who applied to a career magnet, but whose first choice really was their comprehensive school (*certain comprehensive*), we assume that the honor of being offered a seat at a career magnet might engender a temporary feeling of pride, but this would not be a powerful enough emotion to affect their ninth grade school performance at their comprehensive school.

If "X" is the measured educational outcome of lottery winners and "Y" the outcome of lottery losers, then changing the percentage distribution to decimals and summing up the effects in Table A.2 gives us equations (1) and (2) below:

$$(1)\ X = .300b + .021u + .020c + .027w + .056d + .143y + .427e$$

$$(2)\ Y = .300a + .021u + .020v + .027w + .056x + .143y + .427z$$

The experimental difference between the lottery winners and losers is then, after canceling identical terms,

$$(3)\ X - Y = .300(b-a) + .020(c-v) + .056(d-x) + .427(e-z)$$

(For this analysis, we assume that coefficients measure the effect of attending a given school, and that the effect of being selected but not attending is zero.)

The goal of this study is to estimate (e-z), the effect of attending a career magnet versus attending a comprehensive school. In order to estimate (e-z), we must make assumptions about the size of the other coefficients.

As a first step, we asked what the most plausible set of assumptions might be. We assumed that the difference in the educational outcomes among lottery winning and lottery losing certain career magnet students (b-a) would probably be small relative to some of the other terms. The certain career magnet students who lost the lottery are highly likely to have been school selected by their first-choice career magnet schools, the same schools they would have attended had they won the lottery. Since they would not know whether they were school selected or randomly selected, there cannot be any differential effect. The only effect would be for the students who were school selected or lottery selected by their

second or less-desired choice but who, had they won the lottery, would have gotten into their first choice; the effects of the educational quality of these second-choice career magnet schools versus the first-choice schools would mostly cancel out (since one person's first choice is another person's second). For a portion of the thirty percent, there would be a motivational effect of not getting one's first choice, but we are inclined to assume that this effect is relatively small.[2]

Examining the rest of equation (1), we were inclined to assume that for academically oriented students, the effect of being in a selective school, "v," is not much different from being in a career magnet, "c." However, the effect of being in a vocational school, "x," would be considerably less than the effect of being in a career magnet, "d." Conversely, for students with a strong career focus, being in a selective school may be much less beneficial than being in a career magnet, while being in a vocational school may not represent a great loss. We still would assume, however, that students would not improve their educational outcomes as much in a vocational school.

It seems quite reasonable to assume that comprehensive schools are educationally weaker than selective schools and probably do not motivate students the way a vocational school does. Thus, it is safe to assume that the differences (b-a), (c-v), and (d-x) are all smaller than (e-z).

In examining the assumptions we made, we saw that they split the difference between two extremes: At one extreme is the assumption that being in one's first choice career magnet means a much better educational outcome than being in any other kind of school, even a selective academic school. At the other extreme was the assumption that getting into any sort of magnet school, even a vocational school, had an equally positive effect. So we decided to algebraically estimate the implications of both extreme assumptions.

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[2] One reason we believe the motivational effects are all rather small in this study is that the educational effects in the experiment are not all positive and are only for specific outcomes, which is usually true for only one of the two reading groups, and often true only for one of the two types of magnets. This complex pattern of effects seems too complicated to be predicted by a simple motivational argument, since the impact of being offered a seat, independent of actually attending the school, is likely to be fairly constant, especially across type of school attended, but also across a variety of outcomes. The pride associated with being offered a seat is not likely to cause attendance to go down and total credits earned to go up at the same time.

If we assume, first, that career magnets are not better than either selective or vocational schools, and attending one's second (or less desired) choice career magnet is not harmful, then in equation (1) the terms (b-a), (c-v), and (d-x) would all become 0, and equation (3) would simplify to become equation (4):

$$(4)\ X\text{-}Y = .427(e\text{-}z)$$

At the other extreme, we can assume that being randomly selected into almost always one's first choice career magnet program is superior to attending either a selective, vocational, or comprehensive school, or even one's second choice career magnet school. We assume the benefit over all these other types of schools is the same; we also assume that one-third of the certain career magnet students who lose the lottery do not get into their first choice career magnet. If so, then in equation (3) we can set (b-a) = (c-v) = (d-x) = (e-z), and change the coefficient .300 to .100. Then the experimental effect found in the experiment would be given by equation (5):

$$(5)\ X\text{-}Y = (.100 + .020 + .056 + .427)(e\text{-}z) = .603(e\text{-}z)$$

Perhaps the most reasonable thing to do is to split the difference. Let us assume X-Y = approximately .5(e-z), and our conclusion is that *the effect found in the experiment, X-Y, is about half the size of the effect on a student of being in a career magnet program instead of a comprehensive school.*

It is often important to look at the ratio of the rate of growth in career magnet schools to the rate of growth in comprehensive schools. If X represents the performance of lottery winners, Y represents the performance of lottery losers, "M" represents the effect of attending a career magnet, and "N" represents the effect of attending a neighborhood comprehensive school, and we assume (based on Table A.1) that eighty percent of lottery winners experience educational benefits like those received from a career magnet education while only thirty percent of lottery losers do, so, then the educational effects on lottery winners and lottery losers are

$$(6)\ X = .8M + .2N, \quad \text{and}$$
$$(7)\ Y = .3M + .7N.$$

Solving these two equations for M and N, we conclude that the true ratio of the effect of career magnet schools, M, to the effect of comprehensive schools, N, is

$$(8)\ \frac{M}{N} = \frac{.7X - .2Y}{.8Y - .3X}$$

This equation implies that if lottery winners have outcomes twenty-five percent higher than lottery losers, then we should expect students in career magnets to have outcomes approximately sixty percent higher than students in comprehensive schools. If the lottery winners have scores fifty percent higher than those of lottery losers, we should expect students in career magnets to have outcomes about two-and-one-half times greater than students in comprehensive schools.

This analysis has also answered our second question: "To what population can we generalize our results?" The particular group of students for whom we can estimate effects are only those whose effects are e and z. Any attempt to solve equation (3) for any of the other school effects would require making very extreme assumptions including assuming the size of coefficients e and z. The only reasonable assumption is that any difference between X and Y is overwhelmingly the result of a difference between e and z. Because of this, *our conclusion is that the impact of career magnets are on students who, if they were not selected randomly, would not have gotten into any magnet school.* The algebraic discussion above may leave many readers dissatisfied, thinking that the mathematical slight of hand has deceived rather than informed the reader. For those who feel this way, the following discussion, with the algebra omitted, may serve either to persuade them that the analysis is sound or help them discover the questionable assumptions or logic which caused them to be suspicious.

To begin with, the students who were not randomly offered a career magnet seat and nevertheless attended a career magnet would almost certainly be attending a career magnet had they "won the lottery" and been admitted randomly to their first choice school. Since the left column and the right column of Table A.1 refer to students who are identical because of random sampling, this implies that the thirty percent admitted to career magnets on the right hand side are matched by a very similar group of students on the left hand side who are among the eighty percent who are attending career magnet schools after having been randomly offered seats. Conversely, it seems highly unlikely that the fourteen percent

of students who were randomly offered career magnet seats and still chose to go to their comprehensive school would have attended a career magnet school had they lost the lottery instead of winning it. Thus, the fourteen percent in the lower left of the table are almost assuredly identical to a corresponding fourteen percent group who are part of the fifty-seven percent in comprehensive schools on the right hand side of the table. By the same logic, the two percent in the left hand column who chose selective schools and the three percent who chose vocational schools are students who, had they lost the lottery, would still have chosen these same schools to attend. Thus, they correspond to a similar two percent and three percent on the right hand side whose educational experience has not been altered by the lottery outcome.

This totals to forty-nine percent and leaves a remaining group of fifty-one percent of the students on each side who have had a different educational experience than they would have had if their lottery luck had been different. On the left hand side, those fifty-one percent have attended a career magnet school—on the right hand side, forty-three percent of them, the result of subtracting fourteen from fifty-seven, are in comprehensive schools and eight percent are in vocational and selective magnets. If the students in the left hand column do indeed have an overall educational outcome which is different from the students in the right hand side, this must be the result of some difference in the educational outcomes for this fifty-one percent. One possibility is that the forty-three percent of the students who are attending career magnets who, had they lost the lottery, would be attending comprehensive schools, are the only beneficiaries, and are responsible for all the differences found in the experiment. If so, then the true impact on each student is 1/.43 = 2.33 times the impact measured by the experimental design. There are probably some benefits from attending one's first choice career magnet school, even if the consolation prize is another magnet, vocational, or selective school. There may also be a small motivational effect. If so, then the effect on randomly selected career magnet students is less than 2.33, and, thus, it might be reasonable to guess the true impact of a typical career magnet program to be approximately twice the magnitude measured by the experiment.

Finally, note that the students whose middle school records are strong enough to win them admission to a career magnet program will not be affected by the lottery; they will attend career magnets regardless of whether they win or lose the lottery. Since winning the lottery cannot affect the quality of education they receive, any positive effect of the lottery on all students must be due to the lottery's effect on some other students, not these. Of the

remainder, the only group who could be positively affected by the lottery are those who attended career magnets after winning the lottery, but would not have attended had they lost the lottery.

APPENDIX II

PROGRAM ADMINISTRATOR'S QUESTIONNAIRE

Note: This questionnaire version is for programs located in comprehensive and vocational schools; the version for programs in freestanding magnet schools is a slight variant of this.

Questionnaire for Educational Option Programs in Comprehensive Schools

Hello Mr./Ms. _____. My name is _____ and I'm calling from Teachers College, Columbia University. We are conducting a large statistical study of fifty thousand New York City high school students in collaboration with the Office of Research, Evaluation, and Assessment. We are being funded by the federal government. In order to do our analysis, we need to know a small amount of information about the _____ program. We only need approximate answers, and we won't mention your program in our report. This should only take about ten minutes. First, I will ask you a group of specific questions that only require short answers. Then I will ask you for your general comments about the most important features of your program. IF BREAKOFF, RECORD SUGGESTED CALLBACK TIME ON APPOINTMENT SHEET.

1. First, does your program prepare students for any specific careers?

Yes	1	(Ask 1a)
No	2	(Go to 2)

1a. What are they? (WRITE ALL DOWN)

2. Do your students take any special classes which are not taught to students in the rest of your school?

Yes, take special classes	1	(Ask 2a-d)
No, classes same as rest of school	2	(Go to 3)
Other	3	

2a. Approximately how many special classes like this would a typical student take in four years of high school?

_____ (Ask 2b)

2b. In these special classes, do students use any special equipment other than a computer lab?

Yes, use special equipment	1	(Ask 2c)
No, no special equipment	2	(Go to 3)
No, just computer lab	3	(Ask 2e)

2c. In a typical week, would you say that most of your students will do some work using specialized equipment?

Yes, most use	1	(Ask 2d)
No, most don't use	2	

2d. How many hours per week would the typical student use special equipment?

_____hours

2e. In a typical week, would you say that most of your students use computer labs?

Yes, most use	1	(Go to 2f)
No, most don't use	2	(Go to 3)

2f. How many hours per week would the typical student use a computer lab?

_____ hours (Go to 3)

3. Think a moment about the classes your students take which are the same as those taught to other students in the school. Do they usually take these courses in separate classes with students from their own program, or are they usually mixed in with students from the rest of the school?

Usually separate classes	1	(Go to 4)
Mostly mixed in with other students	2	(Ask 3a)
Half one way/half the other	3	(Go to 4)

3a. (IF MOSTLY WITH OTHER STUDENTS) Are there any cases where a course has a special section reserved only for students in your program?

Some classes only with program students	1
All classes with other students in the school	2

4. Some schools are experimenting with altering their academic courses to make them more closely related to the students' career interests. However, many educators think this waters down the academic standards in a course. What is your personal view? Do you think it is generally a good idea or a bad idea to integrate career interests into academic classes?

Bad idea	1	(Ask 4a)
Good idea	2	(Go to 4b)

4a. (IF BAD IDEA) As far as you know, do any of the instructors in your academic courses spend much time integrating examples from the students' career interests into their teaching?

Yes	1	(Go to 4c-d)
No	2	(Go to 5)

4b. (IF GOOD IDEA) Are any of your academic teachers able to make their classes relevant to the career interests of your students, or is it generally too difficult to make them relevant?

Most are able	1	(Ask 4c-d)
It is too difficult	2	(Go to 5)

4c. Do most of your instructors do this, or only a few?

Most	1
Only a few	2

4d. Are any of these academic courses interdisciplinary?

Yes	1
No	2

5. Do any of the instructors in your academic classes use specialized texts that are tailored to the career interests of students?

Yes	1	
No	2	

6. Do the students in your program work on personal or individual projects?

Yes	1	(Ask 6a-c)
No	2	(Go to 7)

6a. (IF YES) In a typical week, how many students are working on independent projects? Would you say only a few, 1/4, 1/2, 3/4, or nearly all?

Only a few	1	
1/4	2	
1/2	3	(Go to 6b)
3/4	4	
Nearly all	5	

6b. How many hours per week would a typical student work on an independent project?

_____ hours

6c. Do students usually work alone, or in teams?

Alone	1
In teams	2
Half and half	3

6d. Besides independent projects, are there any other opportunities for students to work in teams or otherwise learn how to work cooperatively with other students?

Yes	1
No	2

6e. In any semester, how many students will be involved in these projects? Would you say only a few, 1/4, 1/2, 3/4, or nearly all?

Only a few	1	
1/4	2	
1/2	3	(Go to 8)
3/4	4	
Nearly all	5	

7. Are students in your program encouraged to work in teams with other students in order to learn how to work cooperatively?

Yes	1	(Ask 7a)
No	2	(Go to 8)

7a. (IF YES) In any particular week, how many of the students in your program are involved in some sort of team project? Only a few, 1/4, 1/2, 3/4, or nearly all?

Only a few	1
1/4	2
1/2	3
3/4	4
Nearly all	5

8. A few schools have some classes or programs in which some students do work designed to help them develop their interpersonal skills. Do you have anything like that?

Yes	1	(Ask 8a)
No	2	(Go to 9)

8a. (IF YES) In the four years of high school, how many semesters would a student be involved in these classes/projects?

Number _____

9. Do students in your program have unit requirements that differ from requirements for students in the regular portion of the high school?

Yes	1	(Ask 9a)
No	2	(Go to 10)

9a. How do the unit requirements for graduation differ for students in your program?

English

Social Studies

Science

Mathematics

Introduction to the Humanities

Health and Physical Education

Unit sequences

Additional requirements

10. Do the students in your program c any sort of internships or part-time work assignments?

Yes	1
No	2

11. Do any faculty members in your school have released time in order to help locate employment for graduates of the program or help locate part-time work employment while students are in school?

Yes	1	(Ask 11a)
No	2	(Go to 12)

11a. If yes, how many faculty have released time for this?

Number _____

11b. How many periods of released time do each of them have?

Number _____

12. Did your program open before the Fall of 1987?

Before Fall 1987	1	(Ask 13)
Fall 1987 or later	2	(Go to 14)

13. Some school administrators have told us that taking randomly assigned students has seriously hurt the quality of their programs. Others say that it hasn't hurt their program. Do you think your own program has been harmed or not?

Harmed	1	(Go to 15)
Not harmed	2	

14. Do you think you would have a better program if you were able to select all your students instead of having to take the randomly assigned students?

Would have better program	1
Would not have better program	2

15. Do you think that the randomly assigned students in your program are able to benefit from your program, or would they really be better off in a regular high school program?

Able to benefit	1
Better off in regular high school	2
Don't know	3

16. What about your students who had academic difficulty or discipline problems in middle school? Do you think most of these students would be better served by a regular high school program, or are most of them better off in your program?

Most better off in a regular program	1
Most better off in option program	2

17. Do you think the academically weak students receive more or less remedial help than they would in the regular program in your school?

More	1
Less	2
Same	3

18. What do you think are the most important aspects of your program?

Thank-you very much. Your answers will be very helpful to us. The school board will release at least one research report on this project and we will see to it that one is sent to your school. Your responses will be treated with complete confidentiality and your school will not be mentioned in our report. Is there anything about your program which you think would be especially important for us to know when we do?

APPENDIX III

SAMPLE PAGE FROM THE DIRECTORY OF HIGH SCHOOLS

NORMAN THOMAS HIGH SCHOOL FOR COMMERCIAL EDUCATION
111 East 33 Street
New York, N Y. 10016
School Telephone: (212) 532-8910
Admissions Telephone: (212) 532-8910
Guidance Telephone: (212) 532-8910, ext 14
Special Education Telephone: (212) 725-8065

Zones: No zoning restrictions. Educational options school open to all New York City residents.

School Schedule: Overlapping sessions. Grades 9, 10: 8:59 A.M. to 3 10 P.M., grades 11, 12: 8:05 A.M to 2.16 P.M.

Number of Students: 2,850

Transportation: ***Subways:*** IRT No. 6 train to 33 St.; BMT. R, N, QB train to 34 St., ***Buses:*** Nos M15, 101, 102, 1, 2, 3, 4 to 34 St., M16 to Park Ave.

Languages: Spanish 1-6, French 1-6

Admissions Information: Applications due, November 4, 1987
All students—general education students, Special Education students, and students with limited English proficiency—in grades 8 and 9 of K-8, intermediate and junior high school and in grade 9 of high school, are eligible to apply to all programs except where restricted by residence or grade. *Only students in Special Education self-contained classes may apply to Special Education programs offered in self-contained classes.*

Programs are grouped in career clusters. Within each program cluster, the same general selection criteria are used for all programs to which students may apply on a citywide basis.

Program Clusters:

Norman Thomas is a total educational option high school.*—Based on Citywide Reading Test administered in the term preceding application, all students accepted must include 16% who score above the average, 68% who score within the average range, 16% who score below average. Any student scoring in the top 2% who lists the program as choice #1 on the high school application is automatically accepted. Half of the students are selected by the computer and half by the high school. Other selection criteria are listed for programs offered within each cluster.

CLUSTER 08—MANAGEMENT AND FINANCE

Other Selection Criteria:
—English, Social Studies, Mathematics and science grades, earned in the term preceding application
—Student Interest—as demonstrated by priority choice (the higher the student lists the program on the high school application, the better the chance of acceptance)
—Attendance—no excessive absence or lateness in the school year preceding application

Grades 9 and 10
- **Computer Programming and Accounting Careers—Program Code 6201-420**—prepares students for all aspects of business and further study in college. There are courses in bookkeeping, business machines, business law, and business analysis/business applications. Students learn how to use computers in electronic bookkeeping applications and prepare financial statements using visicalc and spread sheets. Computerized business graphics is also taught. Students prepare assignments using database. The curriculum includes processing of programs using machine languages of RPG II, COBOL and BASIC. College credit courses in accounting are given as an option to the students
  Grade 9 Applications: 5440 Seats Offered: 86 Seats Filled: 57
  Grade 10 Applications: 3172 Seats Offered: 71 Seats Filled: 63
- **Computer Programming and Accounting Careers: Bilingual-Chinese—Program Code 6201-820**—This is a new program.

- ***CLUSTER 13—BUSINESS***

Other Selection Criteria:
—Student Interest—as demonstrated by priority choice (the higher the student lists the program on the high school application, the better the chance of acceptance)

Grades 9 and 10
- **Marketing Careers—Program Code 6201-254**—offers courses in business analysis/business computer applications, business ownership and marketing and basic core requirements in business/marketing and principles of marketing.
  Grade 9 Applications: 923 Seats Offered 136 Seats Filled: 86
  Grade 10 Applications: 875 Seats Offered 103 Seats Filled 76

Grades 9 and 10
- **Secretarial Studies and Word Processing Careers—Program Code 6201-271**—develop skills in stenography (Gregg, Pitman or Alphahand), word processing, transcription and typing; prepares students for jobs as legal, medical, school or executive secretaries and as teachers of secretarial subjects. Instruction in word processing includes training on Wang word processors, IBM Memory typewriters, Tandy 1000 computers, IBM electronic typewriters, text editors and dictating and transcription machines
  Grade 9 Applications: 2,438 Seats Offered 249 Seats Filled 164
  Grade 10 Applications: 1,674 Seats Offered: 196 Seats Filled 147
- **Secretarial Studies and Word Processing: Bilingual-Spanish—Program Code 6201-871**—This is a new program

Special Features:
- Cooperative Education—see Contents Part III
- Gospel Choir—students give concerts thoughout the city
- Advanced Placement in English
- College Accounting Course—given in the senior year in conjunction with Long Island University for college credit
- Mentoring Program
- Modern Dance—provides creative expression through the dance medium