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Research Article

Model Minority, Model for Whom?

An Investigation of Asian American Students in Science/Engineering

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Abstract

This study examines the attainment of the bachelor's degrees in science and engineering among Asian American students, including those who are immigrant children and children with immigrant parents. Using data from *National Education Longitudinal Studies: 1988-2000*, this study finds that Asian Americans have the highest rate of expectation for majoring in natural science and engineering. After they attend college, they have the highest rate of persistence. Drawing from Bourdieu's theory of cultural capital and habitus, this article finds that Asian American students are disadvantaged in cultural capital compared with other racial groups from the similar socioeconomic backgrounds, and they tend to formulate certain negative self-perceptions associated with their inclination towards science, technology, engineering, and mathematics (STEM) fields. These findings provide further evidence to challenge the model minority thesis, which suggests the choice and the attainment of STEM degrees by Asian American youth is entirely a success story.

Introduction

Asian Americans have become the fastest growing minority group enrolled in selective public and private institutions of the United States (Massey et al., 2003). Asian American students include both Asian immigrant students and American-born Asians with immigrant parents. Their inclinations[1] towards natural science and engineering have attracted much public and scholarly attention (NCES, 2009; Xie and Goyette, 2003; Song and Glick, 2004; Ma, 2007, 2009). Even though the number of Asian American students concentrating in science and engineering has declined in recent years, (Chang, Park, Lin, Poon, and Nakanishi, 2007), Asian Americans[2] surpass whites in the rates of attaining the bachelor's degrees in science, technology, engineering, and mathematics (STEM) fields (NSB, 2008). Partially due to this, Asian Americans are the only minority group excluded by all federal initiatives to promote the representations of racial minorities in Science, Technology, Engineering and Mathematics (STEM) fields. This not only represents another case of the "exceptional" profile of Asian Americans, but also reinforces the stereotypical "model minority" image of Asian Americans.

Unlike many other professions such as arts, business and education, which can be entered through multiple pathways, STEM fields require a much more structured educational preparation. In particular, it is very unlikely one could enter a STEM profession without a bachelor's degree in a STEM field. Therefore, this study focuses on the attainment of a STEM baccalaureate.

Previous studies have attempted to provide explanations for the inclination of Asian American students in STEM fields. In a recent article that proposes a comprehensive framework to understand this issue, Xie and Goyette (2003) provide the "strategic adaptation" rationale to account for the strong tendency of Asian American youth to choose technical and business fields (467). They contend that Asian American youth are aware of the barriers in other fields such as politics. They argue that Asian American youth consider entering technical fields, such as becoming a nuclear physicist, to be more feasible as an occupation goal than being a representative in Congress, even though the two occupations have similar occupational prestige (Xie and Goyette, 2003). However, their research has not empirically studied what specifically constitutes the barriers. This article draws from Bourdieu's theory of cultural capital and habitus[3] to provide the conceptual tools to understand the barriers that Asian American students may experience.

Using *National Education Longitudinal Studies: 1988-2000* and postsecondary transcript data from it, this research focuses on the critical locations of the STEM pipeline,[4] starting from college expectations during high school, to claiming the initial college major within two years after high school,[5] to the attainment of a bachelor's degree. This study finds that Asian Americans have the highest rate of expectation of majoring in natural science and engineering, while they are still in high school. After they matriculate in college, they have the highest rate of persistence in STEM fields. With the high expectation and persistence rates, it is not surprising that

Asian American youth have the highest rate of attaining a STEM bachelor's degree.

In what follows, I first discuss the pipeline model that provides the framework for studying the key factors in STEM degree attainment. What the pipeline model indicates is that Asian American students are inclined towards and prepared for STEM careers well before college, which contributes to their STEM degree attainment later. The question is how to understand their inclinations towards STEM fields. This study focuses on two related and complementary rationales. The first rationale emphasizes the unique features associated with science and engineering fields that are potentially appealing to Asian student. The second rationale draws from the theory of cultural capital and habitus to understand how Asian students may experience barriers in other fields.

Literature Review

The Pipeline Model

The pipeline model was introduced by Berryman (1983) in her seminal work *Who Will Do Science?*, which empirically analyzed the process of becoming a scientist. Since then, it has become the predominant framework to understand the educational and occupational attainment in science, particularly pertaining to the issue of the underrepresentation of women and racial minorities in science. Since science and engineering often require overlapping training in terms of quantitative methodology, the pipeline model has also been applied to understand the process of becoming an engineer as well (Tang, 2003).

As the imagery implies, the process of becoming a scientist or an engineer is characterized by an explicitly sequential structure of academic preparation, particularly in math and science during pre-college years; this is followed by choosing a college major in STEM, then persisting in the attainment of the STEM degree, which is often the necessary requirement to get a job in STEM careers. Xie and Shauman (2003) in their comprehensive studies of women in science have focused on the key locations of the STEM pipeline, including the expectation of college majors during high school, first college major, and degree attainment. They find that women were much less likely to have early inclinations for STEM fields, evidenced by their much lower expectation to major in STEM fields as compared to men. However, they also found that women were more likely to enter STEM fields later during college. This finding challenges the rigid and linear structure that the pipeline model indicates. However, the three stages of the pipeline remain important to understanding the process of the STEM degree attainment. This study examines expectation, initial major, and degree attainment respectively in its multivariate analysis.

In addition, the pipeline model has identified key factors for the attainment of the STEM degree. Academic preparation in grades K-12 has been cited as the key determinants for participation in STEM fields in college (Oakes, 1990; Astin, 1992; Sax and Harper, 2007). Math achievement and coursework, among other dimensions of pre-college academic preparation, are widely regarded as the key screening factors of attaining a STEM baccalaureate (Catsambis, 1994; Chang, 2002; Frehill, 1997; Hyde, et al., 1990). For a long time, the explanation for gender and racial underrepresentation in STEM has been that women and non-Asian racial minorities fall behind in math achievement. Yet Xie and Shauman (2003) find that "mathematics achievement per se does not explain the gender differences in S/E educational and degree attainment at the undergraduate level" (96). However, for non-Asian racial minorities, pre-college disadvantages in math have been cited as the major barrier to entering STEM fields. They are reported to be more likely to switch out of STEM programs due to lack of preparation for advanced coursework in math (Seymour and Hewitt, 1997).

Course-taking patterns, including both the level and number of courses taken in certain subjects, have been consistently identified in educational literature as the most powerful predictors for achievement and later participation in that field (Adelman, 1998, 1999; Leahey and Guang, 2001; Montmarquette, 2002). Students who enroll in certain elective courses will have more exposure to the subjects, which potentially prepare them for a college major in a related field (Ma, 2007). Eccles (1984, 1994) once argued that course-taking activities reflect the variation in aspiration for achievement in specific substantive areas. This article hypothesizes that Asian American students take more math and science courses and achieve higher in math and science tests during high school than other students, which contributes to their STEM degree attainment. Then a question emerges: why do Asian American students aspire to achieve in science-related subjects in the first place? To begin, I discuss the characteristics of STEM fields in the following section.

What Is Unique about Science and Engineering Fields?

Robert Merton has claimed that universalism remains the most important premise for modern science. Universalism is a principle that scientific claims are to be subject to "preestablished impersonal criteria: consonant with observation and with previously confirmed knowledge" (269). Hence, personal or social attributes such as race, nationality, religion, and class are irrelevant. To make it more concrete, Merton further states that "the Haber process cannot be invalidated by a Nuremberg decree nor can an Anglo-phobe repeal the law of gravitation" (269). Apparently, the scientific disciplines Merton had in mind are natural sciences, such as physics and chemistry.

Then what is unique about natural sciences and engineering fields? Sociological studies of science and higher education literature have long identified the hard-soft distinction defining natural sciences and engineering fields as hard disciplines, and social sciences and the humanities as soft disciplines. The criteria for distinguishing hard-soft fields include paradigm development, extent of using mathematics, and impersonality (Braxon and Hargens, 1996; Storer, 1967, 1972). According to Kuhn (1970), paradigm "stands for the entire constellation of beliefs, values, techniques, and so shared by the members of a given [scientific] community" (175). Kuhn continues: "A paradigm is what the members of a scientific community share, and conversely, a scientific community consists of men who share a paradigm" (176). Thus, the essence of a paradigm lies in the degree of consensus about theory, methodology, and problems in a given field. Within a field, the dominant paradigm produces agreements on what problems are important, what techniques and methods are appropriate for tackling the problem, what is already proven, what is yet to be proven, and what needs to be known for the next step of investigation. In their study of faculty from four disciplines (chemistry, physics, sociology, political science), Lodahl and Gordan (1972) asked the faculty what they agreed upon in terms of theory, methods, and graduate school socialization. They found that chemists and physicists showed greater agreement than political scientists and sociologists.

Biglan (1973) defines the natural sciences, engineering, and mathematics as high-consensus fields, while the social sciences, the humanities, and the arts are low-consensus fields. Hard fields usually use quantitative approaches to achieve a high consensus over theory and methods, whereas soft fields are often open to the use of qualitative approaches in addition to quantitative approaches given the lack of consensus. Largely due to the high consensus in hard fields regarding the theory and methods, knowledge and skills evolve and progress cumulatively in hard fields, which became manifested in their sequential curriculum structure. Such a linear fashion, however, is seldom found in soft fields of study where the curriculum structure is more flexible. Frequent course assignments, exams, and projects are common in hard fields, whereas essays and term papers are common in soft fields. In this way, hard fields are more predictable and systematic than soft fields in terms of what knowledge and skills are taught and learned.

Partially due to their cumulative and systematic knowledge structure, the natural sciences and engineering have remained one of the key economic growth engines, bringing about blossoming job opportunities and promising financial remuneration. According to *Science and Engineering Indictors 2008*, employment in STEM occupations grew from fewer than 200,000 to approximately 4.8 million workers between 1950 and 2000. The average annual growth rate of 6.7 percent contrasts with a 1.6 percent annual average growth rate for total employment (NSB 2008). As documented by the National Science Board (2008), the mean real salary for recent STEM bachelor's degree recipients increased in all fields by 15 percent, with greater increases in computer and mathematical sciences (23.3%) and engineering (20.4%).

Previous studies have reported that racial minority students are more inclined towards lucrative fields in their college major choices (Ma, 2009). The predictability and certainty of knowledge and skills learned in science and engineering fields, coupled with the promising external opportunity structure, may be appealing to Asian American students. The next section, drawing from Bourdieu's theory on cultural capital and habitus, discusses how STEM fields require less of cultural capital, as compared with the humanities and social science fields. Due to their distinct racial and immigrant backgrounds, Asian American youth may be disadvantaged in cultural capital, and they are aware of these barriers and disadvantages. This awareness contributes to their inclination towards STEM fields.

Cultural Capital, Habitus, and the Choice for STEM Fields

Cultural capital, widely recognized as one of the late Pierre Bourdieu's significant contributions to understanding the issue of education reproduction (1984, 1990), is commonly understood to denote culture as a resource that provides access to scarce rewards (Lareau and Weininger, 2003). In Bourdieu's original definition, cultural capital is comprised of "linguistic and cultural competence and that relationship of familiarity with culture which can only be produced by family upbringing when it transmits the dominant culture" (Bourdieu, 1973, 80). Empirical studies have various ways to operationalize cultural capital. In an article that reviews research using cultural capital in education research, Lareau and Weininger (2003) have argued that, despite the various approaches to understanding cultural capital, one dominant way to operationalize cultural capital is through the engagement and participation in cultural activities, which can be measured by attending concerts, participating in artistic pursuits, and other activities.

In addition, most studies presume that cultural capital is analytically distinct and empirically separable from the technical skills. This dominant interpretation of cultural capital is heavily influenced by Paul DiMaggio's 1982 article on the relation between cultural capital and school success. DiMaggio argues that cultural capital is more relevant to students' grades in "nontechnical subjects" than technical ones:

> English, History, and Social Studies are subjects in which cultural capital can be expected to make a difference; standards are diffuse and evaluation is likely to be relatively subjective. By contrast, Mathematics requires the acquisition of specific skills in the classroom setting, and students are evaluated primarily on the basis of their success in generating correct answers to sets of problems (94).

DiMaggio clearly implies that cultural capital is analytically distinct from technical skills. Others take issue with this stance and suggest that cultural capital and technical skills are "irrevocably fused" (Lareau and Weininger, 2003). Although the value of cultural capital is not separable from education outcomes, including technical skills and abilities, there are important differences in terms of the extent that cultural capital exerts its effects. DiMaggio's point regarding the differences between math and English is consistent with the conceptualizations of the hard-soft divide discussed in the previous section. If cultural capital exerts the greater effect on humanities subjects than technical subjects, it follows that students with less cultural capital would be more inclined towards technical subjects than humanities subjects.

Previous studies have shown that a broad knowledge of culture belongs to members of the upper classes and, thus, the lower classes are relatively disadvantaged (Bourdieu and Wacquant, 1992; De Graaf, De Graaf, and Kraaykamp, 2000). According to various socioeconomic measures, Asian Americans, at least on average, are not very disadvantaged, though there is great variability of national origins within the Asian American racial category. Socioeconomic standing does set Asian American apart from other racial minority groups in the U.S. Because of it, scholars have most recently described Asian Americans as non-minority minority (Sakomoto, Goyette, and Kim, 2009).

As a result, it is unclear whether Asian American students are disadvantaged in terms of cultural capital. In particular, how do they compare with others in cultural capital at a similar socioeconomic strata? In addition, factors besides social class contribute to the differential command of cultural capital. It is worthwhile to revisit Bourdieu's initial framing of cultural capital as "linguistic and cultural competence and that relationship of familiarity with culture which can only be produced by family upbringing when it transmits the dominant culture." What kinds of families are more or less likely to transmit the dominant culture? Social class is an obvious concern.

Yet for Asian Americans, race and immigrant status add complexity to the issue. The history of racial exclusions and the lingering effect of marginality and discriminatory treatment put Asian American youth, at best, at a distance from the dominant culture (Chen, 1999; Leong and Hayes, 1990). Asian American students in the U.S are often immigrants themselves or children with immigrant parents (Xie and Goyette, 2004) who have faced linguistic and cultural barriers to their process of adapting to their host country. Even though this would not necessarily prevent them from attending the high-brow activities, such as attending concerts and museums, they may experience some disadvantages in cultural capital.

In addition, Asian Americans in the U.S are uniquely distinct from other descendents of immigrants. Previous studies (Takari, 1990;

Zhou and Gatewood, 2000) have reported that Asian Americans are often perceived as foreigners, even for those whose ancestors have lived in the U.S. for generations. This is most vividly illustrated by the question that Asian Americans are sometimes asked: "Where are you from?," with the expectation that they would give an answer of an area outside the America. Previous studies have shown that the experiences of being treated as foreigners have led Asian Americans to feel alienated by American culture and society (Woo, 2000; Zhou and Gatewood, 2000). This sense of alienation and marginality undoubtedly puts Asian Americans in a socially disadvantaged position, which may influence their dispositions and particularly, how Asian American youth perceive themselves among their peers.

The above is related to another key concept this study draws from Bourdieu's framework—complex concept of habitus. Habitus can be understood as internalized dispositions and thought processes that are generated by and reflect one's place in the social structure (Bourdieu, 1973; 1984). Habitus and cultural capital are closely related, to the extent that they are both generated by one's place in the social structure. It is worth noting that the social structure is not just about class, as Bourdieu and Wacquant (1992) have noted: "these structures are already pre-defined by broader racial, gender and class relations" (18). The social position of Asian American youth is strongly defined by race, class, and immigrant status. Due to the complexity and nebulous nature of habitus, various interpretations have been used by previous studies of it, including aspirations, tastes, and dispositions. In this article, habitus is interpreted as internalized dispositions, and operationalized through the way Asian American youth perceive themselves among their peers. Information on perceptions of popularity, athleticism, sociability, and academic ability is expected to tap into the multidimensional nature of habitus. This article contends that habitus provides a useful conceptual tool to understand the formation and development of Asian youth's inclination toward STEM fields.

Teenage years are the formative period when youth develop interests and self-understanding through interaction with people around them, particularly their peers (Johnson, 2002; Kohn and Schooler, 1983; Mortimer, Lorence, and Kumka, 1986). Throughout the process, they slowly come to identify who they are, which is to a great extent based on perceptions of how others consider them to be. In middle school and high school, some students are considered to be social and popular, while others are not. These different perceptions are often mapped along with the disparate activities students are engaged in. Previous research (Chen, 1999; Pascoe, 2003) based on qualitative data reports that students who are good at athletics are "jocks" in school and often considered to be popular and social. However, those who are good at math and science are often considered to be socially awkward "nerds" and "geeks" (Leong and Hayes, 1990). Qualitative studies have reported repeatedly that Asian students in American schools are often voluntarily or involuntarily cast into the roles of "nerds" and "geeks" (Oakes, 1990; Seymour and Hewitt, 1997). Media plays a key role in shaping these perceptions. First of all, scientists and engineers rarely attract media attention. A longitudinal study found that only two percent of the characters in the prime time TV show are scientists (Gerbner and Linson, 1999). Compared to extensive coverage of athletes, entertainers, and sometimes politicians and journalists, scientists and engineers somehow escape the limelight.

In sum, this study hypothesizes that Asian American youth may be disadvantaged in terms of cultural capital, when compared with peers of a comparable socioeconomic standing. At the same time, Asian American youth may develop a set of dispositions or habitus out of their unique racial experiences and immigrant history. The previous discussion has established that science and engineering fields may require less cultural capital than other fields, and that certain aspects of the identities of Asian American youth may fit the stereotypical images of scientists and engineers as well. The features of science and engineering as a field of study and profession, coupled with the cultural capital and habitus of Asian American youth, contribute to Asian youth's inclinations towards STEM fields.

Methods

Data

The current study uses the *National Education Longitudinal Study* (NELS: 1988-2000), collected by National Center for Education Statistics (NCES). NELS data provides the most recent representative longitudinal study, tracking students from a period that spans their eighth-grade year to eight years after high school graduation.[6] The 1988 eighth-grade cohort was followed at two-year intervals as the students passed through high school and entered post-secondary education. Similar to previous datasets collected by NCES, NELS data contains rich information on student pre-college academic preparation, including detailed information on coursework. Its postsecondary transcript data contains detailed curriculum information, as well as postsecondary attendance and attainment information. This information perfectly suits the need to understand the pipeline determinants of STEM degree attainment.

Sample

The sample (N=838) used in this article constitutes all high school graduates who identified themselves with Asian and Pacific Islander ancestry. Among the total sample of 838 students, 40 identified as Pacific Islanders. Over 70 percent of these students are either immigrant children or children with immigrant parents. Although the sample contains students with ancestry from various countries of origins such as China, Japan, South Korea, Vietnam, India, the Philippines, no sufficient sample size is available to separately examine them by these groups, especially considering the outcome of the study is the bachelor's degree attainment.

Analytical Strategy

The descriptive analysis examines the trajectories of these students at key stages in the STEM pipeline. The first stage is in the twelfth grade in 1992, when students looked ahead and stated their expected fields of study. The next stage in 1994 covers the initial field of study in college. The last stage in 2000 considers the field of study associated with the students' bachelor's degrees. The descriptive analysis also documents the differences between Asian American students and others in achievement and course taking in math and science, along with their habitus and cultural capital. These are independent variables in the multivariate analysis.

The multivariate analysis examines the three stages of the pipeline step by step. The first step investigates what the expectations of high school students are for majoring in a STEM field in the future, and the sample includes high school graduates in 1992 (N=11,155). The second step focuses on the choice of the first college major in STEM fields, and the sample includes college attendants in 1994 (N=7,038). The final step examines the attainment of a bachelor's degree in STEM, and the sample includes students who have obtained a bachelor's degree by 2000. There were 4,037 NELS respondents attaining a bachelor's degree by 2000, among whom 1,017 respondents (or 25%) achieved bachelor's degrees in STEM fields. All of the three dependent variables are dichotomous variables of whether the college major (expected major, first major, earned bachelor's degree) is in STEM fields.

Independent Variables

High School Achievement and Course Taking

High school achievement variables refer to the math and science standardized test NELS administered to all the respondents in the twelfth grade in 1992. The coursework information is from high school transcript data, and details on relevant course credits are available for calculus, physics, chemistry, biology, and computer science classes. I group them into two sets of variables based on the affinity between certain subjects: one is the sum of all course credits in physics, computer science, and calculus; the other is the sum of all the course credits in biology and chemistry.

Habitus and Cultural Capital

Habitus is operationalized in this article by the four items surveyed when students were in the tenth grade. Students were asked whether they were considered by their peers to be popular, athletic, socially active, or good students. Four dichotomous variables were created for these four aspects. Even though these four aspects could be readily interpreted as personality/disposition differences at the individual level, the previous theoretical discussion has suggested that Asian Americans as a group have been perceived to be collectively embodying certain dispositions reflecting their racial backgrounds and immigrant origins. In this sense, these aspects are operationalized as habitus—the internalized dispositions that reflect structural differences, race, class, immigrant origins, among other traits.

The NELS parents questionnaire includes information on the cultural activities parents and their children are engaged in. One set of questions asked: "Do you or your eighth grader take part in any of the following activities?" The activities include "attending concerts or other musical events" and "going to art museums." Another set of questions was related to whether students took lessons in high culture activities; for instance, "has your eighth grader ever taken classes outside of school in one of the following activities?," which include art classes and music classes outside of school. The parents answer all of the questions with a yes or no response, so it is not possible to measure the frequency of those activities. I constructed cultural capital as the sum of the number of activities in which the student participates. For each student, the cultural capital variable can range from zero (participating in no activities) to four (participating in all the activities included in this study).

Control Variables

Control variables include education expectation, family SES, college selectivity, and college GPA. Educational expectation is measured as a dummy variable that indicates whether students expect to attend college. Family SES is a composite measure including the father's and mother's education, occupation, and family income.[7] The college selectivity variable is about the first institution the student has attended, which is from the postsecondary transcript files. There are five broad selectivity bands: highly selective, selective, nonselective, open door. and not-ratable. The assignment of institutions to the bands is based on the Cooperative Institutional Research Project (CIRP) for 1992. The NELS open door category includes community colleges and area vocational technical institutes. Non-ratable applies, for instance, to foreign institutions.

Descriptive Analysis

Trajectories in the Pipeline

Figure 1 delineates the trajectories of the STEM pipeline according to its three locations. Since gender is a very significant dimension in STEM fields, I examine the trajectory for men and women

Figure 1. Trajectories in the Locations of the Pipeline

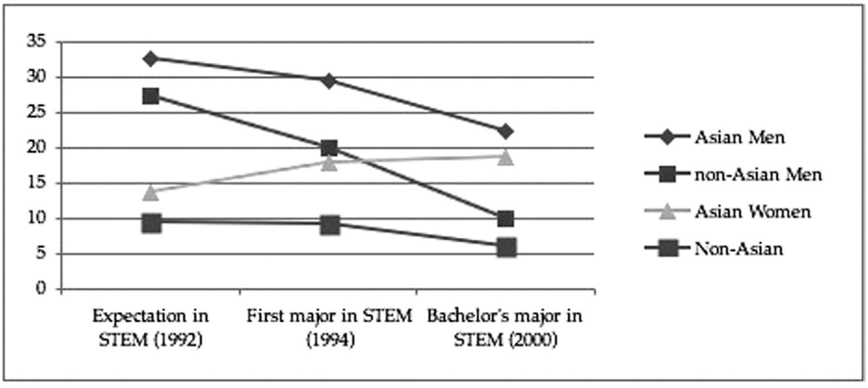

Table 1. Achievement and Course taking for Asian and Non-Asian Men and Women

	Asian Men	Non-Asian Men	Asian Women	Non-Asian Women
Math Achievement	56.56	52.21	56.15	50.83
Science Achievement	55.06	53.02	52.37	49.7
Bio and Chemistry	2.04	1.67	2.2	1.74
Physics, computer and calculus	1.51	0.91	1.32	0.82

separately. There is a gender gap in favor of men at each of the three locations of the pipeline. However, both Asian American men and women top their gender groups in final degree attainment in STEM fields. 22 percent of Asian American men earned STEM baccauleates by 2000, compared with 11 percent of non-Asian American men; 18 percent of Asian American women earned a STEM degree by 2000, compared with only 6 percent of non-Asian American women.

Is it more likely for Asian American students than others to expect to major in STEM fields? The answer is yes, but the gap is not big. Thhirty-three percent of male Asian American high school graduates expect to major in STEM fields, while about 28 percent of other male students expect a STEM major. For females, Asian American students follow an exceptional path during college: While attrition is likely for most demographic groups, Asian American women increase their representation in STEM fields at later locations of the pipeline—over 18 percent of them who got the bachelor's degrees graduated with STEM degrees, compared to 14 percent who expected to major in STEM fields as high school students. This indicates that some Asian women enter STEM fields late in college.

Differences in Achievement and Course Taking

Table 1 reports the differences in achievement and course taking for Asian American students and others by gender. The achievement test scores were taken from the standardized tests administered by NELS, in which the survey respondents were taking twelfth-grade-level math, reading, science, and social studies. Because math and science are the most important subjects for STEM fields, Table 1 reports the scores for math and science achievement tests. Considering that standardized test scores are limited in predicting students' future achievement and choice, Table 1 also reports course credit information from the high school transcript data from NELS. Based on the affinity of domain fields, I put the sum of the biology and chemistry credits in one category, and the sum of calculus, physics, and computer science credits in another category.

Table 1 shows that higher percentages for Asian Americans in every aspect of STEM-related achievement and course taking, for both men and women. Sometimes, the gap between Asian American women and other women is even more salient than that between Asian American men and other men. For example, Asian American women outperform other women in math achievement by close to 6 points, whereas Asian American men outperform other men by about 4 points. Women in general take more biology and chemistry courses and fewer physics and computer courses than men, but the gender gap is quite minimal when compared to the racial gap. Asian American students take over 25 percent more biology and chemistry courses than others, with similar figures for men and women; they take over 60 percent more total courses in physics, calculus, and computer science courses.

Differences in Habitus

Figure 2 presents four indicators of habitus, whether the respondents are considered to be popular, athletic, socially active,

Figure 2. Habitus for Asian and Non-Asian Men and Women

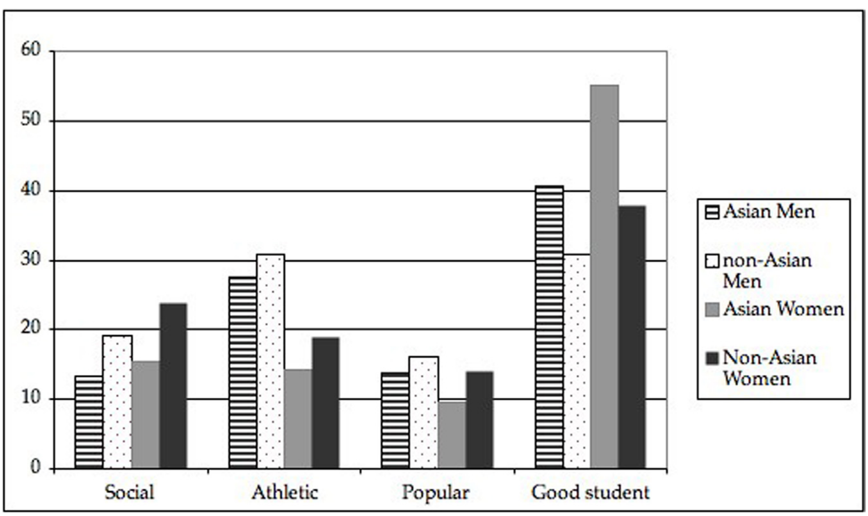

Table 2 Cultural Capital by SES Quartile for Asian and Non-Asian Men and Women

	Asian Men	non-Asian Men	Asian Women	Non-Asian Women
1st Quartile	0.42	0.51	0.26	0.63
2nd Quartile	0.59	0.79	0.73	0.99
3rd Quartile	1.07	1.08	1.25	1.4
4th Quartile	1.48	1.48	1.8	1.86

and good students. The results show quite a stark contrast: Asian American students are considered to be less popular, athletic, and socially active than others, whereas they are considered to be better students than others. This applies to both men and women, and sometimes the differences among women are starker. For example, about 55 percent of Asian American women are considered to be good students, while only 37 percent of other women are.

Differences in Cultural Capital

This article adopts the measures of cultural capital in terms of four aspects: attending music school outside of school, attending art classes outside of school, going to concerts with parents, going to museums with parents. Considering that all these cultural activities are not separable from socioeconomic resources, I examine the cultural capital by SES quartile. Specifically, I compare the cultural capital at each of the four SES quartiles. The higher the quartile, the higher the SES level is. Table 2 confirms that cultural capital is positively associated with family SES: the higher SES level is, the more cultural capital children have. This applies to both Asian Americans and the population in general. However, within the lower-SES quartile, specifically the two lower quartiles, both Asian American men and women have much less cultural capital than their counterparts. For the third and the fourth SES quartiles, Asian American students have less or similar cultural capital than others.

It is worth noting some gender differences here. At the lowest quartile, Asian American women has the lowest cultural capital among all the groups, that is, they have less cultural capital than Asian American men and other women from the same SES strata. This not only indicates that Asian American students from lower

SES backgrounds are disadvantaged in cultural capital, but also underscores the inferior treatment of women within lower SES Asian American families in terms of resource allocation in favor of men. However, the disadvantage disappears among higher-SES quartiles, in that Asian American women have more cultural capital than their male counterparts, even though they still lag behind other women from the same SES background.

Multivariate Analysis

The multivariate analysis investigates the three locations in the pipeline separately: the expectation of majoring in a STEM field, the first college major choice in STEM, and the attainment of bachelor's degrees in STEM. Given the large disparities in STEM attainment between whites and underrepresented minorities (URM), the multivariate analysis treats Asian Americans, whites, and URMs as separate groups. Considering that gender differences are quite salient to participation in STEM fields, I examine men and women separately for each step of the analysis.

Table 3 presents the logistic regression model on whether the sampled students expected to major in STEM fields when they were high school seniors. The coefficients are the odds ratio. Model I is the baseline model that includes Asian Americans and URMs as dummy variables, with whites being the reference category. For both men and women, model I shows that Asian Americans are significantly more likely to expect majoring in STEM fields than other students. For example, Asian American women have over 50 percent higher odds (odds ratio 1.57) of expecting to major in a STEM field in college than white women, whereas Asian American men have about 21 percent higher odds of (odds ratio 1.21) such an expectation than white men. However, after taking into account of high school achievement, course taking, and habitus and cultural capital measures, the odds drop significantly in both the men's and women's samples.

Model II shows the detailed relationship of how these independent variables are related to the outcome. Science achievement matters more than math achievement in predicting the expectation of majoring in STEM fields. High school course taking is important, but physics and calculus course taking seem to matter more than biology and chemistry in predicting expectation. Biology and chemistry seem to matter more for women than for men. Habitus measures reflect an interesting relationship: being popular is

Table 3 .Odds Ratios for Logistic Model on the Expectation to Have a STEM Major

	Women		Men	
	Model I	Model II	Model I	Model II
Asian	1.571***	1.12	1.208*	0.968
	-0.236	-0.179	-0.135	-0.114
URM	1.187*	1.552***	0.801***	0.911
	-0.12	-0.171	-0.061	-0.074
Achievement and Course taking				
Math achievement		0.996		0.984
		-0.009		-0.006
Science achievement		1.037***		1.027***
		-0.009		-0.006
Biology and chemistry credits		1.181***		0.976
		-0.065		-0.041
Physics, computer, and calculus credits		1.561***		1.554***
		-0.074		-0.056
Habitus				
Perceived to be popular		0.770*		0.680***
		-0.113		-0.068
Perceived to be athletic		1.187		0.91
		-0.138		-0.068
Perceived to be socially active		0.767**		0.928
		-0.089		-0.079
Perceived to be a good student		1.179*		1.185**
		-0.113		-0.084
Culture capital				
		1.019		0.941*
		-0.041		-0.029

Note:

1) Standard Errors are shown in parenthesis.
2) *p<.05 **p<.01 ***p<.001
3) URM refers to under-represented minorities.

negatively associated with expecting the STEM college majors for both men and women, whereas being a good student is positively associated with the outcome. The effect of cultural capital on the expectation of a STEM major is negative for men in a statistically significant way, but such effect does not exist for women. In other words, the more cultural capital Asian American men have, the less likely they would expect to major in STEM.

Table 4 presents models on whether students choose STEM fields as their first college major choice. Model I shows that the odds for Asian American women to have first major in STEM fields is 90 percent higher (odds ratio 1.91) than that for white women, whereas the odds for Asian American men is about one quarter higher (odds ratio about 1.26) than white men. Model II shows that, given the same pre-college achievement, course taking, habitus, and cultural capital, the positive effect of Asian American men dropped its significance level, yet the significant effect of Asian American women still remains, albeit reduced.

Model II shows that high school course taking continues to exert important effects on predicting the choice of a STEM major. One unit of increase in the sum of biology and chemistry credits is associated with 32 percent increase in the odds (odds ratio 1.32) of choosing a STEM field as the initial major for women, but no significant effect exists for men. However, physics and calculus credits promote the chance of choosing STEM as the initial major for both men and women. Habitus measures continue to be influential in the initial college major choice. Being popular, athletic, and socially active are negatively associated with choosing a STEM college major, whereas being a good student has positive effects. Cultural capital effect is similar as in Table 3, which is more salient for men than for women.

Table 5 shows the last step of the analysis—the attainment of the bachelor's degrees in STEM fields. Model I shows that Asian American women are more than two times as likely as white women in terms of the odds of attaining STEM bachelor's degrees. After including all the other independent variables in model II, the odds for Asian American women are close to 60 percent (odds ratio 1.59) higher than that for white women. The difference between Asian American men over other men is smaller, and dropped to non-significant level after controlling for those independent variables.

Habitus measures show interesting gender differences. Being considered athletic predicts the expectation for STEM fields

Table 4. Odds Ratios for Logistic Model on Choosing the Initial College Major in STEM Fields

	Women		Men	
	Model I	Model II	Model I	Model II
Asian	1.912***	1.362**	1.257*	1.084
	-0.27	-0.212	-0.156	-0.145
URMs	1.142	1.452***	1	1.115
	-0.124	-0.184	-0.095	-0.122
Achievement and Course taking				
Math achievement		1.008		0.988
		-0.01		-0.008
Science achievement		1.016*		1.030***
		-0.01		-0.008
Biology and chemistry credits		1.320***		0.981
		-0.078		-0.053
Physics, computer, and calculus credits		1.442***		1.407***
		-0.074		-0.061
Habitus				
Perceived to be popular		0.831		0.782**
		-0.126		-0.095
Perceived to be athletic		1.181		0.850*
		-0.145		-0.08
Perceived to be socially active		0.797*		0.775**
		-0.095		-0.083
Perceived to be a good student		0.977		1.13
		-0.099		-0.097
Culture capital				
		1.032		0.905***
		-0.043		-0.034

Note:
1) Standard Errors are shown in parenthesis.
2) *p<.05 **p<.01 ***p<.001
3) URM refers to under-represented minorities.

Table 5. Odds Ratios for Logistic Model on Attaining the Bachelor's Degrees in STEM Fields

	Women		Men	
	Model I	Model II	Model I	Model II
Asian	2.104***	1.586***	1.648***	1.274
	-0.314	-0.275	-0.25	-0.221
URM	0.877	1.1	0.94	1.053
	-0.145	-0.206	-0.151	-0.204
Achievement and Course taking				
Math achievement		1.023*		1
		-0.014		-0.012
Science achievement		1.043***		1.040***
		-0.012		-0.011
Biology and chemistry credits		1.419***		1.361***
		-0.105		-0.104
Physics, computer, and calculus credits		1.475***		1.518***
		-0.092		-0.086
Habitus				
Perceived to be popular		0.788		0.806
		-0.147		-0.135
Perceived to be athletic		1.293*		0.934
		-0.19		-0.122
Perceived to be socially active		0.834		0.712**
		-0.122		-0.11
Perceived to be a good student		1.095		1.148
		-0.139		-0.137
Culture capital				
		0.916*		0.899**
		-0.045		-0.046

Note:
1) Standard Errors are shown in parenthesis.
2) *p<.05 **p<.01 ***p<.001
3) URM refers to under-represented minorities.

for women, but not for men. Being considering socially active is negatively associated for the expectation for STEM fields for men, but not for women. Cultural capital is negatively associated with the attainment in the STEM fields for both men and women, in that the more cultural capital one has, the less likely they would graduate with the STEM bachelor's degrees.

Discussion and Conclusion

The Significance of Pipeline Model

The pipeline model of education attainment in STEM proves to be useful in understanding of the higher likelihood of Asian American students attaining a STEM bachelor's degree. Previous studies have identified the critical points of transition in the pipeline (Adelman, 1999; Berryman, 1983) and this article focuses on the three key locations: the expectation of the college major, the initial college major, and bachelor's degree attainment. Asian American students are found to be inclined towards STEM fields at each location of the pipeline, and more importantly, the gap seems to be widened as they progress further along the pipeline. That is to say, as other students drop out or switch from STEM to non-STEM fields (Seymour and Hewitt, 1997), Asian American students are more likely to push through and persist.

Underlying their attainment of STEM bachelor's degrees is their academic preparation in high school. The linkage between pre-college and college is also underscored in the pipeline model. This article examines the math- and science-related achievement test scores and course taking information, and finds that Asian American students overachieve in every aspect of pre-college academic preparation. The multivariate analysis further examines the relationship between the specific aspects of pre-college academic preparation and each of the three locations of the STEM pipeline. Course taking in high school is found to be more important than achievement test scores. This article differentiates different types of math and science courses, and finds that physics, computer science, and calculus course credits matter more than biology and chemistry courses, in the pipeline of STEM degree attainment. In addition, interesting gender differences emerge: biology and chemistry courses matter more for women than for men. This may have something to do with women's higher representation in life sciences in college than men (Ma, 2009).

Comparisons between Asian Americans, Underrepresented Minorities, and Whites

The analysis of this study shows that, overall, Asian Americans are much more likely than other minority groups and whites to major and attain degrees in STEM fields. Other minorities include African Americans, Hispanics and Native Americans, based on NELS racial classifications. Since gender differences in STEM concentrations are of perennial interest to scholars and policymakers alike, this article separately examines Asian American men versus other groups and Asian American women versus other groups.

The underrepresentation of women in STEM fields remains one of the most stubborn sources of gender inequality in higher education (Jacobs, 1989, 1995), which is particularly puzzling when women are now the majority of college students and college graduates. Previous research has found that low SES women generally are more inclined towards technical fields, and their class background trumps gender in career-related educational choices (Ma, 2009). Therefore, it is important to examine sub-groups among women. This study has found that both Asian American women and underrepresented minority women are more inclined towards STEM majors than white women in terms of expectation and first major choice, though the gap between Asian American women and white women is more salient. However, Asian American women managed to maintain a lead over white women in degree attainment, while underrepresented minority women lost their lead, which indicates that attrition is an issue for them. Interestingly, underrepresented minority men were not as inclined towards STEM fields as whites at every stage of the pipeline, while Asian American men managed to maintain their lead over whites.

As such, the focus on Asian American students sheds some new light on the issue of women's underrepresentation in STEM fields. This article has found that the overrepresentation of Asian Americans in STEM fields is actually more salient for women than for men. Certainly, it is possible that Asian American women might not be overrepresented beyond the baccalaureate level, and that further along the pipeline (i.e., in graduate school and later academic careers), they might follow the similar path of attrition—to drop out of graduate school or switch careers, partially due to the so-called "chilly environment" in some graduate research programs and to the not-so-family-friendly lifestyles in certain STEM academic careers (Ginorio, 1995; Shauman and Noonan, 2007). This could be interesting to examine in future research.

However, attaining a bachelor's degree in STEM fields is monumental in gaining access to a STEM profession or furthering education in graduate school. Asian American womens' excellence in academic preparation and their inclination towards math and science contradicts the stereotypical notion that women are innately unprepared and uninterested in math and science, even though Asian American women still lag behind Asian American men in STEM degree attainment.

Model Minority—Model for Whom?

Diversity in STEM education has been a longstanding national policy issue, primarily because such minority groups as African American and Hispanic students, in particular, and women, in general, are underrepresented in STEM fields. Asian students, men and women alike, are exceptional in this regard, which definitely reinforces the "model minority" image.

However, the link between Asian American students' attainment in STEM fields and the model minority image is perhaps more apparent than real. This article has focused on a set of measures of Asian American students' thoughts indicating how they think they are perceived by their peers. This article has found that they think they are less popular, less socially active, and less athletic than their peers. They perceive themselves to be good students. These aspects are significantly related to the choice and attainment in STEM fields. Though being a good student is very important, popularity and having an active social life are as important, if not more so, to a teenager (Leong and Hayes, 1990; Pascoe, 2003). This raises an obvious question: in the discourse of model minority, for whom are Asian American students models? If models are people that their peers try to emulate, then apparently Asian American students themselves do not consider they are models for their peers.

This negative self-perception of Asian American students in terms of sociability and popularity may hinder their confidence in their people skills in general and leadership skills in particular. Research on adult Asian American workers already shows that they are overrepresented in STEM professions, yet underrepresented in the managerial ranks of STEM professions (Tang, 2000; Woo, 2000). Debates center on the extent to which racial discrimination lead to the barriers experienced by Asian American workers attempting to move up the occupational ladder. Though this study is not studying occupational attainments, it suggests that Asian American students' negative self-perception might contribute to their occupational aspirations and confidence in labor market.

If habitus is subjective and tends to vary depending on the circumstances, the measures of cultural capital, as adopted by this article, tap into the relatively objective conditions of resources. This article has found that Asian American students are not in advantageous social positions—they have less cultural capital than their counterparts at comparable socioeconomic levels. However, this article has also found that cultural capital is negatively associated with attaining a bachelor's degree in STEM fields, controlling for pre-college academic achievement and preparation. In other words, children rich in cultural capital may not favor STEM fields, given the same academic preparation. In the multivariate model of the choice and attainment in STEM fields, Asian American men are not significantly more likely than others to choose a college major choice in STEM fields or to attain a bachelor's degree in STEM fields, after controlling for cultural capital and academic variables. This, on the other hand, implies that Asian American students and their families are consciously choosing STEM fields to circumvent the limitations of their cultural capital.

Therefore, the choice and the attainment of degrees in STEM fields among Asian American youth seem to be a success story. But behind the facade lies many disadvantages, in the adaptations and compromises that Asian American students make. This has some important implications for higher education institutions and other communities in promoting social status and success for Asian Americans. First, people working in education institutions should not take it for granted that Asian American students are naturally inclined towards STEM fields. Teachers, counselors, advisors, and administrators need to develop some sensitivity to what are the perceived strengths and weaknesses of Asian American students. Every effort needs to be made to avoid stereotypes that Asian American students are good at and only interested in math and science. Failure to do so will reinforce stereotypes of Asian American youth and prevent them from discovering their true selves (Chen, 1999; Leong and Hayes, 1990; Woo, 2000). Second, education institutions, both secondary and higher education institutions, need to increase awareness in order to provide support and opportunities for Asian American students to engage in cultural and social activities, especially for those from low-SES family backgrounds who are disadvantaged in terms of cultural capital compared to their counterparts.

While this study focuses on understanding the processes leading to the choice and degree attainment in STEM fields among Asian American students, recent studies have shown that this tendency has started to decline. Chang et al. (2007) found that, among Asian Americans, there has been a trend in moving away from majoring in STEM fields in the last three decades, and that business attracted more Asian students. It may be that, as Asian Americans are more acculturated and integrated within American society, they are more aware of the opportunities in fields other than science and engineering. Influenced by post-1965 immigration policy, most of the Asian Americans in the U.S, particularly those on college campuses, are children of immigrant families. Media coverage has examined the inclination among children of immigrants towards math and science achievement. For example, a recent *New York Times* article from October 10, 2008, highlighted that "girls who do succeed in [mathematics] are almost all immigrants or the daughters of immigrants from countries where mathematics is more highly valued." Future studies could investigate the broad question of whether first- and second-generation children from immigrant families are more likely to study in STEM fields.

Notes

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1. The trend of Asian American students participating in STEM fields is decreasing, but this has not changed the fact that they are still far more likely than other groups to be in STEM fields.
2. The variations among Asian Americans from different ethnic groups are important, in that some ethnic groups among Asian Americans are not over-represented in STEM fields. But this study is subject to data constraint, which does not permit study at the level of ethnic groups. However, the category of Asian Americans is relevant, in that federal policies and programs promoting STEM education refer to Asian Americans as one category.

3. This article chooses to focus on cultural capital and habitus, which does not mean that they are the only relevant mechanisms. Social capital, among other things, is also useful for understanding the presence of Asian American students in STEM fields. Asian American adults are overrepresented in science and engineering workforce, primarily due to the post-1965 immigration policy that admits workers with technical expertise. Asian Americans now make up 14 percent of the science and engineering work force, according to recent data from the National Science Foundation (2008). Many Asian American youth are children, relatives, friends, and acquaintances of those adults working in the science community. However, the NELS data does not contain the detailed occupation information of students' parents, nor that of other family and friends. For detailed information, please see the footnote 5. In addition, the explanation that social capital provides additional support for Asian Americans' choices in STEM fields, but cultural capital provides an alternative and often neglected perspective to highlight the barriers and disadvantages that prevent them from pursuing other fields.
4. The pipeline could start earlier than high school expectations of majoring in a STEM field. Courses and other curricular activities during middle school and primary school are part of the pipeline that could potentially influence a student's inclination towards STEM. However, we agree with Xie and Shauman (2003) that an expectation of a STEM college major during high school is viewed as a beginning of a serious commitment to STEM. Therefore, we followed their decision in charting the STEM pipeline from the expectation.
5. NELS did not provide the information regarding the specific time students declare their college major. This study used the college major information at the first postsecondary institution students attended by 1994 to capture the initial college major information.
6. This study used the survey commands in STATA to address the NELS complex survey design, so as to yield the correct variance and significance tests.
7. It would be ideal to have the detailed parental occupation information controlled, but NELS data has parental occupation information only on a broad scale that would not be able to describe the differentiation, for example, between engineers from accountants, since they are all grouped under the category of professional.

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