Jumping on the STEM Train: Differences in Key Milestones in the STEM Pipeline between Children of Immigrants and Natives in the United States

Abstract

We focus our study on children of immigrants in STEM fields because children of immigrants represent a diverse pool of future talent in those fields. We posit that children of immigrants may have a higher propensity to prepare entering STEM fields, and our analysis largely confirms this conjecture. Using the NELS: 88-00 and its restricted postsecondary transcript data, we examine three key milestones in the STEM pipeline:1) highest math course taken during high school; 2) initial college majors in STEM; and 3) bachelor's degree attainment in STEM. Using individual level NELS data and country-level information from UNESCO and NSF, we find that children of immigrants of various countries of origin are more likely to take higher-level math courses during high school, with the exception of Mexicans, than children of natives. Asian and white children of immigrants are more likely to complete STEM degrees than third-generation whites. Drawing on theories of immigrant incorporation and cultural capital, we discuss the rationales for these patterns, and the policy implications of these findings.

Keywords: children of immigrants, immigrant incorporation, second generation, STEM, math, science, attainment, achievement, higher education

Jumping on the STEM Train: Differences in Key Milestones in the STEM Pipeline between Children of Immigrants and Natives in the United States

A great deal of attention has been paid of late to the need for diversity in science, technology, math, and engineering (STEM). For example, a National Research Council report, *Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads* (2011) pointed out that those groups that are underrepresented in science and engineering are also among the fastest growing population in the U.S. However, the report did not mention children of immigrants as a resource in the task of building up the STEM pipeline. Indeed, few academic studies have been conducted on children of immigrants in these disciplines, in spite of some media coverage. We do know that Asian American students are disproportionately majoring in STEM fields (Ma 2010; Sakamoto, Goyette and Kim 2009; Song and Glick 2004; Xie and Goyette 2003), but whether this phenomenon extends beyond children of immigrants to later-generation Asian Americans is largely unexplored. We also are not clear of whether children of immigrants from other racial-ethnic groups are also more likely in STEM fields. There is no doubt that increasing numbers of foreign-born students and professionals enter STEM degree programs and professions, particularly engineering, which accounts for half of all STEM workers (Burton and Wang 1999; Gurcak et al 2001; NSB 2010). While the immigrant origins of increasing numbers of STEM workers in the United States is well known, the propensity for children of immigrants to join these fields is not clear.

In this research, we examine whether children of immigrants are disproportionately represented in various stages of the STEM pipeline. To attain STEM degrees, a student has to not only have an interest, but also sufficient academic preparation (Seymour and Hewitt 1997) because STEM fields are more structured and sequential than other fields in terms of the

curriculum (Xie and Shauman 2003; Oakes 1990). The role of math in affecting individuals' educational and career choice has been confirmed by various studies (Montmarquette et al.2002; Paglin and Rufolo 1990; Ma 2009; Seymour and Hewitt 1997; Xie and Shauman 2003). In this study, we examine three key milestones in the STEM pipeline: highest math course taken during high school, initial college majors in STEM fields, and bachelor's degree attainment in STEM. In this article, children of immigrants include the first generation, members of the 1.5 generation and the second generation. We refer to children of native-born parents as members of the third-and-later generations.

Drawing from theories of immigrant incorporation and cultural capital, we posit that children of immigrants may be more likely to study math and science subjects than their native counterparts based on four considerations. First, STEM education tends to lead students to good job opportunities in modern economies (Crosnoe, Lopez-Gonzalez and Muller 2004; Oakes 1990; Tang 2000) something that may be appealing to children of immigrants seeking financial security and mobility. Second, given math and science are not as dependent on language and culture, particularly in high-brow cultural capital (Bourdieu 1990; Dumais 2002; DiMaggio 1982; Xie and Goyette 2003) as humanities or social sciences, children of immigrants may consciously eschew their disadvantages and opt for math and science fields that are less demanding in high-brow cultural capital. Third, we propose that home-country cultural capital is relevant (Fernandez Kelly 2008), in that children of immigrants may retain some of their parents' home culture where science may be a greater part of the collegiate culture than in the US. Finally, because of policy changes in the post-1965 migration that allow for migration based on occupational categories (Gurcak et al 2001; Espenshade et al 2001), engineers and scientific workers have been specifically recruited to the United States and given entry through the H1-B

visa program, and many children of immigrants may be influenced by their parents and inclined towards these fields.

Immigration Incorporation and STEM Education

We draw from theories of immigrant assimilation and selectivity to understand the choice and attainment in the STEM pipeline by children of immigrants. Choosing math or science may be a route to socioeconomic assimilation as conceptualized vis-à-vis the traditional (Gordon 1964) and neoassimilation theories (Alba and Nee 2003) insofar as they lead to relatively good career prospects. Song and Glick (2004) argue that "migration status may play a role in choice of college major if immigrant parents are more likely to place a high emphasis on upward social mobility and higher economic security" (p. 1403). Children of immigrants may take a more practical stance on majors than do children of native-born parents, selecting fields based on prospective earnings. There is some evidence that immigrant parents think about their children's college major choice in this way. Zhou (2009) finds that Chinese immigrant parents "take a pragmatic stance on education" steering their children toward the fields of "science, math, engineering and medicine, and to a lesser extent, law" in part because these fields are seen as offering a path to a good job, and in part because of parents' perceptions that other fields may be difficult to enter due to lack of social networks or discrimination (p. 151). Likewise, Tang (2000) suggests that Asian college students, who are disproportionately children of immigrants, tend to be more "opportunity-oriented" in their college major choices than their peers of other racial-ethnic backgrounds (p. 35). Technical fields, such as engineering with universal standards, and particularly those oriented toward government employment such as mechanical and civil engineering, have been found to offer greater protection from employment discrimination than other professional fields and have attracted a high proportion of Asians in particular (Sakamoto,

Goyette and Kim 2009; Tang 2000). Children of immigrants may prioritize security and monetary rewards over other forms of fulfillment.

In addition to the motivation of jobs and money, children of immigrants likely follow their parents into STEM fields, where immigrants are disproportionately represented. Thus, immigrant selectivity may also play a role in the likelihood of children of immigrant groups from different social origins to enter STEM fields. Feliciano (2005, 2006) has noted that ethnic differences among children of immigrants relate to selectivity of immigrant generation. The post-1965 immigration policy ushered in a series of policies that target foreign students and workers in STEM fields (Gurcak et al 2001; Espenshade et al 2001). Many immigrant parents therefore are selected precisely based on their skills and expertise in STEM fields. In recent years, the children of immigrants who arrived on H1-B visas, through which most of the scientific workers enter the United States, have demonstrated extraordinary interest and capacity for science. For example, in the 2011 Intel Science Search (a prestigious national science competition whose finalists have largely gone onto professional careers in science and whose alumni include 7 Nobel Prize winners), 60% of the finalists were children of immigrants whose parents arrived through the H1-B visa program (Anderson 2011). Given the propensity of children to follow their parents into scientific careers (Preston 2004), it would be helpful to examine which countries are sending the largest numbers of immigrants through the H1-B visa program.

INSERT FIGURE 1 HERE

Figure 1 shows the numbers of H1-B visas by country of origin. Over three quarters of H1-B visa were granted to people from Asia, particularly India, and to a lesser extent, China. The next major region to send H1-B visa workers is Europe. Because of the greater propensity of

immigrants from Asia and Europe to arrive through the H1-B program than other regions of the world, we might anticipate that children of immigrants with origins in those continents would have greater likelihood to enter STEM fields. Although Mexicans make up by far the greatest source of migration to the United States (Migration Policy Institute Data Hub 2011), relatively few Mexicans come through the H1-B visa program, which is the primary program through which scientific workers are admitted[i]. As suggested by Feliciano's work (2005, 2006), immigrants who come in large numbers through the H1-B visa program, are likely to be more selective, both in terms of being higher educated and more likely to be a STEM worker, than those who come through other channels. As such, we expect that children of Mexican immigrants may not be as likely as children of Asian or White immigrants to study in STEM fields.

While we have outlined several reasons why children of immigrants may find STEM fields attractive, we argue that there are reasons that their native counterparts may not find STEM fields that attractive. Children of natives may see that the route to careers in math and science requires a great deal of hard work in order to obtain the security of a position in fields that are similarly, or even less rewarded in the long run than some other career paths, such as business, which seemingly requires less effort of students during the college years. Indeed, Arum and Roska (2011) find that business majors spend less time on their studies than students of other majors, but reap higher than average rewards upon graduation. Such understandings are parodied by students of the engineering-focused school, Georgia Tech, in the video of the song, "Jumping on the M train" giving current students the advice to jump on the M (Management) train by becoming business majors. The song's lyrics ask, "Why would you take the harder route when there's an easy way?" adding, "The engineers are gonna pout; you'll be their bosses one day"

(Swafford 2008, http://www.swaff.net/). Indeed, scholars in labor economics, such as Freeman (2006), have argued that one of the primary reasons that STEM fields have failed to attract enough native students is that they do not offer competitive salaries, compared to other high-level occupations that require graduate education such as law or an MBA. At the undergraduate level, STEM fields generally are well-paid, particularly for certain majors such as computer science and engineering. This is attractive for many immigrant youth who aim for landing a job right after getting their bachelor's degrees. Still, in recent years the most popular college major choice overall has been Business and Management, which accounts for nearly 1.5 times as many majors as all of the STEM field majors combined (Choy and Caroll 2008, p. 4). Also worth noting are the salaries that college graduates make in their occupations, irrespective of their college majors, as the returns to the fields themselves may serve to attract or detract potential majors to the field. Choy and Carroll (2008) find that those working as business workers and managers have the highest salaries regardless of major. This may lead students to perceive even higher returns to business majors than actually exist. Thus, native students may eschew STEM fields in favor of business, which they perceive to be easier and more lucrative in the long run.

Cultural Capital and STEM Education

Choosing to study math, science, or engineering, like any career choice, involves cultural knowledge and personal values as well (Correll 2001, 2004; Eccles 1994), implying that cultural capital may come into play in college major choice. Traditional definitions of cultural capital usually refer to the engagement and participation in "highbrow" cultural activities (Bourdieu 1990; Dumais 2002) such as attending concerts, studying arts, and going to museums. Most studies presume that cultural capital is analytically distinct from the technical skills (Lareau and

Weininger 2003). For example, DiMaggio (1982) 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.

Traditional definitions of cultural capital, rooted in the French cultural context, emphasize the educational importance of the arts and humanities. In that sense, because traditional conceptions of cultural capital are rooted in Western, and particularly European, cultural traditions, children of immigrants from non-European societies may lack these forms of cultural capital. To the extent that children of immigrants want to eschew the disadvantages associated with this lack of high-brow cultural capital, they may opt for STEM fields that require less of this type of cultural capital.

New ways of thinking about cultural capital are also emerging that focus squarely on immigrant culture. For example, Patricia Fernandez Kelly (2008) has recently emphasized the importance of home country-based cultural capital among children of immigrants. A high degree of home country-based cultural capital may indicate a strong influence of home country values and norms. Children whose parents come from countries where greater emphasis is placed on math and science may have a greater desire to pursue math and science careers as fitting more squarely within their own (and importantly, their parents') cultural repertoire. If a student has

origins in a country where STEM represents a large proportion of total college graduates, indicating that STEM is highly valued and popular in the home country, then a student may be influenced by this and may be more likely to pursue STEM when thinking about their college options. Figure 2 shows cross-national differences in the ratio of STEM degrees among the first degree population in 2005. We draw the data mainly from UNESCO Institute for Statistics (2011), but due to missing data on key countries such as China, we supplement it with information from NSF that pooled data from various sources in 2005 (National Science Foundation 2009). Figure 2 shows that most migrant groups in the US come from countries where STEM majors represent a higher proportion of college graduates than in the US. Countries with the highest proportions are in Asia. In particular, Singapore and China have as high as half of their postsecondary degree earners in STEM fields.

We propose that the percentage of STEM fields among college graduates is a key indicator of the relevant home-country culture and values that bear on children of immigrants' decisions to study STEM fields. However, if children of immigrants do not really identify with their home country culture, the premium on STEM fields is still irrelevant in students' decisions. One way of measuring a student's cultural ties to the home country is whether the child retains the parents' mother tongue. As such, as part of our home-country cultural capital conceptualizations, built on Fenandez-Kelly's (2008) concept of home-country cultural capital, we also include home-language proficiency for these children of immigrants. Although Bourdieu and Passerson's (1990) original conceptualization of cultural capital as well as Lareau's more recent work on cultural capital (2011[2003]) emphasize language as an indicator of cultural capital (See also Lareau and Weininger 2003)[ii], we distinguish our use of language to conceptualize this newer idea of home-country cultural capital from their earlier

conceptualizations. Since the article is about children of immigrants, we also focus on their proficiency in a parent's mother tongue, which taps into the ties and familiarity of children of immigrants with their home country culture.

In sum, we focus on the theory of immigrant incorporation and cultural capital to understand children of immigrants' interest and study in STEM pipelines, as compared to their native counterparts. In our empirical analysis, we examine three key milestones of STEM pipelines: highest math course taken, first college major choice in STEM, and bachelor's degree attainment in STEM.

INSERT FIGURE 2 HERE

Data and Analytical Strategy

For individual micro-level data, we use the National Education Longitudinal Study (NELS: 88-2000) including its postsecondary transcript data, collected by the National Center for Education Statistics (NCES). NELS data[iii] is a nationally-representative longitudinal study that spans from students' 8th grades to 8 years after high school, when students are about 26 to 27 years old. NELS[iv] is the most recent national longitudinal data available to examine bachelor's degree attainment. It has rich pre-college information on course taking, attitudes and family contexts. Among the NELS respondents, approximately 4040 students attained a bachelor's degree by 2000, among whom, approximately 1020 respondents (about 25 percent) received degrees in STEM fields, including the fields of natural science, technology, engineering and mathematics.

Our study examines three outcomes of the STEM pipeline: the highest math course taken during high school, the initial college major in STEM field, and the attainment of a STEM

bachelor's degree. High school math courses lay the foundation for many STEM fields in college. Initial college major choice is an important marker of entry into STEM fields. As such, we examine the full spectrum of academic preparation, choice, and degree attainment of STEM fields.

In examining the educational pathways of children of immigrants, a question that arises is whether children of immigrants should be compared to native majority youth or native youth from the same group (Kasinitz et al 2008, Harris et al 2008). We take a dual approach by looking at the educational pathways leading to science and math careers relative to both the native majority group as well as natives from the same racial-ethnic group. This design focuses on the key group comparisons. We examine racial ethnic groups by focusing on the four major groups: non-Hispanic whites, non-Hispanic blacks, Latinos and Asians. For Latino immigrants, our sample allows us to examine Mexicans separately, and other Latino immigrants. Due to considerable heterogeneity among subgroups within the Asian immigrant population in terms of assimilation patterns and opportunities for social mobility (Xie and Goyette 2003; Zhou 1997), we examine separately Asians from countries with more and less advantaged circumstances (See also Harris et al 2008). The following section on measures provides the details.

Measures

Dependent Variables

Highest Math Course in High School

The first dependent variable is the highest math course taken, which is from the high school transcript data. The NELS provides the coding for this variable, which ranges from 0 to 6: coded 6-calculus, 5-precalc, 4-trig, 3-algebra2, 2-geometry, 1-algebra1, 0-below algebra.

Initial College Major in STEM

The second dependent variable is a dichotomous measure of whether one claimed the initial college major in STEM. The initial major is based on students' self-reports. STEM fields include life science[v], math, physics and computer science; engineering[vi] (of all types); non-STEM fields include humanities, social science, business and arts.

Completion of STEM Bachelor's degree

The third dependent variable is a dichotomous measure of whether one attained a STEM bachelor's degree. The bachelor's degree major is obtained from the NELS: 88/2000 Postsecondary Transcript files.

Independent Variables

Race-Ethnicity/Immigrant generation

Our primary variable is race-ethnicity and immigrant generation. We take an intersectional approach to examine the impact of both race-ethnicity and immigrant status. Race-ethnicity and immigrant generation were measured in the base year when the student was in the eighth grade. For each racial/ethnic group in our study, we distinguish children by their parents' nativity between children of immigrants (including both first and second-generation children of immigrants) and children of native-born parents (third-and-later generation children).[vii] Among Latinos, we distinguish between Mexicans and other Latinos. Additionally, we follow Harris et al's (2008) strategy in separating Asian children of immigrants into two groups: Advantaged Asians and Disadvantaged Asians. The former group, which is generally more advantaged, includes Chinese, Japanese, Korean, Filipino, South Asian, Asian Middle Eastern respondents. The latter group, which is generally less advantaged, includes Cambodians,

Laotians, Hmong, Vietnamese, Pacific Islanders, West Asians and other Asians. The sample size for the third generation Asians is too small to divide it into these categories and thus includes all third-and-later generation Asians. As such, we have twelve racial-ethnic/parental generation groups in total. They are: native whites, immigrant-origin whites, native blacks, immigrant-origin blacks, native Mexicans, immigrant-origin Mexicans, native other Latinos, immigrant-origin other Latinos, native Asians, immigrant-origin Asian advantaged group, and immigrant-origin Asian disadvantaged group. For those who have not identified with the four major racial ethnic categories, they are grouped into an "other" category.

Cultural Capital

High-brow cultural capital

We follow Dumais (2002) in measuring the traditional definition of cultural capital, *high-brow cultural capital*. The NELS parental 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 cultural activities: "has your eighth grader ever taken classes outside of school in one of the following activities?" The activities include "art classes outside of school," and "music classes outside of school." The parents answer all of the questions in the form of yes or no, so it is not possible to measure the frequency of those activities. We 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 six (participating in all the activities included in this study)[viii].

Home-country cultural capital

We use two measures to tap into Fernandez-Kelly's (2008) concept of *home-country cultural capital*. The first measure is the percentage of bachelor's degrees in STEM fields in different countries, based on the information provided in Figure 2. We use this measure to tap into home-country values in STEM fields. We match the country information in Figure 2 as closely as possible with the country of origin data in NELS. All the third generation students in NELS sample are assigned the US value, which is 17% of bachelor's degree graduates in STEM fields. Children of immigrants are assigned with their country of origin values[ix]. The second measure is based on home-country language proficiency. We created a dichotomous measure to indicate those who can speak and understand their home language very well. We use language proficiency as an alternative definition of cultural capital to highlight the cultural norms based on the immigrant context.

Control Variables

We include family and school background variables as control variables. The composite measure of family SES from NELS includes education, occupation and income of both parents. We include the average of math and reading standardized test scores in 12th grade as a measure of college preparation for the model on STEM college major choice and degree attainment. In addition, high school quality was captured by a set of dummy variables that distinguished between private and public sector and low to high levels of school lunch program participation. We also include a dummy variable indicating whether calculus is offered to capture high school curriculum offering that is relevant to students' highest math course taken.

Results

Group Differences

Figures 3 through Figure 5 present the distribution of the twelve groups for the three dependent variables respectively: the highest math course taken in high school, the initial college majors, and the attainment of the bachelor's degree in STEM fields. In these three figures, we can first compare the native racial ethnic minority groups relative to the native whites to see the racial ethnic differences, and then we can compare within each racial ethnic groups between children of immigrants and children of natives.

INSERT FIGURE 3 HERE

In Figure 3, the mean of the highest math courses taken among native whites is 3.24, and the mean of all the other native racial minority groups is lower than native whites. However, a different picture emerges when we compare the children of immigrant groups to children of native groups within each racial-ethnic group. The mean for immigrant-origin whites is 3.61, higher than for native-origin whites. Likewise, the mean for the immigrant-origin Asian advantaged group is 4.51, the highest of all the 12 groups under study, and the mean for immigrant-origin Asian disadvantaged group is 4.22. What is notable is that native-origin Asian students take substantially lower-level math courses than their counterparts who are children of immigrants; the mean is only 3.18, which is lower than native white students. The same pattern is found for black students and other Latinos—children of immigrants take higher-level math courses than their counterparts who are children of natives. Among all the groups, Mexican children of immigrants stand as an exception—their mean is slightly lower than their native-origin counterparts. In fact, Mexican children of immigrants have the lowest mean among all the groups. Ultimately, Figure 3 shows

that the children of immigrant groups tend to take higher-level math courses during high school than their native-origin counterparts, with the exception of Mexican children of immigrants.

INSERT FIGURE 4 HERE

Figure 4 presents the percentage of people claiming initial college majors in STEM fields by each group, and Figure 5 presents the percentage of people attaining the STEM bachelor's degrees by each group[x]. Due to the small sample size of immigrant blacks in the sample of college students, Figure 4 has not included this group. Among the 10 groups in Figure 4, the pattern that children of immigrants are more likely to claim STEM as their initial majors than their third generation counterparts remains largely true. Immigrant Asian students show the strongest tendency. Immigrant white students are also more likely to major in STEM fields than third generation white students. Although Latino students generally are not likely to major in STEM, immigrant Latino, including Mexicans, are slightly more likely to major in STEM, although the difference is not statistically significant.

Figure 5 is from the sample of graduates with bachelor's degrees. Due to small sample size, immigrant blacks and other Latinos (both immigrants and natives) are not included in Figure 5. Overall, Asian immigrant students are likely to both claim majors and complete degrees in STEM fields. Asian disadvantaged groups in particular attained the STEM bachelor's degrees in the highest numbers--almost 1 out of 2 bachelor's degree earners among this group got their degree in STEM fields. On the other hand, the native-origin Asian students do not show significant tendency towards STEM compared to native whites. Although not as salient as Asian immigrant students, immigrant whites are also more likely to both claim their initial majors and complete bachelor's degrees in STEM fields.

INSERT FIGURE 5 HERE

Multivariate Analysis

Multivariate analysis can test whether the group patterns still hold after taking the relevant factors into account, and also examine the roles of certain key factors, including cultural capital. Tables 1 through 3 present the analysis on the three outcomes respectively, highest math course taken in high school, initial college majors in STEM, and bachelor's degree attainment in STEM fields. For these three tables, the reference group is native whites, in order to examine the racial/ethnic effect. To further elucidate the effect of immigration status, we compare children of Asian immigrants with their third-generation Asian counterparts in Table 4, and children of Latinos with their third generation Latino counterparts in Table 5. Due to the small sample size of the third-generation Asians and Latinos in college, Tables 4 and 5 only examine the outcome of high school math course taken.

INSERT TABLE 1 HERE

Table 1 presents four incremental models using ordered logit regression estimation, given that the variable of highest math course taken is an ordinal variable. The baseline model includes 11 groups, with native whites as the reference group. It reveals patterns similar to those described in the descriptive analysis. All the native minority groups took significantly lower-level math courses than native whites, but some immigrant-origin groups, particularly whites and Asians, took significantly higher-level math courses than native whites. Model II adds family SES and whether the student's high school offers calculus courses, but group patterns largely remain. Models III and IV add high-brow cultural capital and home-country cultural capital variables respectively. They are both positively related to the highest math course taken. In

model IV, in particular, after introducing home-country information on the percentage of STEM graduates, some of the group tendencies in taking high level math courses are reduced or even become insignificant. For example, advantaged Asian immigrant students and white immigrant students do not take significantly higher math courses compared to third-generation white students, after taking into account the home-country cultural capital variable.

INSERT TABLE 2 HERE

Table 2 and 3 examine the initial college major and bachelor's degree attainment in STEM fields, using logistic regression estimation given that the dependent variable is binary. Immigrant Asian students are significantly more likely to choose their initial college major in STEM than third-generation Asian students and native whites. Interestingly, after taking into account academic achievement in high school, native black students are more likely to claim initial majors in STEM fields than native whites. However, this lead on the part of native black students fades out when it comes to STEM degree attainment, as shown in Table 3. Also interestingly, the measure of high-brow cultural capital is negatively associated with both the initial college major in STEM and the attainment of a STEM bachelor's degree, as shown in Table 2 and Table 3. This is consistent with our expectation that STEM fields may require less high-brow cultural capital than other fields such as the humanities, or perhaps that people with high levels of cultural capital are simply more interested in the humanities and thus pursue them. That high-brow cultural capital is associated with high-level math in high school, as shown in Table 1, but not majoring or graduating in STEM may be related to students who may take high-level math as part of being on the "college track" in high school in order to get into college, but who may choose to major in other subjects.

For the outcome of STEM degree attainment in Table 3, due to their small sample size (less than 10), the baseline model excludes children of black immigrants, children of other Latino immigrants, and third generation other Latino groups. Among all the groups, only children of Asian immigrants and white immigrants are significantly more likely to attain a STEM bachelor's degree than native whites. Among children of Asian immigrants, the disadvantaged group shows a higher likelihood than the advantaged group to graduate with a STEM bachelor's degree. After taking into account academic and family backgrounds during high school, the tendency of white children of immigrants to attain a STEM degree disappears, indicating that their increased likelihood to pursue STEM is related to academic and family SES background, but the two Asian groups' tendency still remains.

INSERT TABLE 3 HERE

Table 4 examines Asian groups in the highest math course taken at 12^{th} grade, with two immigrant-origin groups compared against third generation Asian students. The two groups of children of Asian immigrants take higher math courses than their third-generation counterparts, until we take into account of measures of home-country cultural capital. Note that we include two measures of home-country cultural capital in this analysis, and they are both positively related to the math course taking. This may imply that the value placed on math and science in Asian countries in college programs or specifically among Asian immigrants, who are disproportionately selected as scientific workers through the H1-B program, could have an impact on Asian immigrant-origin students in the U.S, particularly for those who are under heavy influence of their home country culture, as indicated by their retention of home country language.

INSERT TABLE 4 HERE

Table 5 runs the parallel analysis for immigrant students of Latino origins, as compared with the native Latino students. It shows that Mexican children of immigrants do not take significantly higher-level math courses than native-origin Latino students, but children of immigrants of other Latino origins did take higher-level math courses than their native-origin Latino counterparts. Note that high-brow cultural capital is positively associated with taking math courses, but that home-country cultural capital is not significantly related with taking high-level math courses. Retention of Spanish, unlike Asian languages, is not significantly associated with high-level math course taking. This may be related to the fact that children of immigrants from Spanish-speaking countries, despite a collegiate culture of STEM in the home country, are less likely to be children of scientists or engineers than children of immigrants from Asian countries, probably due to lower levels of participation in the H1-B visa program and higher migration through other channels such as family reunification.

Discussion and Conclusion

The issue of diversity in STEM fields has always been able to garner much scholarly and policy attention. Individually, STEM graduates have better access to lucrative and prestigious job opportunities in this technologically-transformed world. Nationwide, full participation by all members of society has increasingly become necessary to maintain the U.S's position as a global leader in science and technology. We focus our study on children of immigrants in STEM fields because children of immigrants represent a diverse pool of future talent in those fields. We posit that children of immigrants may have a higher propensity to prepare entering STEM fields, and our analysis largely confirms this conjecture.

What are the implications of our finding that children of immigrants, for the most part, are inclined towards studying in the STEM pipeline? We propose that fields of study, often neglected in the context of education stratification and immigrant incorporation, are important to consider as a mobility strategy for children of immigrants and their families. Most extant studies on college major choices center on students' interest formation or personality match with what a given field of study can offer, which may be true at individual level. However, what our study highlights is the unique role of college majors as a structural nexus with labor market outcomes. STEM degrees, in particular, provide almost an entry ticket to STEM occupations (Xie and Shauman 2003), which often promise stable and predictable career paths, something attractive to children of immigrants who often don't have the kinds of social connections in the mainstream society that can assist entry into other fields. Constrained by "who you know"—the key linkages and connections in the labor market, children of immigrants want to make sure that "what they know" can help offset their disadvantages. A STEM bachelor's degree can also provide relatively competitive financial remuneration, which is attractive to children of immigrants who do not intend to or cannot afford further investment in education. For example, our research differentiates between disadvantaged and advantaged children of Asian immigrant groups and finds that the disadvantaged Asian group shows an even greater tendency to obtain STEM degrees than the advantaged group. However, in terms of academic preparation, the disadvantaged group has not taken as high-level math courses as their advantaged Asian peers. Although the differences in academic preparations regarding highest math course taken are quite small, the stronger inclination of disadvantaged Asian students towards STEM fields is still noteworthy. It may be that the disadvantaged Asian students are especially motivated to study

STEM fields that potentially promise job opportunities and good financial remuneration upon graduation.

Other than the mobility strategy that is relevant in children of immigrants' considerations in their educational decision-making, this study also highlights the role played by cultural capital. Unlike most of the studies finding the positive associations between high-brow cultural capital and educational outcomes, this study finds instead that high-brow cultural capital is negatively related to the STEM degree attainment. We posit that STEM degrees are less dependent on the humanity-based cultural practices, and children of immigrants may consciously eschew fields demanding high-brow cultural capital to minimize their disadvantages. Most significantly, this study presents how a new conceptualization of cultural capital—home country cultural capital—is especially relevant to the study on children of immigrants. We include home country language fluency and proportion of STEM graduates in different countries to tap into the connection with immigrants' home countries and the collegiate culture of science and engineering in their countries. We find that the impact of home-country cultural capital indeed differs for children of immigrants of different origins. That fluency in Asian languages, but not Spanish, is positively related to the study in STEM pipeline suggests that there may be a cultural value around STEM in Asian immigrant communities, where immigrants are disproportionately selected through the H1-B visa program. We present NSF and UNESCO data indicating that in a large majority of Asian countries, a much greater proportion of college graduates are in STEM fields underlining a strong collegiate culture of science. In addition, many immigrant parents from the more advantaged Asian groups are already in STEM fields, driven by the post-1965 employment-based immigration policy. The occupations of immigrant parents may therefore

influence children of immigrants' career-related decisions, although NELS data has not provided the detailed occupation information for parents, which prevents us from testing this idea directly.

We find that Mexican children of immigrants stand out as being less likely to pursue the STEM pipeline relative to their native-born counterparts and other groups. This likely has to do with the lower levels of educational selectivity of Mexicans relative to other groups and relatively low entry of Mexican scientists relative to many other immigrant groups and Mexican immigrants in general, who are more likely to arrive through family reunification (See also Feliciano 2005, 2006). Although Mexico does not have a low proportion of STEM college graduates, Mexican scientists and engineers are not as likely to work permanently in the U.S as their Asian counterparts vis-à-vis the H1B visa program. Our data on H-1B Visa show that most of the visas were awarded to Indian and Chinese immigrants. In other words, we may infer that there is not as a strong culture of STEM in Mexican immigrant community as in Asian immigrant community in the U.S due to differences in selectivity in migration. Children of Mexican immigrants may be less informed of the opportunities in STEM and/or may not be receiving opportunities or guidance in secondary education in the high-school courses that can prepare them for a career in STEM (See also Schneider and Stevenson 2000), evidenced by their relatively lower level of high school math course taken compared to other immigrant groups. We contend that the employment-based immigration policy to recruit more of STEM workers from diverse regions of the world, particularly, Spanish-speaking countries, will boost the diversity in STEM workforce. More importantly, as previous research has already shown about the strong demographic-based modeling in STEM fields (Ma 2011; Xie and Shauman 1997), this interest and expertise in STEM fields will trickle down to second-generation children who promise to be future STEM talents.

What are the implications of our findings that children of natives are not likely to be in STEM fields? It is quite revealing that third-generation Asian students are no more likely than their white counterparts to study STEM fields, although children of Asian immigrants exhibit strong preferences towards STEM. There might be something about American popular culture that is not so keen on science and engineering. Previous research (Pascoe 2003; Chen 1999) based on qualitative data indicates that students who are good at math and science are often considered to be socially awkward nerds and geeks (Leong and Hayes 1990). Perhaps telling in how deeply these perceptions now pervade American culture is that President Obama remarked in the 2011 State of the Union address, "We need to teach our kids that it's not just the winner of the Super Bowl who deserves to be celebrated, but the winner of the science fair" (Obama 2011). Public opinion data shows that the American public respect science and engineering and appreciate that STEM fields play a key role in national competitiveness , but most do not consider STEM as something good for themselves (Xie and Killewald 2012). This can also be seen by the relative low percentage of American students on average graduating in STEM fields compared to other countries in Figure 2. However, the importance of having sufficient human capital in STEM fields is obvious to American policy makers. Just recently, the report "STEM: Good Jobs Now and for the Future," released by Department of Commerce, highlights the fact that STEM fields are more likely to generate jobs and good jobs in the next ten years, and it is imperative to motivate more of American students to be interested in these fields again.

Finally, this paper has limitations primarily due to data restrictions, which also suggests future directions along this line of research given better access to richer data. First, we don't have access to detailed parental occupation information. Having access to this information would allow us to directly test parental influence on their children's entry into the STEM pipeline.

However, NELS has only aggregate parental occupation data at the level of manual labor, professional, and managerial work, which does not allow us to identify STEM occupations. We suggest future surveys collect as detailed parental occupation data as possible, to identify potential impacts on children's educational and career related outcomes. Second, we are not able to examine a gender effect, or better yet, the three way interactions between gender, immigrant generations and national origins. Such an analysis demands a much larger sample size. News articles have already reported that immigrant daughters have strong performance in math and science competitions, much more so than their native counterparts (NY times 2008). Some of our rationales for children of immigrants' inclinations towards STEM fields could be applicable to both males and females, such as the cultural value on STEM, the family mobility strategy, etc. But future research with a larger sample size should definitely take a close look at the gender dimensions.

Also, although our findings reveal that children of immigrants are, in general, more likely to pursue the STEM pipeline than their native-origin counterparts, we cannot really assess from these findings whether this is a generational effect or a cohort effect. A generational effect would imply that over generations, there is a loss of interest in pursuing STEM, perhaps implicating something about assimilation to American cultural norms. However, if our findings are evidence of a cohort effect, it may imply that changes in the post-1965 immigration policy that have prioritized scientists and engineers in the employment categories have created selective migration of people with an interest in science. In addition, our study focuses on the STEM pipeline at the high school and college levels. However, the question remains as to whether children of immigrants disproportionately pursue the STEM pipeline further, such as in graduate school. Bachelor's degree attainment in STEM fields is often the pre-requisite for graduate

school admission in STEM fields (Seymour and Hewitt 1997). In this sense, children of immigrants are well-prepared for the graduate school STEM pipeline. On the other hand, as we argued earlier, a bachelor's degree in STEM fields can easily lead into the world of work in STEM professions. For children of immigrants, especially for those from disadvantaged family backgrounds, getting a job and starting to earn a decent income may be especially enticing. As such, future studies can look at the post-baccalaureate trajectories of children of immigrants.

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ENDNOTES

[i] It is worth noting that Mexican scientists and engineers may be more likely to enter through a TN visa, which is temporary, and unlike the H1-B visa does not lead to permanent residence (USCIS 2012).

[ii] There are some things to consider when using language as an indicator of cultural capital, however. Bilingualism may give students an educational advantage for other reasons such as cognitive advantages (Peal and Lambert 1962; Cummins 1976; Bain 1974; Duncan and De Avila 1979; Bialystok 1988; Willig 1985, Kesckes and Papp 2003), personal traits such as diligence (Lutz 2004) or enhanced parental involvement or social capital ties maintained through the language (Mouw and Xie 1999, Lutz and Crist 2009, Zhou and Bankston 1996, Fernandez-Kelly 1998)

[iii] We use svy commands in STATA to adjust the complex sample design of NELS, so as to yield correct estimates for standard errors.

[iv] This study used the weight variable F2F2P1WT for the analysis. This postsecondary education weight applies to the 12th-grade freshened panel who responded in 1992, 1994, and 2000 (F2, F3, and F4) and who had credible claims of participation in postsecondary education by the return of a postsecondary transcript, transfer credit noted on another institution's transcript, or support for postsecondary attendance provided by other sources (e.g., the National Student Loan Data System or accounts of the respondent's occupation, income, and high school background).

[v] Life science includes biology and agricultural science.

[vi] We want to differentiate computer science from computer engineering here. The former is less applied than the latter. But sometimes, computer science is housed under engineering school. Our typology cannot accommodate those situations.

[vii] See also Bennett and Lutz 2009, Massey et al 2007 for similar combined measures of race and immigrant generation.

[viii]We run internal consistency test and the Cronbach alpha is 0.83 for these items.

[ix] NELS provides some country of origin information for children of immigrants from Asia, and limited information for children of Latino immigrants, and no country of origin information for children of immigrants from Europe. Here is the coding strategy we developed: we assigned the average of European countries information from Figure 2 to all white immigrant students in NELS data; The group of other Latinos are assigned the average value of Brazil, Colombia and El Salvador, which are all the countries we have had in our data in that region(.20); The group of Chinese is assigned the value of the average of Hong Kong, Taiwan and Mainland China (.41); Mexican, Japanese and Korean have exact match; The group of Southeast Asian is assigned the value of the average of Laos and Vietnam (0.185); For those Asian countries that do not have a exact match, we assign the average value of Asian regions to them (.34), based on UNESCO and NSF data.