Three Essays on Asian Americans' Educational Outcomes

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THREE ESSAYS ON ASIAN AMERICANS' EDUCATIONAL OUTCOMES

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This dissertation explores patterns and sources of Asian American students' educational success, focusing on their greater likelihood of selecting and completing a science, technology, engineering, or mathematics (STEM) major in college, their lower self-assessed math ability, and their differential patterns of residential segregation by race, income, and household structure. First, using the Educational Longitudinal Survey of 2002 ("ELS"), I show that Asian-white differences in STEM outcomes in college are strongly predicted by Asian students' stronger academic preparation and greater likelihood of planning to enter STEM occupations in high school, but partially offset by Asian students' lower self-assessed math ability than whites with similar academic preparation. Moreover, Asian students' initial choice of STEM majors is more elastic than whites' with respect to academic achievement in STEM, and they are more likely to initiate STEM majors in college even if they don't articulate an occupational plan or take advanced STEM courses in high school. Second, I show that the Asian disadvantage in mathematics self-assessment is only pronounced among students who take advanced mathematics courses. Among students who take advanced mathematics courses, Asian students' lower mathematics self-assessment relative to whites' is largely driven by the higher level of Asian concentration in the schools in which Asian students are enrolled. However, among students who take nonadvanced mathematics courses, there is a psychological premium in assessing one's mathematics ability for Asian students relative to whites, especially among the lowest achieving ones. Finally, using census tract-level data from the American Community

Survey linked to school district boundaries, I find that the residential segregation of poor Asian households from nonpoor White households is less driven by sorting across school district boundaries than it is for poor Black or Hispanic Households, but that within-race segregation of poor from nonpoor households is greater among Asian households than for other racial and ethnic groups. These findings are consistent with the hypotheses that nonpoor White parents have lower level of resistance toward poor Asian than toward poor Black and poor Hispanic households but are not consistent with the notion that poor Asian parents are able to draw on their unique resources from their ethnic communities for their children to access similar school options as nonpoor Asian parents.

BIOGRAPHICAL SKETCH

Yuanyuan Liu was born and raised in Zhengzhou, China. She holds a Bachelor of Science in Statistics from the Chu Kochen Honors College of Zhejiang University, China. Prior to beginning her doctoral work in Sociology at Cornell University, she obtained a Master of Arts in Applied Economics and a Master of Arts in Asian Studies from the University of Michigan, Ann Arbor. Her research interests lie in the areas of social stratification and mobility, sociology of education, race and immigration, work and occupations, and gender and the life course.

To my parents, Dong Li & Fengrong Liu

献给我的父母亲，李冬 & 刘凤荣

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CHAPTER I. Introduction

Asian Americans enjoy higher average incomes (Zeng and Xie 2004) and stronger prospects for upward educational and income mobility (Chetty et al. 2020; Fishman 2020) than other broad racial and ethnic groups, including White Americans. Classic explanations for these empirical regularities typically focus on parental resources, both socioeconomic and cultural, as well as on the historical, legal, and institutional treatment of Asian American immigrants in the United States. More recently, explanations have focused on social psychological factors, both positive and negative, as well as resources in their coethnic community that shape the Asian American socioeconomic experience (Lee and Zhou 2015), including the educational decisions that Asian American students make for themselves and that their parents make for them.

This dissertation contributes to this literature by examining three important aspects of Asian Americans' educational outcomes that have been understudied. First, prior research suggests that the high likelihood among Asian Americans to hold a college degree in the fields of science, technology, engineering, and math (STEM) plays a positive role in driving their labor market success. Yet, few studies have provided a systematic assessment of the extent to which Asians are over-represented among STEM college majors relative to whites and the mechanisms behind such racial disparity. Moreover, qualitative research points to the active role that low-income Asian parents play in strategically choosing where to live based on the quality of school districts (Lee and Zhou 2015), which contributes to Asian Americans' high level of socioeconomic mobility. Yet, no empirical research so far has tested whether this argument holds true across metropolitan areas in the United States. Third, even though Asian American students are generally successful academically, they tend to assess their own academic performance and potential lower than students of other racial and ethnic groups (Massey et al. 2003; Sidanius et al. 2008; Lee and Zhou 2015; Hsin and Xie 2014). Prior studies imply that Asian students are more likely to set a high bar for themselves (and their parents to set a high bar for them), but the structural conditions under which this holds (or not) are largely unknown, and their empirical models rarely include indicators of social psychological mediators in the attainment process.

This dissertation represents my effort to fill these gaps in literature to paint a more nuanced picture of Asian Americans' experiences in the United States, focusing in particular on Asian-white (and Asian ethnic group-white) differences in the patterns and predictors of STEM degree selection and completion (Chapter II), on racial differences in self-assessed math ability (Chapter III), and on racial differences in patterns of residential and school district segregation (Chapter IV). I describe each chapter in turn.

Using a choice-theoretic framework, Chapter II investigates patterns and sources of Asian-white, and Asian ethnic group-white, differences in STEM degree selection and completion in college. It shows that Asian-white differences in STEM outcomes in college are strongly predicted by Asian students' stronger academic preparation and greater likelihood of planning to enter STEM occupations in high school. However, Asian students have lower self-assessed math ability in high school than whites with similar academic preparation, which reduces the Asian-white gap in STEM outcomes. Moreover, Asian students' initial choice of STEM majors is more elastic than whites' with respect to academic achievement in STEM, and they are more likely to initiate STEM majors in college even if they don't articulate an occupational plan or take advanced STEM courses in high school. Lastly, it finds substantial intra-Asian ethnic variation in the size and predictors of the Asian-white gap in STEM major choice.

Chapter III examines patterns and sources of Asian-white gap in mathematics self-assessment among students who reached different strata of the mathematics curriculum in high school. It shows that an Asian disadvantage in mathematics self-assessment is only pronounced among students who take advanced mathematics courses. Among students who take advanced mathematics courses, Asian students' lower mathematics self-assessment relative to whites' is largely driven by the higher level of Asian concentration in the schools in which Asian students are enrolled. However, among students who take nonadvanced mathematics courses, there is a psychological premium in assessing one's mathematics ability for Asian students relative to whites, especially among the lowest achieving ones. It also shows substantial intra-Asian ethnic heterogeneity in the size and predictors of the Asian-white difference in mathematics self-assessment. These findings uncover important diversity in Asian students' academic experience which is largely ignored in empirical research as well as public discourse surrounding Asian Americans.

Chapter IV investigates how poor Asian households' residential decisions in relation to school options might contribute to Asian American students' comparatively high educational attainment and upward socioeconomic mobility. Using census tract-level population count data from the 2008-2012 ACS and a spatial crosswalk to map census tracts into school district boundaries, I find that although poor Asian, Black, and Hispanic households' level of neighborhood segregation from nonpoor white are comparable, a much smaller proportion of the poor Asian-nonpoor white neighborhood segregation is attributable to sorting across school district boundaries. Moreover, the level of within-race poor-nonpoor segregation is the largest among Asian households and the proportion of the level of within-race poor-nonpoor segregation attributable to sorting across school district boundaries is also the largest among Asian households. These findings are consistent with the hypotheses that nonpoor White parents have lower level of resistance toward poor Asian than toward poor White and poor Hispanic households but are not consistent with the notion that poor Asian parents are able to draw on their unique resources from their ethnic communities for their children to access similar school options as nonpoor Asian parents.

CHAPTER II. Understanding Asian-White Differences in STEM Major Selection and Completion

Asian Americans' educational success is by now well documented: Asian American students earn higher standardized test scores and have better grades in high school than students from other racial and ethnic groups, they are more likely to enter and complete college, and they are more likely to attend selective baccalaureate institutions (Bozick, Lauff, and Wirt 2007; Byun and Park 2012; Hsin and Xie 2014; Kao 1995; Kao and Thompson 2003; Lee and Zhou 2015; Liu and Xie 2016; Snyder and Dillow 2015). Aside from those racial differences in the levels of educational success, there is also qualitative differences between Asian and white students in their college major choice. Specifically, Asian students in four-year colleges are more likely than whites to enroll and obtain a college major in the fields of science, technology, engineering, and math (STEM) (National Science Foundation 2014; Simpson 2001). Previous research shows that STEM college degrees yield high lifetime income returns (Kim, Tamborini, and Sakamoto 2015, 2018) and have crucial implications for Asian-white differences in adult earnings (Kim and Sakamoto 2010; Kim and Zhao 2014). Yet, few studies have attempted to understand why Asian and white students have different propensities of choosing a college major in STEM (for exceptions, see Ma 2010; Wang 2013; Xie and Goyette 2003).

This article makes four contributions to our understanding of Asian-white differences in STEM major choice. First, we develop a model that focuses on three families of micro-level predictors that may help generate the macro patterns of Asian-white differences in STEM major selection and completion in college: (1) the qualitative content of students' occupational plans while they are in high school; (2) students' prior academic preparation in STEM, as indicated by

STEM course-taking, test scores and grades in high school; and (3) their perceptions of their own abilities in math and related fields ("self-assessed math ability"). Prior research has assessed the explanatory power of students' high school academic preparation on STEM major choice (Ma 2010). Yet, no existing research has assessed the explanatory power of self-assessed math ability. In terms of occupational plans, one study has attempted to assess how Asian-white difference in occupational plans is shaped by the two groups' differential responsiveness to the characteristics of different occupations, which in turn may help explain Asian-white differences in their representation across different college majors (Xie and Goyette 2003). Nonetheless, the empirical models that the authors developed do not have an explicit focus on either the distinction between STEM and non-STEM in the content of occupational plans or the distinction between STEM and non-STEM college majors (Xie and Goyette 2003). In this paper, we adopt a modeling strategy that not only enables us to explicitly evaluate the explanatory power of students' occupational plans with three well-defined categories (i.e., STEM, non-STEM, and "don't know"), but also enables us to offer a comprehensive assessment of the relative contribution of the three families of predictors.

Second, we broaden the scope of prior research assessing Asian-white differences in educational outcomes – which typically focuses on the differential distribution on the key predictors between the two groups of students (e.g., Goyette and Xie 1999; Hsin and Xie 2014; Kao 1995; Peng and Wright 1994; but see Byun and Park 2012; Liu and Xie 2016;) – by also including an assessment of the differential predictive power of the three families of our predictors for Asians and whites. The theoretical rationale behind our modeling strategy draws on the insights from two strands of social science literatures on human decision making in social environments. The first strand of literature attempts to use a choice-theoretic framework to illustrate the key insights from the Wisconsin Model (Morgan 2005). Morgan (2005) argues that the normative and imitative pressures from parents, peers, and similar others in the labor market can be seen as part of the "costs" that students face when conducting cost-benefit analysis to make their short-term as well as long-term educational and occupational decisions and that such costs could vary substantially across students of different social origins. The other strand of research, which lies at the intersection of sociology and cognitive science, demonstrates that the formation of individuals' preferences for alternative choices are highly sensitive to the social environment they are located in – more specifically, when a certain option is emphasized more than its alternatives in individuals' immediate environment, it tends to become their "default" choice option when they are not able to articulate their own preferences (for a review, see Bruch and Feinberg 2017). In this paper, we develop an account of the differential predictive power of our predictors for Asian and white students by focusing on the differential socialization experience of Asian and white students.

Third, we analyze students' STEM outcomes in terms of both their choice of initial college major and their choice of bachelor's degree major. Although the former outcome is the focus of most prior studies on Asian-white differences in STEM major choice (Wang 2013; Xie and Goyette 2003; but see Ma 2010), to the extent that there is systematic racial variation in the likelihood of switching in or out of STEM majors during college (Gelbgiser and Alon 2016; Riegle-Crumb, King, and Irizarry 2019), it is the latter outcome that matters as an important pre-labor market characteristic that helps explain Asian-white differences in labor market outcomes (Kim and Sakamoto 2010; Kim and Zhao 2014).

Fourth, we include an analysis of heterogeneity in the Asian-white differences in STEM major choice decisions and the related high school experiences of Asian ethnic groups from different national (Chinese, Japanese, Korean, and Filipino) and regional (South Asian, Southeast Asian) origins. Early work on Asian-white differences in STEM major choice treated Asian as a pan-ethnic identity (Ma 2010; Wang 2013; Xie and Goyette 2003), under the assumption that cultural or structural factors common to all Asian ethnic groups overwhelm subgroup differences. Although scholars have questioned the notion of a pan-ethnic Asian experience in studies assessing Asian-white differences in the levels of educational achievement (e.g., Byun and Park 2012; Goyette and Xie 1999; Hsin and Xie 2014; Kao 1995), within-group heterogeneity in STEM college major selection and completion has not been explored. As we will argue below, intra-Asian heterogeneity may be substantial.

In the sections that follow, we develop our model of ethnic group differences in STEM major selection and completion, focusing on (1) potential sources of Asian-white differences in the distribution of students on these three sets of predictors; and (2) potential heterogeneity in the predictive power of these factors across the two groups. We then turn to a discussion of possible intra-Asian differences in the Asian-white gaps in STEM selection and attainment, which is necessarily speculative given so much of the extant theoretical and empirical research treats Asian students as a homogenous category. We estimate the Asian-white gaps, Asian ethnic-white gaps, contributions of the predictors to these gaps, and cross-group heterogeneity in sensitivity to the predictors using data from the ELS2002 cohort. We conclude with a discussion of the implications of our results in terms of how they advance the theoretical literature on Asian Americans' educational choice, assumptions about the universality of the "Asian" experience, and possible directions of future research.

Background

Prior research has consistently demonstrated that family socioeconomic background does not have a significant effect on obtaining a college degree in STEM (Torche 2011; Xie and Achen 2009). However, it does not necessarily mean that family does not play a significant role in shaping Asian-white differences in STEM major choice. In the literature on the Asian-white differences in the level of educational attainment, it has been repeatedly shown that Asian children of immigrants who come from socioeconomically disadvantaged backgrounds have similar levels of educational attainment as their middle-class co-ethnic counterparts, and consistently surpass the average level of educational attainment of similarly disadvantaged whites (Fishman 2020; Goyette and Xie 1999; Kao and Thompson 2003; Lee and Zhou 2015; Xie and Goyette 2003). Scholars have argued that this weaker relationship between family socioeconomic background and children's level of attainment may reflect the distinct socialization processes within the Asian family as well as other social institutions that are especially conductive to upward social mobility (Fishman 2020; Lee and Zhou 2015; Liu and Xie 2016).

In this article, we focus our attention on three sets of predictors of Asian-white differences in STEM-related college outcomes – students' plans to enter STEM occupations, their prior academic preparation, and their self-assessed math ability – while treating family socioeconomic background as a set of adjustment variables. Yet, we argue that the differential socialization experience of Asian and white students in family and other social institutions are not only the key sources of differences between Asian and white students in their distribution on these predictors of STEM attainment, but are also the key sources of differences in the predictive power of these predictors.

Occupational plans in high school

Much of the early educational attainment literature in the Wisconsin tradition focused on occupational aspirations or expectations as a mediator between family socioeconomic background and gradational differences in educational attainment and occupation standing as adults. A more recent literature focuses on the relationship between occupational plans and differences between status groups (e.g., defined by gender, race/ethnicity) in the fields of study that students choose in college (Morgan, Gelbgiser, and Weeden 2013; Xie and Shauman 2003). The underlying theoretical model draws on the insights of the Wisconsin tradition but supplements it with rational-choice theoretic logic about educational decision-making. In Morgan's (Morgan 2005; Morgan, Leenman, et al. 2013) "stutter-step" model of attainment, for example, students form and update plans for the future, including their future occupation, on the basis of beliefs about costs and benefits of different occupational outcomes, normative processes, and imitative processes, all of which may be affected by gender, race, or other status group membership. These plans serve as "prefigurative commitments" that guide proximate educational decisions, such as the decision to go to college or the decision about the field in which to major while in college (Morgan 2005). Consistent with this model, Morgan and colleagues found that gender differences in occupational plans in high school account for a larger share of gender differences in STEM major selection (Morgan, Gelbgiser, et al. 2013) and completion (Weeden, Gelbgiser, and Morgan 2020) than prior academic achievement (course-taking, grades, standardized test scores) and self-assessed math ability.

In extending this model to understand racial differences in STEM attainment, we must first establish that there are systematic Asian-white differences in the likelihood of planning to enter STEM occupations. Since students tend to factor in their significant others' expectations of them when forming their own occupational plans (Morgan 2005; Sewell, Haller, and Portes

1969), Asian students may be more likely than their white counterparts to hold an occupational plan in STEM due to the distinct family influence that they receive. Past research has repeatedly shown that Asian parents hold high expectations for their children's socioeconomic attainment, regardless of their own socioeconomic position (Fishman 2020; Goyette and Xie 1999; Lee and Zhou 2015; Liu and Xie 2016; Peng and Wright 1994). Additionally, Asian parents' expectations span their children's entire schooling career, which not only entail achieving high grades throughout the whole course of schooling, but also entail entering selective colleges and obtaining college degrees in fields that lead to high status and highly paid occupations, such as doctors, scientists, engineers, and lawyers (Goyette and Xie 1999; Jiménez and Horowitz 2013; Lee and Zhou 2015; Peng and Wright 1994; Xie and Goyette 2004). Asian parents' perception of having a professional career in STEM as an ideal way of achieving socioeconomic success may be based on their observations of the rise of the high-tech industry in the United States ever since the 1960s that provides lucrative monetary payments and the influx of immigrants from Asian countries into this industry who have achieved notable socioeconomic success (Xie and Killewald 2012). But how can this parental ideation of STEM attainment be transmitted to Asian children, especially among those Asian parents who are not highly skilled STEM immigrants themselves? Previous research shows that in many collective cultures in Asia, achieving socioeconomic success is considered as one's obligation to honor one's family (Sakamoto, Kim, and Takei 2012; Tao and Hong 2014). The socialization of Asian children in their families, especially where parents have experience living in Asia, focuses more on their duties to their family and the extrinsic rewards that an education could bring about, in contrast to the childrearing practices adopted by most white parents that generally focuses on fostering children's independence from others, discovering their own passion and the sources of their intrinsic happiness (Jiménez and Horowitz 2013; Markus and Kitayama 1991; Sakamoto et al. 2012; Tao and Hong 2014). As such, Asian parents' occupational expectations, as is linked to their children's future socioeconomic success, can be successfully transmitted to their children through the socialization process within the family, regardless of their socioeconomic background.

Moreover, when conducting cost-benefit analysis weighing the likelihood of receiving high returns from alternative occupational choices, Asian students themselves may consider the choices made by their co-ethnic predecessors in the labor market who have already achieved socioeconomic success and imitate their choices to reduce uncertainty. Indeed, Xie and Goyette (2003) finds that for a cohort of high school students who graduated in the early 1990s, Asian students' occupational preferences, relative to whites', are more sensitive to whether an occupation offers high pay while having a high level of Asian representation. Although previous research suggests that parents play a significant role in shaping students' understanding of the labor market (Morgan 2005) and we are not able to evaluate the extent to which the rationale of students' own cost-benefit analysis comes from their socialization with their parents, these arguments together predict that, all else equal, a higher share of Asian American students will plan to enter STEM occupations than whites, and that these racial differences in occupational plans will contribute to racial differences in the selection and completion of STEM degrees in college.

The arguments above focus on the content of occupational plans. Should we also expect Asian-white differences in the *likelihood* of articulating an occupational plan, irrespective of its content? On one hand, parental involvement helps students develop concrete occupational plans (Schneider and Stevenson 1999) and parental involvement tends to be quite high in Asian families (Lee and Zhou 2015), leading to the prediction that Asian students are more likely to specify a concrete occupational plan. On the other hand, Asian students may also be more likely to experience a conflict between their own goals and their parents' vision of success, given the latter entails a very limited set of occupations (Lee and Zhou 2015). Where students' own goals differ from their parents' goals, we might expect a lower likelihood of articulating an occupational plan. Moreover, much prior research on judgment and decision-making shows that the social environment in which individuals are socialized shapes the "default" option of individuals' choice when they do not show clear preferences (for a review, see Bruch and Feinberg 2017). We expect that even though Asian high school students may be more likely than whites students to say that they "don't know" what occupation they plan to hold at age 30, they may be more likely than whites to default to a STEM major once they enter college, whether because of the normative pressure from their parents to pursue a professional career in STEM or because of the imitative pressure they experience to emulate their successful co-ethnics who already entered the labor market.

High school academic achievement in STEM and advanced STEM course-taking

Academic preparation in high school, and in particular STEM high school grades, test scores and course-taking, predicts STEM major choice (Correll 2001; Morgan, Gelbgiser, et al. 2013; Wang 2013; Xie and Shauman 2003). Much prior research documents an Asian advantage in academic performance, especially in math and science (Jiménez and Horowitz 2013; Lee and Zhou 2015:2; Liu and Xie 2016). Prior research attributes the sources of the Asian advantage to the much more financial investment commonly found in Asian families in children's education (Kao 1995; Sun 1998), the stronger parental pressure for Asian students to obtain good grades in school (Hsin and Xie 2014; Jiménez and Horowitz 2013; Lee and Zhou 2015; Liu and Xie 2016), as well as the higher achievement expectations, especially in math and science, commonly held for Asian students by academic gatekeepers and peers (Lee and Zhou 2015; but see Sakamoto and Wang 2021). Given that good academic performance in STEM at the secondary level is important for students to decide whether to pursue STEM fields in college (Adelman 1998; Wang 2013; Xie and Shauman 2003), Asian students may be more likely than their white peers to choose a STEM major by virtue of having higher test scores and grades in STEM in high school.

In terms of advanced STEM course-taking, Asian students are more likely to enroll in high track courses than white students (Kelly 2009). One possible explanation points, again, to the agency of Asian families. Asian parents use all resources at their disposal to place their children in the best schools and the most competitive academic tracks, including the advanced math and science courses (Lee and Zhou 2015). Academic gatekeepers and peers may also play a role in reinforcing the expectation for Asian students to enroll in advanced classes in math and science (Jiménez and Horowitz 2013; Lee and Zhou 2015). This exposure to advanced math and science courses gives Asian students more challenging learning tasks, access to more experienced teachers, and contact with more academically motivated peers, all of which amplify initial achievement differences and facilitate achievement later in their educational careers (for a review, see Gamoran 2010). Tracking into the highest levels of math and science courses can also offset low grades, to some extent, and predict later STEM major selection and completion (Adelman 1998).

Asian-white differences in STEM major choice may be reflected in the racial differences in the predictive power of the measures of academic preparation in STEM as well. On one hand, the normative and imitative pressures that Asian students face may mean that they face additional "costs" from their social environments if they do not choose a STEM major, their choice of a STEM major may be less elastic with respect to increase in their academic performance in STEM or whether they have taken advanced STEM courses in high school. On the other hand, however, given that Asian parents emphasize more on the objective markers of academic success and the instrumental value of education than white parents, Asian students may rely more on their academic preparation in math and science to evaluate whether they are suitable for a STEM major than white students. One implication is that Asian students' choice of a STEM major may be more elastic than whites with respect to advanced STEM course-taking and increase in academic performance in math and related fields in high school.

Self-assessed math ability

Self-assessed math ability is another important predictor of STEM major choice in college, regardless of students' racial or ethnic identity (Correll 2001; Eccles 2011; Wang 2013). We argue that Asian students may be disadvantaged in self-assessed math ability relative to whites for at least three reasons, which, in turn, may reduce Asian students' likelihood of selecting or completing a STEM major.

The literature on the formation of academic self-concept suggests that students' self-assessed academic ability depends not only on objective measures of their academic accomplishments, but also on the standard of academic excellence or reference frame that they use to assess their abilities (Marsh 1987; Marsh and Hau 2003). Having high attainment expectations for their children regardless of their own socioeconomic attainment (e.g., Fishman 2020; Goyette and Xie 1999; Lee and Zhou 2015; Peng and Wright 1994; Tao and Hong 2014), Asian parents may set a higher standard of academic excellence for their children, especially in math and science, relative to white parents to pressure their children to realize their expectations. Specifically, qualitative research suggests that Asian parents tend to pass on stories to their children of other co-ethnics who have achieved stellar academic record in high school and set these co-ethnics as role models for their children (Lee and Zhou 2015). As Asian students internalize the parental pressure to achieve high academically, especially in math and science, they themselves may hold a standard of academic excellence much higher than that of their white counterparts. As a result, when Asian students have the same objective scores on measures of math achievement and attainment as their white peers, they may be less inclined to feel they are doing well enough academically in math and thus have lower self-assessed math ability.

Moreover, previous literature shows that schools' average level of academic achievement has a negative effect on students' self-assessed academic ability (Marsh et al. 2008; Marsh and Hau 2003). Since Asian parents in general have greater concerns over children's academic achievement than white parents, Asian students may be more likely to be found in academically competitive schools than their white counterparts (Jiménez and Horowitz 2013; Lee and Zhou 2015) and are thus more likely to feel like "a little frog in a big pond." This implies that Asian students may have lower self-assessed math ability than whites due to the more academically competitive schooling environment they are situated in.

Third, prior research also shows that students' academic self-concept is greatly affected by how they think they fare academically relative to students with similar attributes or their in-groups (Thijs, Verkuyten, and Helmond 2010). If Asian students' racial in-group members perform better, on average, than white students in math, then Asian students may be less likely to feel they are academically successful in math relative to white students with comparable academic accomplishments in math.

Prior empirical research does not find an Asian-white difference in the overall relationship between math self-assessed ability and intention to major in STEM in college (Wang

2013). We will assess this in the context of a more comprehensive model, but also assess whether there are Asians and white differences in the predicted probability of STEM major initiation and completion across different values of self-assessed math ability.

Ethnic variations among Asian Americans

So far, we have treated Asian students as a monolithic group regardless of their ethnic or regional heritage. Many prior studies have identified intra-Asian variability with regard to the level of different educational outcomes (Hsin and Xie 2014; Kao 1995; Liu and Xie 2016). However, little prior research unpacks the Asian pan-ethnicity in the context fields of study in college (Song and Glick 2004). One of the most notable aspect of ethnic diversity among Asian American students in the studies of Asian-white differences in the level of educational aspirations and achievement is the socioeconomic heterogeneity across Asian ethnic groups (Goyette and Xie 1999; Kao 1995; Sun 1998). To a large extent, ethnic variation in socioeconomic attainment in the post-Civil Rights era, especially among the first-generation immigrant parents whose children are schooled either entirely or partially in the U.S., is closely related to the reasons of migration for different ethnic groups from Asian countries – that is, whether an Asian ethnic group immigrate to the United States mainly to seek better economic opportunities (such as Chinese, Koreans, Filipinos, and Indians) or as political refugees from the Vietnam War (Vietnamese and other Southeast Asians) (Sakamoto, Goyette, and Kim 2009; Xie and Goyette 2004). However, since family socioeconomic background is not an important predictor of STEM major choice (Torche 2011; Xie and Achen 2009), our discussion below focuses on the sources of ethnic heterogeneity that is related to the key predictors of STEM major choice concerned in this study.

Existing literature offers at least two reasons to anticipate intra-Asian variability in STEM-related college outcomes. First, the achievement advantage of Asian Americans dissipates over immigration generations (Sakamoto et al. 2009), and different groups of "Asians" in the United States have different shares of first, second, and third or higher- generation students. Although on average, first- or second-generation Asian parents buy into the Asian "success frame" and its associated parenting practices, third or higher-generation Asian parents tend to adopt a more "relaxed" approach to school and allow their children to explore their own passions, as is more common among native white parents do (Jiménez and Horowitz 2013). This suggests that Asian ethnic groups with a relatively high share of third- or higher generation students are likely to have distributions of occupational plans, high school STEM course-taking, grades and test scores more similar to whites than Asian ethnic groups with lower shares of third-plus generation students. Students from these ethnic groups may also be less likely to make within-ethnic social comparisons and subscribe to the mainstream cultural values held by whites, which could reduce differences from whites in self-assessed math ability. Empirically, these arguments may apply particularly well to the comparison between Japanese and whites, since, among Asian ethnic groups, Japanese has the highest proportion of third- or higher generation due to the fact that Japanese was the only Asian ethnic group that had settled in the U.S. with their families prior to the promulgation of the Immigration and Nationality Act in 1965 but has very low proportion of new immigrants seeking economic opportunities post-1965 due to the takeoff and prosperity of the Japanese economy after World War II (Sakamoto et al. 2012; Xie and Goyette 2004).

Second, the origin countries or regions of Asian immigrant groups vary culturally. For example, Asian parents of South Asian or Filipino descent, even when they are first-generation immigrants, may have already been exposed to Western education and culture before they migrate (Xie and Goyette 2004) possibly due to the impact of the colonization of these Asian regions by English-speaking nations (i.e., the United Kingdom or the United States) in their modern histories. They may thus be less likely to insist that their children make within-ethnic group social comparisons. Students from countries heavily influenced by Confucianism (China, Korea, Japan, Vietnam) may be more likely adopt the belief that locates success in greater effort rather than the belief that locates success in natural ability (Hsin and Xie 2014; Lee and Zhou 2015). This may manifest in greater ethnic-white differences in measures of academic achievement, but also lead to lower self-assessed math ability – because when met with failure to achieve high academically even with increased effort, especially if they are placed in high tracks where the learning tasks are more challenging and peers more competitive, Asian students are faced with a denial of their Asian authenticity from both home and school since it demonstrates that they neither have the natural ability to achieve high in math and science nor do they have the ability to achieve high with increased effort (Lee and Zhou 2015).

This discussion, while necessarily speculative, gives reason to believe that Asian ethnic groups will differ in the magnitude and possibly direction of the STEM major selection and completion gaps with whites. Although sample size and other data constraints will prevent us from identifying the sources of these intra-ethnic differences, we offer analyses that can establish, descriptively, the patterns of these differences.

Data and measures

Data

Our main analytic goal is to evaluate the contribution of occupational plans, prior academic preparation in STEM, and self-assessed math ability to Asian-white and Asian ethnic group-white gaps in STEM major selection and completion. We rely on data from the restricted access ELS (National Center for Education Statistics [NCES]), which is a two-stage stratified random sample of approximately 16,200 students in tenth grade in 2002 nested in 750 schools. The ELS includes four waves of data collected from students; surveys of parents, teachers, and school administrators; and high school and college transcripts. It oversamples Asian students.

We restrict our analytic sample to students who participated in the first two waves of ELS and have high school transcript information. In our main analyses, we also restrict the sample to students who graduated high school on time and who entered a four-year college within six months after high school graduation based on information from the second and third follow-up surveys.[1] Our final analytic sample includes 5,790 cases for STEM major selection and completion. (Our restricted access data license requires us to round unweighted sample sizes to the nearest 10.)

We created a custom panel weight by multiplying the base-year and first follow-up panel weight developed by the data distributors by the inverse probability of being in our analytic sample. This probability is estimated from a model that includes all demographic and family background covariates. We retain "missing" as a meaningful category for the occupational plan variable and impute missing values for continuous covariates. We report standard errors clustered by school.

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[1] We prioritized information on the timing of high school graduation and four-year college entry from the second follow-up survey, supplemented by information from the third follow-up survey if the second follow-up had missing data. In less than 1% of cases, measures of high school graduation date and postsecondary college outcomes differ between the second and third follow-up surveys. In these cases, we impute in-sample status based on students' demographic background, parental educational expectation for students, students' own educational expectation, math and science course-taking variables, grades, and math test scores measured in the first two waves. We excluded the very few cases in which high school graduation or college entry information is lacking from either of the follow-up surveys.

Measures

College major

We estimate models with two outcomes: college major selection, and college major completion. Our first outcome variable measures students' initial major as of the 2006 wave of ELS, when most students were college sophomores. The three categories of this variable are STEM, other major, and no major specified or missing. We base this variable on the 2000 Classification of Instructional Programs (CIP), supplemented with information from verbatim responses on the open-field question in ELS that asked students to report their major. Pre-med students are included in STEM, because at many institutions pre-med students cannot be differentiated from non-premed students within a given STEM major (e.g., biology, biochemistry). Students who report a double major are included in the STEM major category if at least one of their reported majors is in STEM.

Our second outcome variable, STEM completion, measures whether and in what field students received a baccalaureate degree by 2012, which for most students was eight years after graduating from high school. This variable also has three categories: STEM major; other major; or associate degree, certificate, or no degree. (As in the STEM selection variable, this third category is too sparsely populated to differentiate further.) The coding of the STEM completion variable is identical to that of the STEM selection variable, including the precedence given to STEM if a student has more than one major.

Race and ethnicity

The base-year (2002) ELS survey asked students to self-identify their race: white, Hispanic, black, Asian, or "other." Students who selected "Asian" were asked in a follow-up question to identify their national or regional origin: Chinese, Filipino, Japanese, Korean, Southeast Asian (Vietnamese, Laotian, Cambodian or Kampuchean, Thai, or other southeast

Asian), and South Asian (Indian, Bangladeshi, Pakistani, Sri Lankan, or other South Asian). About 9% of the self-reported Asian students in our sample identify with a second race or ethnicity. In our main results, we code these mixed-race students as “Asian,” but we also ran sensitivity analyses that exclude them from the Asian group and obtained comparable results. Hispanic, black and other race students are included in the sample. Here we focus on the Asian- and Asian ethnic group-white comparisons.

Other predictors

We measure occupational plans based on students’ verbatim responses in 12th grade to the prompt, “write down the job or occupation that you plan to have at age 30” and a follow-up question about job duties. Morgan and his colleagues (2013) coded these responses into a 1,200-occupation scheme, from which we created a four-category scheme: STEM, which includes doctoral-level biomedical occupations (e.g., doctor, dentist); all other planned occupations; don’t know; and missing. The 1.1% of students who reported a mixture of plans that include both STEM and non-STEM occupations are coded as STEM.[2]

High school academic preparation is measured with three covariates. We create a dummy variable indicating whether students have ever taken advanced STEM courses in high school, which we define as having taken either Calculus or both Chemistry and Physics (Burkam and Lee 2003).[3]We use two measures of high school academic achievement in STEM: performance

[2] Weeden et al. (2020) report 95.8% agreement between a 6-category measure of occupational plans based on their coding of verbatim responses and a 6-category measure based on later-arriving ELS coding of responses. Because of the small cell counts by race, we aggregated Morgan et al. (2013)’s variable into four categories, so our agreement rate with ELS is likely even higher.

[3] We rely on a dichotomized measure of STEM course-taking to facilitate our analysis of differences in the elasticity of STEM major choice with respect to course-taking. This choice may underestimate the maximum contribution of Asian-white differences in STEM course-taking to gaps in STEM major choice, and overestimate the minimum contribution of other predictors, but it will not change the general patterns of our results.

on a standardized math test in 2004; and students' honors weighted academic GPA in STEM courses, which we calculated from students' course-level records in the ELS transcript data.[4] To define STEM courses, we use the Secondary School Course Taxonomy's classification based on the Classification of Secondary School Courses (CSSC) codes.

To measure self-assessed math ability, we construct a factor variable from five component items, asked in the 2004 wave, indicating whether students can understand difficult math texts, understand difficult math classes, master math skills, do an excellent job on math tests, and do an excellent job on math assignments. Valid responses range from "almost never" to "almost always." We imputed missing values on the component items using the other items for which we had data, students' background variables, grades, and math test scores. The five items had standardized factor loadings of 0.84, 0.83, 0.82, 0.82, and 0.81, respectively.

Most of our models also adjust for self-reported gender and parental resources including the highest level of parental education, family income, two-parent family structure, and sibship size. We use a four-category indicator of the highest level of parental education (i.e., high school or below, college, some college, master's or above) and a five-category indicator of family income ranges (i.e., from $25,000 or below to $100,000 or above), both are recoded from ELS-supplied categorical variables derived from the parent surveys.[5] For the 15% of students whose parents did not fill out the survey, the ELS data distributors coded parental education from the student surveys and imputed family income.

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[4] The procedure to calculate students' honors-weighted GPA is in Bozick et al. (2006, p. 88-91).

[5] Some prior studies of differences in educational outcomes adjust for school urbanicity, region, and type (e.g., Goyette and Xie 1999), which may mediate the effects of family background or other covariates. Models in which we adjust for school attributes show very similar results to those reported here.

Modeling strategy

We conduct separate analyses for initial major selection in 2006 and college outcomes in 2012. Following a strategy developed by Morgan and colleagues for the analysis of gender differences in STEM outcomes (Morgan, Gelbgiser, et al. 2013; Weeden et al. 2020), we fit parallel sets of multinomial logit models. The baseline model regresses the outcome on race and ethnicity, gender, and the family background measures, and provides estimates of baseline Asian-white gaps in the probabilities of selecting and completing a STEM major. We then add each set of focal predictors one at time, re-estimate the Asian-white gap, and scale it to the baseline gap. This represents the maximum contribution of each set of predictors to the Asian-white gap, under the assumption that the excluded predictors are post-treatment covariates. We also fit models that remove each set of predictors one at a time from a full model estimated with all predictors, re-estimate the Asian-white differences in the predicted probabilities of the outcomes, and scale these differences to the baseline gap. This represents the minimum contribution of the focal set of predictors, under the assumption that all other predictors are causally prior to the focal set.

An additional modeling step is necessary to estimate the maximum contribution of ethnic differences in self-assessed math ability, because according to this argument the effect of self-assessed math ability on STEM outcomes is conditional on objective measures of academic preparation. The maximum contribution of self-assessed math ability is thus estimated with a revised baseline model that includes math test scores, STEM GPA, and advanced course-taking in STEM as adjustment variables.

This strategy avoids making strong and untestable assumptions about the underlying causal order of the predictors (Morgan, Gelbgiser, et al. 2013). However, it assumes the effects of the predictors and race on the outcomes are additive and have the same association with the outcome variables for Asian students and for white students. To assess this homogeneity in the predictor-outcome association, we also fit a set of models that interact each predictor and race. We then calculate Asian-white gaps in the predicted probabilities of choosing a STEM major across categories of the categorical predictors (occupational plans, advanced STEM course-taking) or at the threshold values of quintiles of the continuous predictors (math test scores, STEM GPA, and self-assessed math ability). The tradeoff is that we now assume identical distribution on the predictors for Asians and whites.

Our final set of analyses disaggregate the Asian pan-ethnicity into the six national or regional groups, and fit analogous models where the predicted probabilities are not "the" Asian-white gap but the gaps among the Asian ethnic groups and whites. We conduct similar analysis to see how the different predictors affect Asian ethnic-white differences in STEM major choice.

Results

Asian-white differences in STEM major choice

Figure 1 presents the weighted distribution of STEM major choice by race and ethnicity in our analytic sample. The percentages of students who selected a STEM major by 2006, which for most students is their sophomore year in college, are in grey. The percentages of students who completed a STEM major by 2012, when most students are eight years out of high school, are in black. Figure 1 shows that Asian students are more likely than whites to select and complete a STEM major, with a gap of roughly 14.3 percentage points for STEM selection and 6.6 percentage points for STEM completion.[6]

[6] The percentages presented in Figure 1 are slightly larger the National Science Foundation's (2014) estimates of 29% of Asian and Pacific Islanders and 17% of white students majoring in STEM. These disparities could be due to differences in the definition of STEM, sample construction and restrictions, and procedures for collecting information about ethnicity. We tested different sample restrictions in ELS that brought our raw estimates closer to the NSF's, but this had no effect on the pattern of associations we report here.

[Figure 1 about here]

These apparent "Asian-white differences" in the percentage of students selecting and completing STEM majors differ across Asian ethnic or regional groups. Specifically, only Chinese, Filipino, and South Asian students are more likely than whites to select STEM initially, and only Chinese and South Asian students are more likely than whites to complete a baccalaureate in a STEM field (see Figure 1). Japanese and Southeast Asian students are significantly less likely than Chinese and South Asian students, and Japanese students are less likely than Filipino students, to select a STEM major. The magnitude of differences between the Asian ethnic groups and whites are less pronounced for STEM major completion.

Asian-white differences on predictors

Table 1 presents the distribution of Asian and white students on our main predictors and the covariates, along with significance tests of the differences.[7]As Table 1 shows, Asian students are more likely than whites to articulate a STEM occupational plan (32.4% vs. 20.6%) and less likely than whites to hold a non-STEM occupational plan (34.9% vs. 51.5%) in 2004. Although a higher percentage of Asian students who "don't know" their occupational plan in 2004 (30.9% vs. 26.2%), the Asian-white difference in this category is not statistically different from zero. Asian students are more likely to have taken an advanced STEM course in high school (53.1% vs. 32.7%) and are likely to have higher average math test score in 2004 (61.4 vs. 59.6) and higher average GPA in high school STEM courses (3.3 vs. 3.1). However, on average, Asian students have slightly lower self-assessed math ability scores (0.28) than white students (0.33). After adjusting for high school academic preparation, gender and family background, this difference is statistically significant at the 0.01 level. Finally, relative to white students, Asian

[7] For categorical variables, the statistical test of difference is based on delta-method standard errors associated with the average marginal effect of race on the variables.

students are disadvantaged in parental education and family income in that Asian parents have significantly lower proportion of having "some college" education and are significantly over-represented at the lower levels of the family income distribution and under-represented at the higher levels of the family income distribution, although the number of siblings and the percentages of students from a two-parent family are comparable.

[Table 1 about here]

These predictors generally have the expected association with the probability of selecting and completing a STEM major (see Appendix Table A1 for a full set of average marginal effects). Advanced STEM course-taking, high school STEM GPA and self-assessed math ability, are all positively associated with STEM major selection and completion. The effect of math test score on STEM major choice is only positive and significantly different from zero when the outcome is bachelor's degree major in STEM. Students who plan an occupation outside of STEM or do not articulate an occupational plan ("don't know") are less likely to select a STEM major than those who plan STEM occupations (Morgan, Gelbgiser, et al. 2013; Weeden et al. 2020). Parental education and family income do not have statistically significant effects on STEM completion, which is consistent with previous research (Torche 2011; Xie and Achen 2009). Parental education is not found to be a significant predictor of initial STEM major selection; however, students in both the lowest and highest family income categories have significantly lower propensity of initiating a STEM major than those whose family income level fall between $50,000 and $75,000 – a pattern not revealed in previous studies focusing only STEM major completion (Torche 2011; Xie and Achen 2009). This result suggests that family income may be a more important predictor of STEM major selection than completion. In a full model with all the predictors, Asian-white differences in the predicted probability of choosing a

STEM major disappear, indicating that collectively, the predictors in the model capture much of the raw Asian-white gaps in STEM major attainment.

Shares of Asian-white gaps attributable to key predictors

Table 2 presents the Asian-white gaps in the predicted probabilities of selecting and completing a STEM major (panel A) and the minimum and maximum estimates of the share of the Asian-white gaps in these probabilities explained by each set of predictors (panel B). Model 1 is the baseline model and includes only gender and family background measures, while Model 7 is the full model. (The average marginal effects in Table A1 are based on Model 7.)

Table 2 shows a large contribution of Asian-white differences in occupational plans and prior academic preparation on both Asian-white gaps in initial STEM major selection and STEM degree completion. Asian students' higher propensity to hold a STEM-related occupational plan accounts for between 24.2% and 46.2% of the Asian-white gap in initial STEM major selection, and between 41.4% and 93.1% of the Asian-white gap in STEM major completion. Advanced STEM course-taking in high school accounts for 9.9% to 48.4% of the Asian-white gap in the predicted probability of initiating a STEM major by 2006, and 10.3% to 100.0% of the Asian-white gap in the predicted probability of completing a STEM major by 2012. High school academic achievement in STEM (i.e., math test scores and STEM GPA) accounts for 1.1% to 33.0% of the Asian-white gap in STEM major initiation and 3.4% to 79.3% of the Asian-white gap in STEM major completion by 2012. The large difference between the minimum and maximum estimates reflects the strong association among the measures of academic preparation, and between academic preparation and occupational plans. Notably, however, even the minimum estimates of the contributions of racial gaps in occupational plans to STEM outcomes – that is, estimates secured under the assumption that academic preparation is causally prior to the formation of occupational plans – are in the range of 1/3 of the Asian advantage in college STEM outcomes.

[Table 2 about here]

To what extent do the Asian-white gaps in self-assessed math ability contribute to Asian-white differences in STEM major attainment? Recall that Asian students tend to have lower self-assessed math ability than whites, conditional on academic preparation (see Table 1). Table 2 shows that the Asian disadvantage in self-assessed math ability reduces the observed baseline gaps in STEM major selection by 5.5% to 6.6%, and it reduces the observed baseline gaps in STEM major completion by about 6.9% . The Asian disadvantage in self-assessed math ability is certainly not large enough to offset Asian advantages in academic preparation in high school and STEM occupational plans. However, it demonstrates that Asian students are not advantaged on all commonly known positive predictors of STEM major choice.

Interaction between race and key predictors

The prior models assume an identical association between the predictors and the outcomes for Asian and white students. We relax this constraint by fitting multinomial logit regressions that include gender, family background, race, one of the key predictors, and an interaction between race and the key predictor. The results are presented in Figure 2.

Panels A and B of Figure 2 present Asian-white differences in the predicted probabilities of STEM major choice depending on whether they plan a STEM occupation, a non-STEM occupation, or "don't know" their occupation as seniors in high school. There is no statistically significant difference between Asians and whites who articulate an occupational plan. Compared to White students, Asian students who "don't know" their occupational plan in high school are more likely than white students to initiate a STEM major, although there is no significant difference in their predicted probabilities of completing a STEM major.

Panels C and D of Figure 2 present Asian-white differences in the predicted probabilities of STEM major choice depending on whether students have had taken advanced STEM courses in high school. Both panels show that Asian students' likelihood of selecting and completing a STEM major is less elastic with respect to advanced STEM course-taking in high school that white students. More specifically, Asians are significantly more likely than whites to initiate a STEM major only when they have not taken advanced STEM courses in high school (Panel C) and they are significantly less likely than whites to complete a STEM major only when they have taken advanced STEM courses in high school (Panel D).

A more nuanced picture emerges in comparing STEM outcome probabilities across levels of math test scores and STEM GPA. Panel E of Figure 2 shows that Asian students have significantly higher predicted probability of selecting a STEM major than whites among those who fall into the third and fourth quintiles of the math test score distribution. The inverted U-shaped relationship between math test score and the Asian-white gaps in initial STEM major selection suggests that Asian students' initial selection of a STEM major is more elastic with respect to math test scores when their math scores are relatively low and less elastic with respect to math test scores when their math scores are very high. Panel F shows that Asian students have significantly lower predicted probability of completing a STEM major than whites among those who fall into the highest quintile of the math test score distribution. This pattern suggests that Asian students' choice of a bachelor's degree major in STEM is less elastic with respect to math test scores when their math scores are very high. Panels G and H show an upwardly tilting trend of the Asian-white gap in the predicted probability of selecting (but not of completing) a STEM major and that Asian students have significantly higher predicted probability of selecting (but not of completing) a STEM major than whites among those falling into the fourth quintiles of STEM

GPA. They also indicate that Asian students' initial selection of a STEM major is more elastic with respect to STEM GPA, when their STEM GPA is not extremely high.

One might reasonably ask whether there is enough common support across the distributions of the achievement variables. In supplementary analysis (see Figure A1), we show sufficient common support across all five quintiles of the distribution of math test score as well as the first four quintiles of the distribution of STEM GPA across the white and Asian subsamples. However, the data are quite sparse for whites at the high end of the high school STEM GPA distribution. The Asian-white gap in the predicted probability of STEM major choice in this part of the distribution relies largely on extrapolation, and is more fragile than the estimated gaps at other values of the high school STEM GPA distribution (Hainmueller, Mummolo, and Xu 2019).

Finally, Panels I and J of Figure 2 present Asian-white differences in the predicted probabilities of STEM major choice across quintiles of the self-assessed math ability distribution. They show that Asians and whites who fall into the third and the fourth quintiles of the self-assessed math ability distribution differ in the predicted probability of selecting a STEM major, but not in the probability of completing a STEM major. The point estimates of the Asian-white gaps in the predicted probability of initiating a STEM major are relatively stable across the self-assessed math ability quintiles. We note, however, that data are sparse for Asians at both tails of the self-assessed math ability distribution (see Panel C of Figure A1).

[Figure 2 about here]

Ethnic variations among Asian Americans

To unpack the ethnic variations among Asian Americans in the probability of selecting or completing STEM degrees (see Figure 1), we first examine differences in the Asian-white gaps on the key predictors, adjusting for gender, family background, and, for the self-assessed math ability gaps, prior academic preparation. As we show in Table 3, Chinese, Korean, Southeast Asian, and South Asian students are all more likely than whites to plan a STEM occupation, but Japanese and Filipino students are not. Chinese students, but not students from other Asian ethnic groups, are more likely than whites to respond that they "don't know" their occupational plan. With the exception of Japanese students, all Asian ethnic groups are more likely to take advanced STEM courses in high school than whites. Chinese, South Asian, Japanese, and Filipino students have higher STEM GPA than whites, but only Chinese and South Asian students have higher average math test scores. Southeast Asian students, by contrast, have lower average math test score and comparable STEM GPAs as white students. Finally, the "Asian" disadvantage in self-assessed math ability (adjusting for prior academic preparation) seems to be driven by entirely students of Chinese or Southeast Asian heritage.

[Table 3 about here]

Table 4 presents the minimum and maximum estimates of the share of the ethnic or racial gaps in the predicted probabilities of initiating a STEM major by 2006 or obtaining a bachelor's degree in STEM by 2012 explained by each set of the key predictors. We limit the table to the three Asian ethnic groups (Chinese, Filipino, and South Asian) with significantly higher percentages of either initiating or completing a STEM major than whites.[8]We also note that by scaling to the baseline racial gap in the outcome, the minimum and maximum percentage contributions to this gap can appear extreme.

In general, we find that the predictors of Chinese-white gaps most closely mimic the predictors of the Asian-white gap, which to some extent reflects the large share of Chinese

[8] The results for Korean-, Japanese-, Southeast Asian-white comparisons are presented in Appendix Table A2.

students among the pan-ethnic “Asian” group. Chinese students’ higher likelihood of holding a “don’t know” occupational plan has a countervailing effect on their likelihood of initiating or completing a STEM major compared to whites; the magnitude of this dampening effect on Chinese-white differences in STEM outcomes in college is comparable to that of Chinese students’ lower average self-assessed math ability.

[Table 4 about here]

The other two Asian ethnic groups whose predicted probabilities of selecting or completing STEM degrees exceed whites, South Asian and Filipino, show slightly different patterns than the Chinese students. Specifically, the gap between South Asian and white students’ probabilities of majoring in STEM in college does not appear to be affected by differences in self-assessed math ability. The large contribution of self-assessed math ability to Filipino-white gaps seems to be driven by an imprecisely estimated self-assessed math ability “effect” and a comparatively small difference in the predicted probability of STEM major choice in the baseline model.

Finally, Figure 3 shows Asian ethnic-white gaps at different categories of the occupational plan variable, much as Panels A and B in Figure 2 did for the Asian-white comparisons. Assuming Chinese and white students have the same distribution across the occupational plan categories, Chinese-white differences in the likelihood of initiating a STEM major are driven by the higher likelihood of Chinese students to declare a STEM major if they plan to enter a STEM occupation *or* don’t know their occupational plans. Korean and Japanese students, by contrast, are less likely than whites to complete a STEM major if they plan a STEM occupation in high school, Filipino students show inconsistent patterns across the two outcomes, and South Asians show no difference from whites in their STEM outcomes in each category of occupational plan. Figure 4 shows Asian ethnic-white gaps at the two categories of the high school advanced STEM course-taking variable, much as Panels C and D in Figure 2 did for the Asian-white comparisons. Chinese students' likelihoods of both selecting and completing a STEM major are less elastic with respect to advanced STEM course-taking in high school than whites and so is Filipino students' likelihood of completing a STEM major. The rest of the Asian ethnic groups do not show significant difference from whites in how their STEM major choice is responsive to advanced STEM course-taking. (We also examined intra-Asian variation in the difference between whites in STEM outcomes at different values of math test scores, STEM GPA, and self-assessed math ability, but sample sizes at some of these values are so small that we hesitate to make much of them here). The overarching result is that Asian ethnic and regional groups do differ, not only in the magnitude of their STEM gap relative to whites, but also in their distributions on the predictors of STEM outcomes and in their likelihood of initiating or completing STEM majors given these distributions.

[Figure 3 about here]

[Figure 4 about here]

Sensitivity checks

Our sample in the "STEM completion" analyses excludes students who graduated from high school late or delayed their entry into college, in part so that we could have the same analytic sample as in the analysis of STEM initiation (which requires data from 2006). It also examines STEM completion from any of up to eight different institutions, thereby treating transfer students the same as single-institution students. To check the sensitivity of our results to the first decision, we expanded the analytic sample to later-college entrants. To check the second decision, we redefined the STEM completion variable to incorporate outcomes from only the first baccalaureate institution attended. In both cases, we found a very similar pattern of results with respect to the racial differences of interest.

We also checked whether our results are sensitive to the functional form of the model by dichotomizing our dependent variables and estimating the relative contribution of the key predictors under logit and linear probability models. The results from the logit and LPM models are similar to each other, and to the results we present here.

Discussion and conclusion

Asian Americans' over-representation in STEM college majors in the United States is well-documented (National Science Foundation 2014; Simpson 2001) and has found to contribute positively to their labor market outcomes (Kim and Sakamoto 2010; Kim and Zhao 2014). Although studies of Asian Americans' educational success on their levels of educational attainment and/or achievement has been abundant (e.g., Byun and Park 2012; Hsin and Xie 2014; Kao 1995; Kao and Thompson 2003; Liu and Xie 2016; Peng and Wright 1994; Sun 1998), there has only been sporadic studies of the qualitative differences in Asian and white students' college major choice (Ma 2010; Wang 2013; Xie and Goyette 2003). To fill this gap, this study proposes an account and provides a comprehensive analysis of three sets of micro-level factors measured in high school that might help give rise to the macro-level phenomenon of college major segregation between Asian and white students: plans to enter a STEM occupation, academic preparation in STEM, and self-assessed math ability. Although prior research on this topic has generally focused on students' initial STEM major selection without paying much attention to their STEM major completion (Wang 2013; Xie and Goyette 2003; but see Ma 2010), we focus on both outcomes.

Our analyses yield several important findings. First, using data from the ELS cohort, our descriptive statistics show that Asian-white gaps in STEM major selection are quite strong, as they were in earlier cohorts (Song and Glick 2004; Xie and Goyette 2003). They also show an Asian-white gap in STEM major completion in the ELS cohort, although it is smaller than the gap in initial major selection. Future research should explore the extent to which this is due to Asian students' higher attrition from STEM or to white students' greater likelihood of entering STEM majors after their sophomore year.

Second, our regression results show that high school occupational plans and academic preparation in STEM have the largest explanatory power for Asian-white differences in STEM selection and completion. To the extent that the inclusion of academic preparation variables greatly reduces the explanatory power of occupational plans, our results suggest that Asian students' beliefs about their occupational future and their everyday academic commitment during high school may positively reinforce each other in producing their higher likelihood of choosing a STEM major during college. To further ascertain the dynamic processes from tenth grade to college completion behind Asian-white segregation patterns across college majors, future research could use relevant variables in the ELS data to model the co-evolution of students' occupational plan and academic preparation throughout Asian and white educational careers.

Third, Asian students' greater academic preparation and likelihood of planning a STEM occupation in high school are accompanied by lower self-assessed math ability than students with comparable STEM course-taking, STEM GPA, and math test scores. This Asian disadvantage in self-assessed math ability tends to suppress the observed Asian-white gaps in STEM selection and completion: in a counterfactual world in which Asian students assessed their math ability at the same level as whites with the same test scores, the Asian advantage in STEM selection and completion would be 5.5-6.9% greater. We speculate that reference group effects may be at play: in assessing their math ability, Asian students may compare themselves to actual or ideal co-ethnic peers rather than to the average student or white students. The reference group effects may also occur because Asian students are more likely to be found in academically competitive schools and therefore tend to feel like “a small frog in a big pond.” This result is consistent with prior studies on the Asian-white differences in the levels of educational achievement which has shown that Asian students are in fact disadvantaged on some factors that facilitates educational achievement (such as family communication behaviors and parents’ social bonding with other parents in students’ schools), despite their overall advantage over whites in educational outcomes (e.g., Kao 1995; Sun 1998). Future research effort could be devoted to empirically evaluate our arguments about the mechanisms behind Asian students’ disadvantage in self-assessed math ability relative to whites.

Fourth, we find among those who did not articulate an occupational plan in high school, Asian students are significantly more likely than their white counterparts to declare a college major in STEM. Noteworthy is that prior research investigating Asian-white differences in college major outcomes as is related to high school occupational plans does not consider “don’t know” as a valid occupational plan category (Xie and Goyette 2003). Our research problematizes this view. We interpret our finding as demonstrating the significant normative and imitative influence of Asian students’ parents, peers, and co-ethnics who already achieved labor market success on Asian students’ choice outcomes, when they themselves does not have a clear preference about their occupational future during high school. Our results also show that the Asian-white gap in the likelihood of choosing a STEM major among those who “don’t know” their occupational plan in high school closes for bachelor’s degree major outcomes. This suggests the diminishing influence of normative and imitative pressures to major in STEM over the course of Asian students' college lives when they leave home and have more opportunities to find out about their own occupational interests. One might argue that the differential predictive power of holding a "don't know" occupational plan for Asian and white students' STEM major initiation could be a statistical artifact that is driven by systematically different psychological thresholds between the two groups of students to provide a concrete occupational title to the survey question when there is uncertainty in their underlying preferences. However, with the data we have, we are not able to evaluate this possibility. We leave this critical challenge to future research.

Fifth, relative to whites, Asian students' STEM major choice is less elastic with respect to whether they have taken advanced STEM courses in high school or increase in math test scores when their math test scores fall in the high end of the distribution. We also interpret this pattern as reflecting the additional normative and imitative pressure that Asian students face to choose a STEM major, making advanced STEM course-taking and math test scores (at the high end of the distribution only) less relevant predictors of their choice outcomes. We note that this finding is consistent with the broader sociological literature showing that individuals' educational decisions is often not driven by an uncontextualized calculation of the payoffs of alternative options, but are instead deeply influenced by the cultural and social norms for a specific social group (e.g., Brand and Xie 2010; Morgan 2005). Yet, our results also indicate that relative to whites, Asian students' initial STEM major choice is more elastic with respect to increase in their STEM GPA and math test scores when their math test score is relatively low. We interpret this pattern as reflecting another logic of choice: for Asian students, objective measures of academic performance, rather than their intrinsic interests, serves as a more important evaluative criterion to decide whether they are suitable to purse a college degree in STEM. However, this pattern is no longer salient when comparing Asian-white differences in the predicted probability of completing a STEM major, which may also suggest the diminishing role of the normative and imitative pressures that students face after they spend more years outside of home or their high school environment. These results combined suggest that although both high school STEM performance and advanced STEM course-taking have strong explanatory power for the observed Asian-white differences in STEM major choice, they in fact provide distinctive sets of information for us to understand how Asian and white students respond to the different dimensions of high school academic preparation.

Finally, we show that it is misleading to speak of an "Asian advantage" in STEM major selection and completion. In the ELS data, only Chinese, Filipino, and South Asian students are significantly more likely than whites to select a STEM major; and only Chinese and South Asian students are significantly more likely than whites to complete a STEM major. The Asian ethnic groups also differ in the extent to which these gaps are associated with differences in occupational plans, academic preparation, and self-assessed math ability. Although limitations in the ELS data mean that we can't tease out the sources of these intra-Asian differences, our results show that STEM major selection and completion may not be the universally racialized experience assumed in previous research on Asian-white differences in STEM major choice (Ma 2010; Wang 2013; Xie and Goyette 2003).

This study is not without limitations. For example, previous research shows that, among Asian students, the proclivity to major in STEM is in fact more pronounced among those who completed high school in Asia and undergraduate studies in the United States than students represented by the ELS data (Kim and Sakamoto 2010). To the extent that international students from Asian countries have become an increasingly sizable presence in America's four-year colleges (Ma 2020), their contribution to the patterns of racial segregation of college majors is important and keeps rising. With appropriate data, future research should investigate these Asian students' similar as well as unique incentives to major in STEM. Moreover, although we include other minority students in our regression models, we do not provide a theoretical account of how we expect these students' college major choices should differ from whites. Aside from space limitations, these students' experience of socialization within family and school as well as their perceptions of labor market opportunities may differ drastically from their Asian counterparts and merit a separate paper.

[Table A1 about here]

[Table A2 about here]

[Figure A1 about here]

Tables and Figures

Table II.1. Means, standard deviations (in parentheses), and percentages of covariates

	White	Asian	Asian-White Difference	
Occupational plan in 2004 (%)				
STEM	20.58	32.39	11.81	***
Non-STEM	51.50	34.93	-16.57	***
Don't know	26.16	30.90	4.74	
Missing	1.76	1.78	0.02	
Advanced STEM coursetaking in high school (%)	32.67	53.08	20.41	***
Math test score in 2004 (mean)	59.58	61.41	1.83	*
	(11.31)	(12.51)		
STEM GPA in high school	3.10	3.28	0.18	***
	(0.70)	(0.65)		
Self-assessed math ability in 2004 (mean)	0.33	0.28	-0.05	[a]
	(1.13)	(1.07)		
Female (%)	54.81	54.79	-0.02	
Parental highest level of education				
High school or below	11.35	14.07	2.72	
Some college	27.84	16.34	-11.50	***
College	31.68	35.19	3.51	
Master's or above	29.13	34.39	5.26	
Family income				
$25,000 or below	6.30	17.76	11.46	***
$25,000 to $50,000	21.75	27.96	6.21	**
$50,000 to $75,000	25.54	20.31	-5.23	*
$75,000 to $100,000	20.20	12.99	-7.21	**
$100,000 or above	26.20	20.98	-5.22	*
Number of siblings (mean)	1.34	1.43	0.09	
	(0.97)	(1.16)		
Two-parent family structure (%)	85.60	86.51	0.91	
Total N (unweighted)	3,770	790		

Note: Data are from ELS 2002-2012. Other races not shown (total unweighted N=5,790). Significance of Asian-white differences are based on t-tests (continuous variables) or on the delta-method standard error of the average marginal effect of race (categorical variables) using weighted data. *** p<0.001, ** p<0.01, * p<0.05.

[a] The Asian-white difference in self-assessed math ability is significant (p<0.01) after adjusting for gender, parental education, family income, family structure, and sibship size, advanced STEM course-taking, math test score, and STEM GPA.

Table 2. Asian-White Differences in the Predicted Probabilities of Choosing a STEM Major (Panel A) and Share of Differences Attributable to Predictors (Panel B)

	Initial Major in STEM, 2006		Bachelor's Degree Major in STEM, 2012	
Panel A: Asian-White gaps in predicted probabilities				
Model 1 (baseline): gender + family socioeconomic background	0.091		0.029	
	(0.024)		(0.019)	
Model 2: baseline + occupational plans	0.049		0.002	
	(0.021)		(0.017)	
Model 3: baseline + advanced STEM coursetaking	0.047		-0.000	
	(0.022)		(0.017)	
Model 4: baseline + math test score + STEM GPA	0.061		0.006	
	(0.021)		(0.017)	
Model 5: baseline + advanced STEM coursetaking + STEM GPA + math test scores	0.046		-0.000	
	(0.021)		(0.017)	
Model 6: Model 5 + self-assessed math ability	0.052		0.002	
	(0.021)		(0.017)	
Model 7 (full): baseline + all high school predictors	0.030		-0.010	
	(0.019)		(0.016)	
Model 8: full - occupational plans	0.052		0.002	
	(0.021)		(0.017)	
Model 9: full - advanced STEM coursetaking	0.039		-0.007	
	(0.020)		(0.016)	
Model 10: full - math test score - STEM GPA	0.031		-0.009	
	(0.020)		(0.016)	
Model 11: full - self-assessed math ability	0.025		-0.012	
	(0.019)		(0.015)	
Panel B: Estimated share of gap attributable to predictor	Min	Max	Min	Max
Occupational plans	24.2%	46.2%	41.4%	93.1%
Advanced STEM coursetaking	9.9%	48.4%	10.3%	100.0%
Math test scores and STEM GPA	1.1%	33.0%	3.4%	79.3%
Self-assessed math ability (max: adjusting for advanced STEM coursetaking, math test score and STEM GPA)	-5.5%	-6.6%	-6.9%	-6.9%

Note: Data are from ELS 2002-2012. Unweighted N=5,790. Estimates come from multinomial logistic regression models with three outcome categories: STEM, non-STEM, or undeclared/missing outcome (column A); or STEM, non-STEM, or no bachelor's degree (column B). Sample includes all races, although only the Asian-white comparisons are shown. Minimum and maximum shares of Asian-white differences "explained" are scaled to the baseline gap (Model 1).

Table 3. Asian Ethnic Group-White Gaps in Occupational Plans, Advanced STEM Coursetaking, Math Test Scores, STEM GPA, and Self-assessed Math Ability

	Occupational Plan (Average Marginal Effects)			Advanced STEM Coursetaking (Average Marginal Effects)	Math Test Score (OLS)	STEM GPA (OLS)	Self-assessed Math Ability (OLS)
	STEM	Non-STEM	Don't Know				
Race/ethnicity (*ref.*=White)							
Chinese	0.135***	-0.264***	0.135**	0.313***	6.990***	0.332***	-0.352***
	(0.041)	(0.034)	(0.045)	(0.054)	(1.001)	(0.061)	(0.094)
Korean	0.117*	-0.151**	0.027	0.204**	2.635	0.066	-0.168
	(0.055)	(0.054)	(0.049)	(0.064)	(2.103)	(0.085)	(0.114)
Japanese	0.017	0.024	-0.024	0.076	2.087	0.242*	-0.147
	(0.070)	(0.096)	(0.054)	(0.106)	(1.910)	(0.122)	(0.099)
Southeast Asian	0.167***	-0.177***	0.028	0.176***	-3.749**	0.012	-0.216**
	(0.049)	(0.047)	(0.047)	(0.051)	(1.260)	(0.065)	(0.080)
Filipino	0.067	-0.091	0.025	0.156*	-2.349	0.153*	-0.150
	(0.071)	(0.077)	(0.068)	(0.078)	(1.603)	(0.077)	(0.128)
South Asian	0.162*	-0.225**	0.032	0.205*	3.905*	0.243*	0.150
	(0.077)	(0.073)	(0.082)	(0.086)	(1.884)	(0.113)	(0.098)

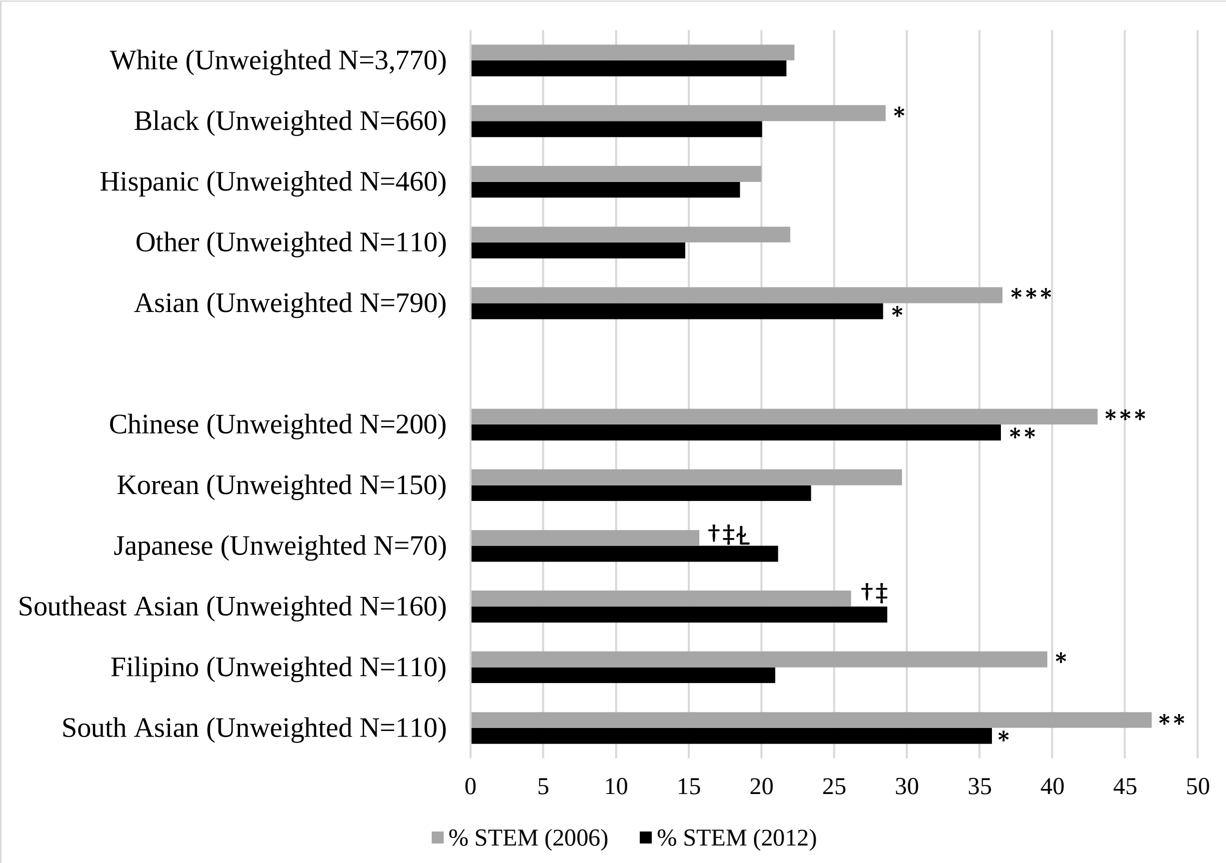
Note: Data from ELS 2002-2012; total unweighted N=5,790. Estimated parameters for Black, Hispanic, and other race are not shown. Model of self-assessed math ability adjusts for gender, parental education, family income, family structure, sibship size, advanced STEM course-taking, math test score, and STEM GPA. Data are weighted, and we report robust standard errors clustered by school. *** p<0.001, ** p<0.01, * p<0.05 (two-tailed tests).

Table 4. Minimum and Maximum Estimates of Share of Chinese-, Filipino- and South Asian-White Gaps in the Predicted Probability of Choosing a STEM Major Explained by Each Predictor

	Chinese-White Gap		Filipino-White Gap		South Asian-White Gap	
	Min	Max	Min	Max	Min	Max
Panel A: Initial Major in STEM field, 2006						
Occupational plans	17.10%	39.70%	8.70%	18.50%	18.60%	35.90%
Advanced STEM coursetaking	6.80%	46.60%	7.50%	25.40%	5.40%	26.90%
Math test scores and STEM GPA	4.80%	47.90%	3.50%	9.80%	0.60%	25.10%
Self-assessed math ability (max: adjusting for advanced STEM coursetaking, math test score and STEM GPA)	-5.50%	-8.90%	-4.60%	-4.60%	1.80%	1.80%
“Don't know” occupational plan	-5.50%	-8.90%	-0.60%	-1.70%	-0.60%	-1.80%
Panel B. Bachelor’s Degree in STEM field, 2012						
Occupational plans	17.60%	54.10%	533.30%	566.70%	30.00%	77.50%
Advanced STEM coursetaking	5.40%	63.50%	166.70%	633.30%	5.00%	67.50%
Math test scores and STEM GPA	16.20%	78.40%	-200.00%	-66.70%	7.50%	80.00%
Self-assessed math ability (max: adjusting for advanced STEM coursetaking, math test score and STEM GPA)	-4.10%	-8.10%	0.00%	-66.70%	0.00%	0.00%
“Don't know” occupational plan	-2.70%	-6.80%	33.30%	-33.30%	-2.50%	-7.50%

Note: Data are from ELS 2002-2012; unweighted N=5,790. See text for explanation of minimum and maximum estimates. Estimates of percentage of gaps attributable to unknown occupational plans based on a model in which the four-category occupational plan variable (STEM/Non-STEM/Don't Know/Missing) is replaced by a three-category occupational plan variable (Know/Don't Know/Missing).

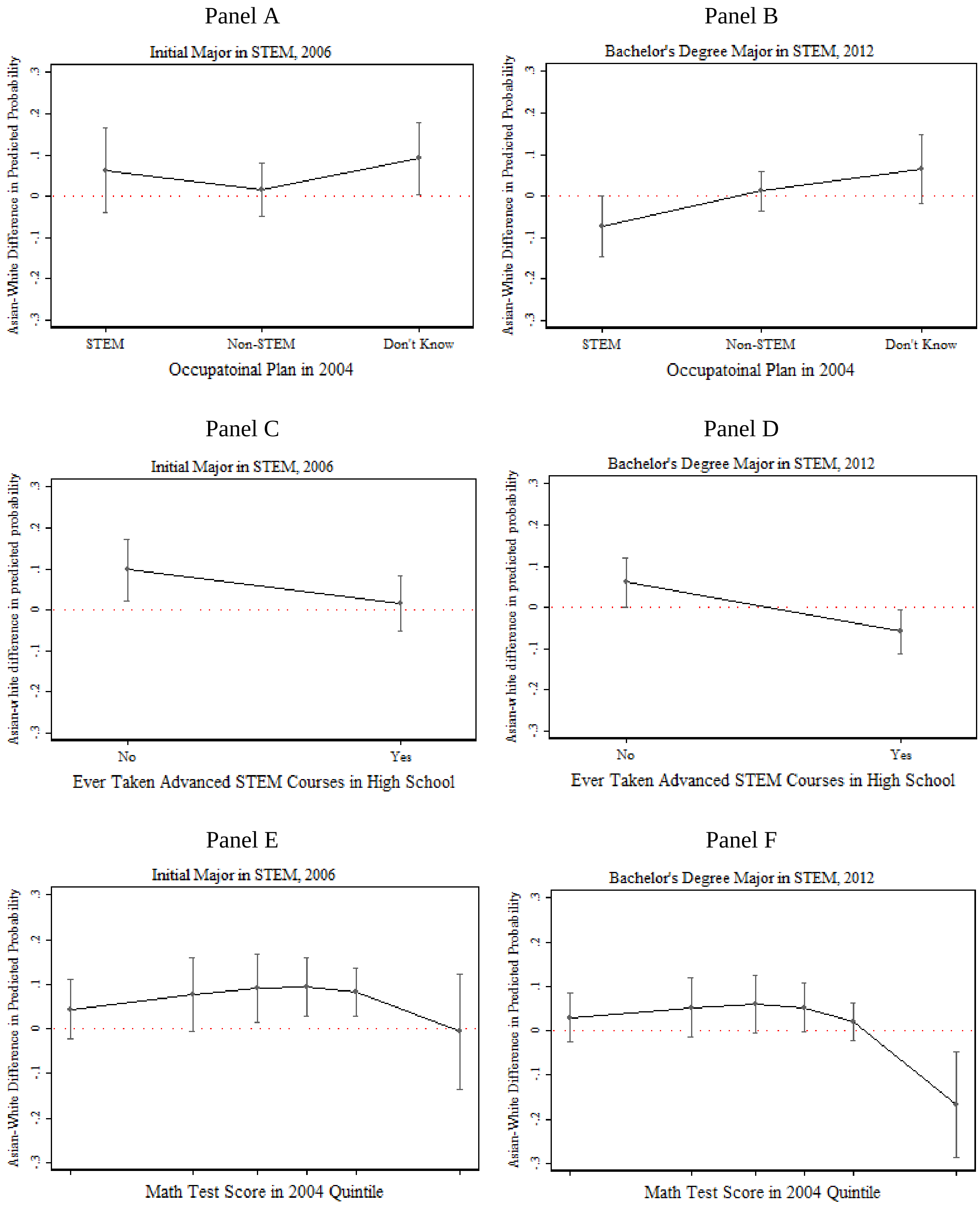
Figure 1. STEM Major Selection and Completion among Four-Year College Students, by Race and Asian Ethnicity



Note: Data are from ELS 2002-2012. Unweighted sample sizes are rounded to the nearest 10 to meet conditions of data license. The grey bars indicate the weighted percentage of students who declared a STEM major by 2006 among those who declared a major. The black bars indicate the weighted percentage of students who earned a bachelor's degree in a STEM field among those who obtained a bachelor's degree by 2012. The "other" racial category includes Native Americans and Pacific Islanders.

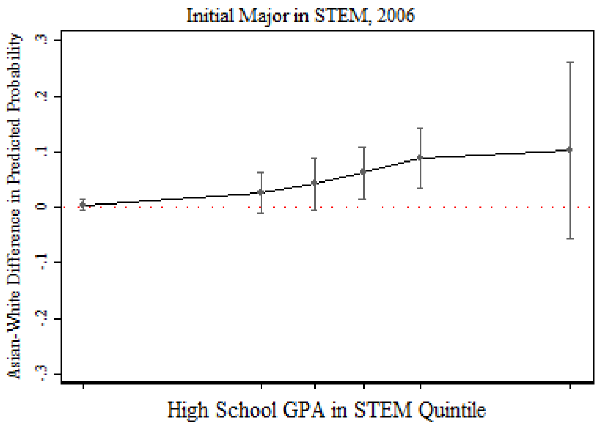
*** p<0.001, ** p<0.01, * p<0.05 (two-tailed tests; reference group=white). For intra-Asian comparisons in the likelihood of choosing a STEM major, † denotes significant differences from Chinese, ‡ denotes significant differences from South Asian, and Ł denotes significant differences from Filipino (p<0.05).

Figure 2. Asian-White Differences in the Predicted Probability of Choosing a STEM Major at Different Locations of Predictors with 95% Confidence Intervals from Multinomial Logit Regressions with Race-Predictor Interactions

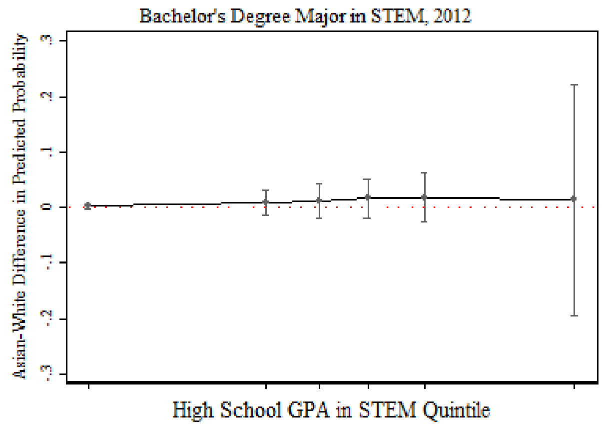


(To be continued)

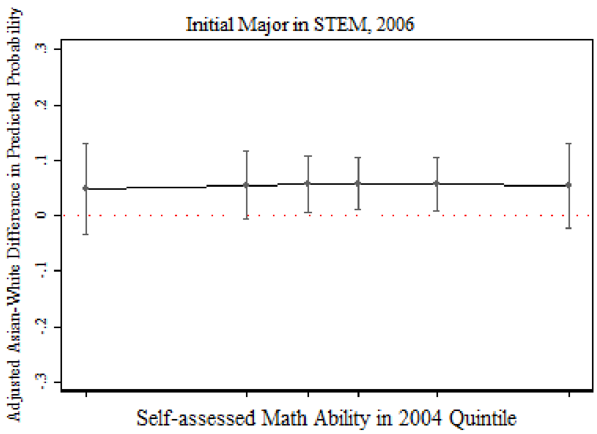
Panel G



Panel H



Panel I



Panel J

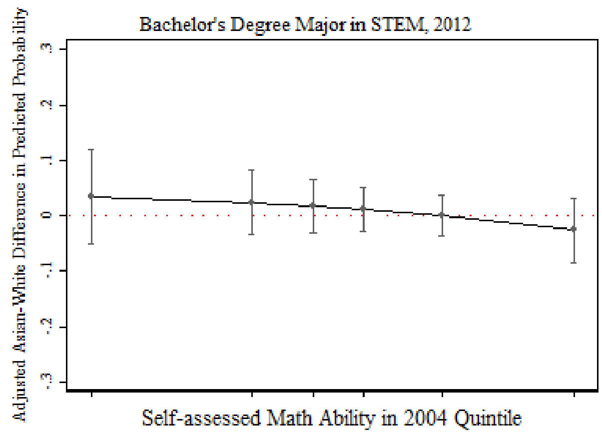
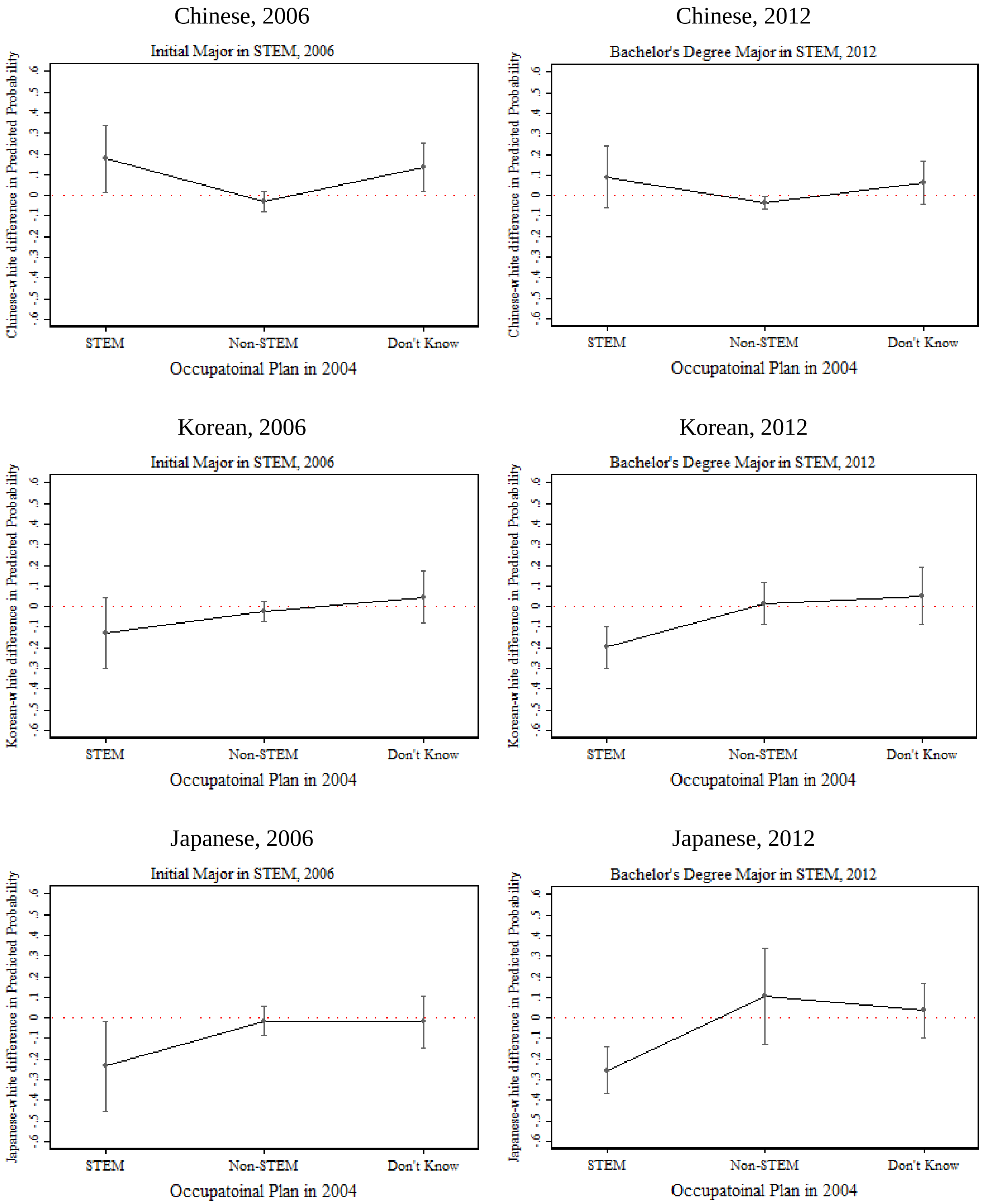


Figure 2. (Continued)

Note: Each model adjusts for gender, parental education, family income, family structure and sibship size. Self-assessed math ability model also adjusts for advanced STEM coursetaking, math test score, and STEM GPA.

Figure 3. Asian Ethnic-White Differences in the Predicted Probability of Choosing a STEM Major at Different Categories of "Occupational Plan in 2004" with 95% Confidence Intervals from Multinomial Logit Regressions with Race/Ethnicity-Predictor Interactions.



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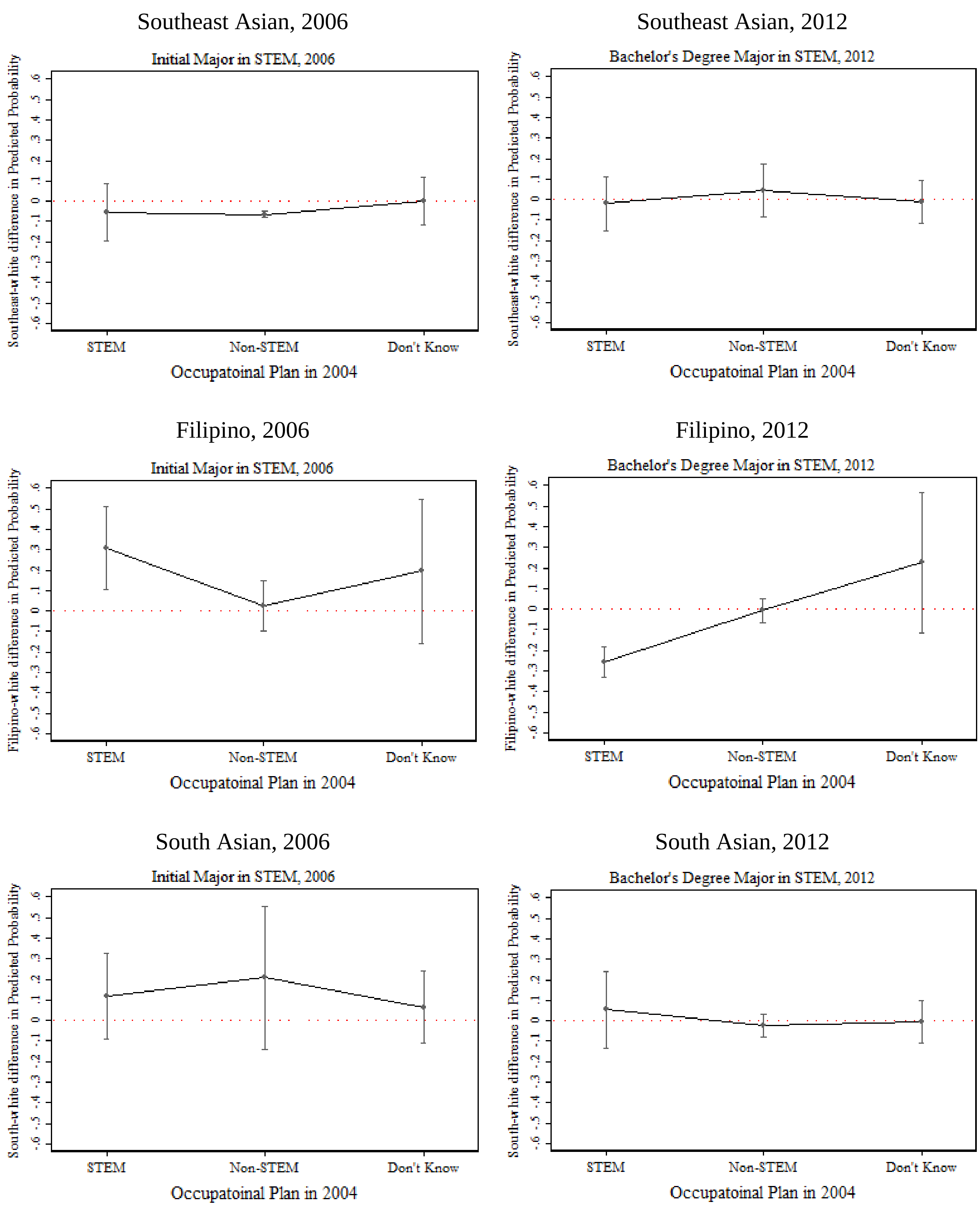
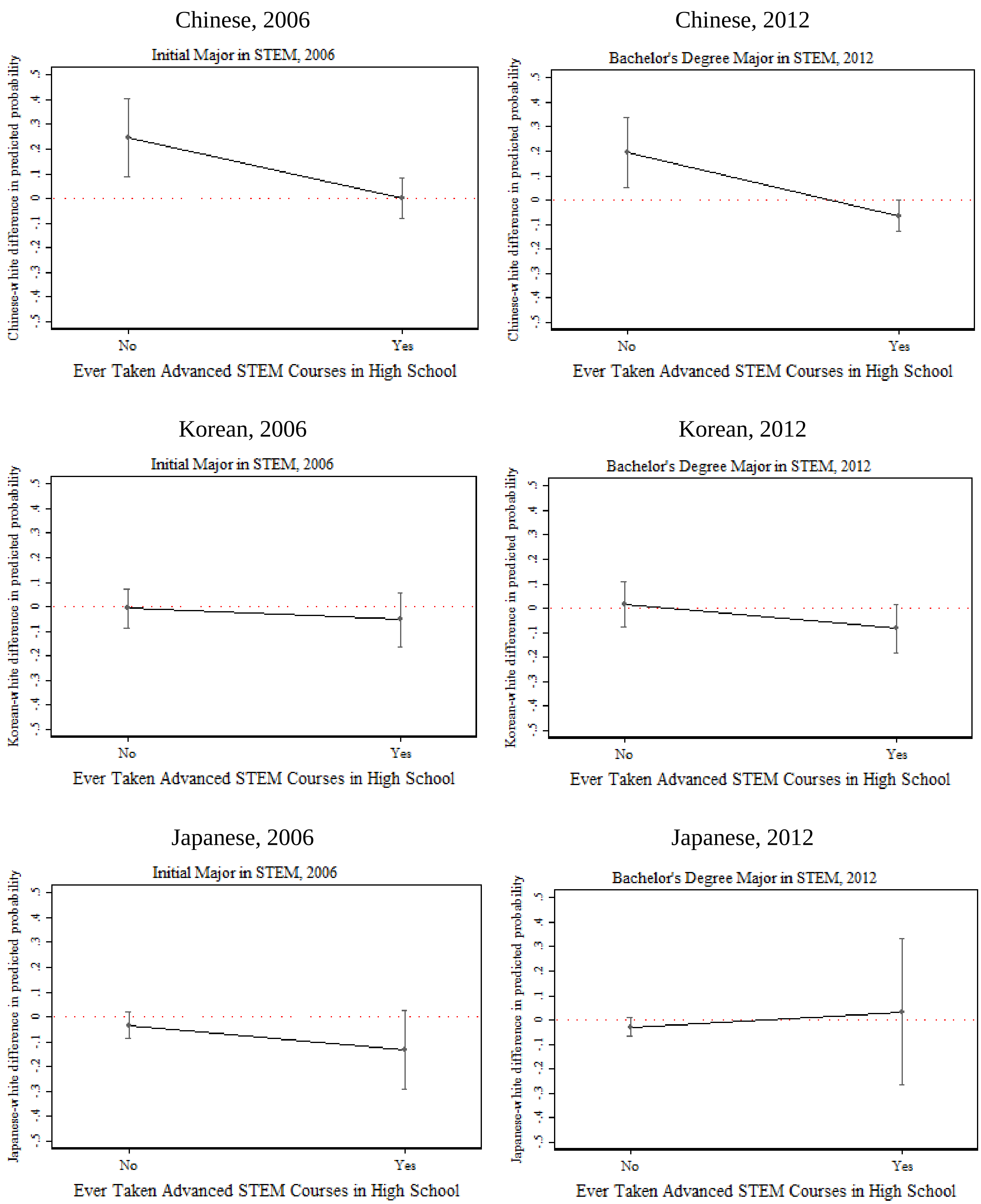


Figure 3. (Continued)

Figure 4. Asian Ethnic-White Differences in the Predicted Probability of Choosing a STEM Major at Different Categories of “Ever Taken Advanced STEM Courses” with 95% Confidence Intervals from Multinomial Logit Regressions with Race/Ethnicity-Predictor Interactions.



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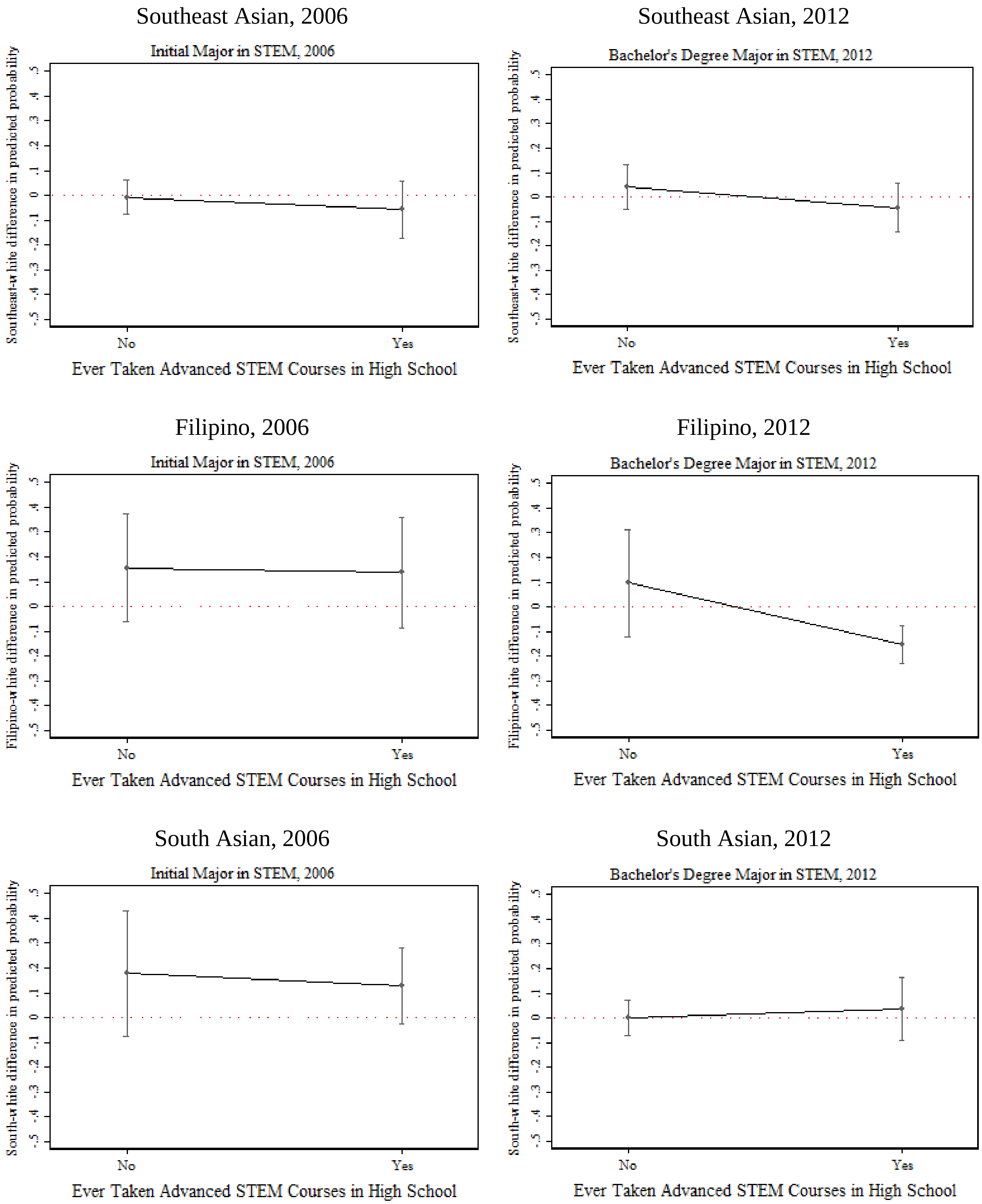


Figure 4. (Continued)

Appendix

Table A1. Average Marginal Effects from Multinomial Logistic Regression Predicting STEM College Outcomes.

Variable	Initial Major in STEM, 2006	Bachelor's Degree Major in STEM, 2012
Asian (*ref*.=White; Estimated coefficients for Black, Hispanic, and other race are not shown)	0.030	-0.010
	(0.019)	(0.016)
Occupational plan in 2004 (*ref*.=STEM)		
Non-STEM	-0.271***	-0.159***
	(0.016)	(0.014)
Don't Know	-0.218***	-0.112***
	(0.019)	(0.015)
Missing	-0.168***	-0.111***
	(0.043)	(0.032)
Advanced STEM coursetaking in high school	0.075***	0.036**
	(0.013)	(0.012)
Math test score in 2004	-0.000	0.003***
	(0.001)	(0.001)
STEM GPA in high school	0.054***	0.041***
	(0.011)	(0.011)
Self-assessed math ability in 2004	0.022***	0.011*
	(0.006)	(0.005)
Female (*ref*.=male)	-0.067***	-0.051***
	(0.011)	(0.009)
Highest level of parental education (*ref*.=college)		
High school or below	0.023	-0.001
	(0.021)	(0.019)
Some college	0.007	0.002
	(0.015)	(0.013)
Master's or above	0.016	0.005
	(0.014)	(0.012)
Family income (*ref*.=$50,000 to $75,000)		
$25,000 or below	-0.056**	-0.003
	(0.022)	(0.020)
$25,000 to $50,000	-0.029	-0.017
	(0.015)	(0.015)
$75,000 to $100,000	-0.018	-0.008
	(0.016)	(0.016)
$100,000 or above	-0.032*	-0.019
	(0.015)	(0.015)
Number of siblings	-0.002	-0.002
	(0.006)	(0.005)
Two-parent family structure	0.006	0.006
	(0.015)	(0.014)

Note: Data from ELS 2002-2012; total unweighted N=5,790 (rounded). Sample is restricted to those who graduated high school on time, entered a four-year college within six month of high school graduation, and have transcript information. Delta-method standard error clustered by school is given in parentheses. Customized sample weight is applied. *** p<0.001, ** p<0.01, * p<0.05 (two-tailed tests)

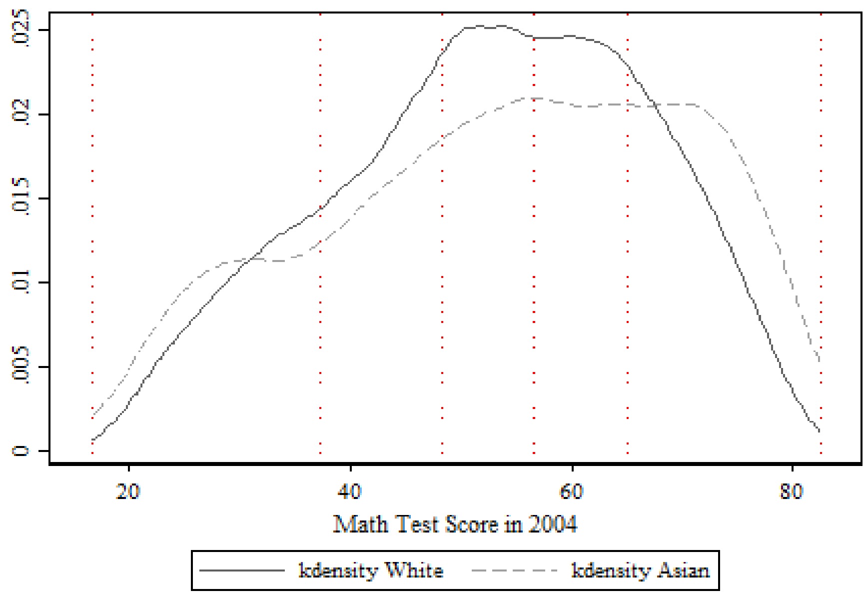
Table A2. Minimum and Maximum Estimates of Share of Korean-, Japanese- and Southeast Asian-White Gaps in the Predicted Probability of Choosing a STEM Major Explained by Each Predictor

	Korean-White Gap		Japanese-White Gap		Southeast Asian-White Gap	
	Min	Max	Min	Max	Min	Max
Panel A: Initial Major in STEM field, 2006						
Occupational plans	200.00%	322.20%	-9.00%	6.00%	145.80%	208.30%
Advanced STEM coursetaking	88.90%	344.40%	-7.50%	6.00%	54.20%	179.20%
Math test scores and STEM GPA	-66.70%	122.20%	3.00%	9.00%	-16.70%	33.30%
Self-assessed math ability (max: adjusting for advanced STEM coursetaking, math test score and STEM GPA)	-33.30%	-44.40%	-1.50%	-3.00%	-12.50%	-25.00%
"Don't know" occupational plan	-33.30%	-22.20%	0.00%	1.50%	-4.20%	-4.20%
Panel B. Bachelor's Degree in STEM field, 2012						
Occupational plans	275.00%	500.00%	-300.00%	150.00%	70.70%	100.00%
Advanced STEM coursetaking	100.00%	600.00%	-250.00%	300.00%	19.50%	97.60%
Math test scores and STEM GPA	-75.00%	350.00%	450.00%	800.00%	-14.60%	22.00%
Self-assessed math ability (max: adjusting for advanced STEM coursetaking, math test score and STEM GPA)	-25.00%	-50.00%	-100.00%	-100.00%	-4.90%	-7.30%
"Don't know" occupational plan	-25.00%	0.00%	0.00%	50.00%	0.00%	-2.40%

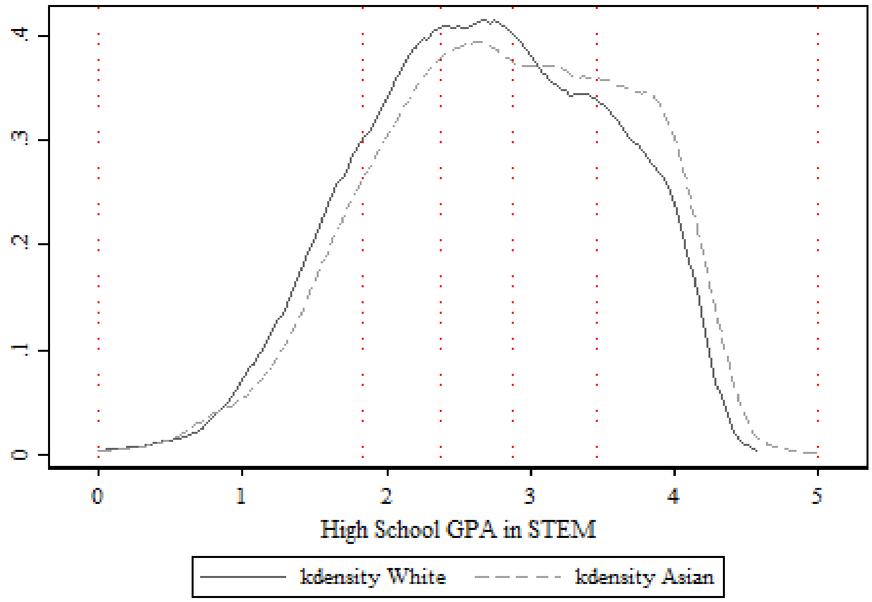
Note: Data are from ELS 2002-2012; unweighted N=5,790. See text for explanation of minimum and maximum estimates. Estimates of percentage of gaps attributable to unknown occupational plans based on a model in which the four-category occupational plan variable (STEM/Non-STEM/Don't Know/Missing) is replaced by a three-category occupational plan variable (Know/Don't Know/Missing).

Figure A1. Kernel Density Plot of Math Test Score in 2004, High School GPA in STEM, and Adjusted Math Self-assessment by Race.

Panel A



Panel B



(To be continued)

Panel C

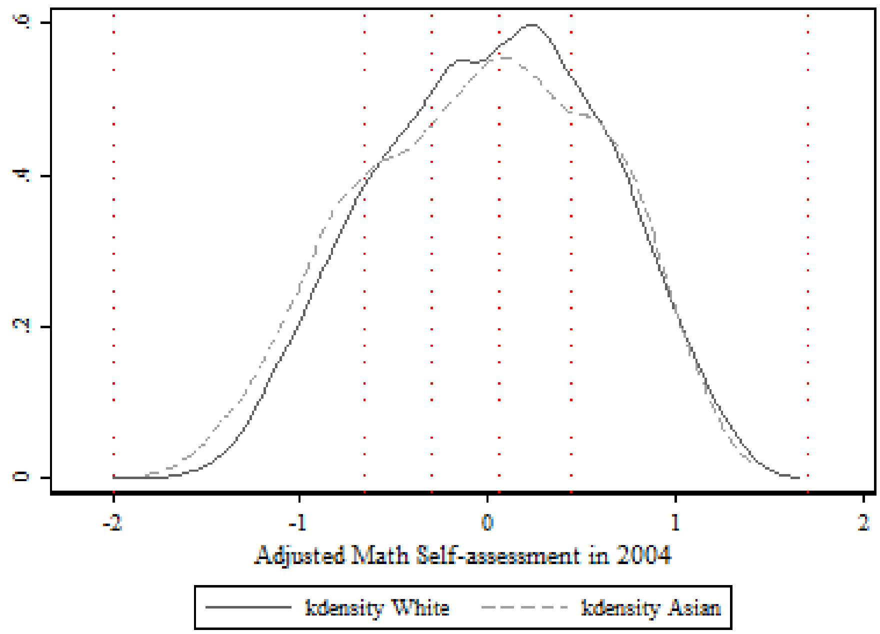


Figure A1. (Continued)

Note: Adjusted self-assessed math ability comes from predicted values from OLS regression model for self-assessed math ability on race, adjusting for gender, parental education, family income, family structure, sibship size, advanced STEM coursetaking, math test score, and STEM GPA. The dotted vertical lines represent the turning points of the different quintiles of the distribution of these continuous variables in a pooled sample with both Asians and whites.

CHAPTER III. Asian-White Differences at the Intersection of High School Mathematics Course-taking and Academic Self-assessment in Mathematics

Relative to students of other racial and ethnic groups, Asian students obtain better grades, achieve higher scores on standardized tests, and are more likely to enroll in the most advanced courses in high school (Kao and Thompson 2003; Hsin and Xie 2014; Liu and Xie 2016; Kelly 2009; National Science Foundation 2014). Stereotypes of Asians point to their greater academic orientation and ability, particularly in math and science (Shih, Pittinsky, and Ambady 1999; Ho, Driscoll, and Loosbrock 1998; Cheryan and Bodenhausen 2000). Paradoxically, however, Asian students have the lowest self-esteem, and are the least likely to identify as good students (Lee and Zhou 2015; Hsin and Xie 2014), even conditional on a given level of academic achievement (Massey et al. 2003; Sidanius et al. 2008; Liu and Weeden, n.d.).

This paper attempts to unpack this paradox by arguing that Asian-white differences in self-assessed math ability are different not only in magnitude but also in valence among students who take advanced and nonadvanced math courses in high school. It also provides an account of how the Asian-white differences in self-assessed math ability among students who take advanced and nonadvanced math courses are driven by the objective measure of math ability, the different academic environments that Asian and white students tend to be found in and the different reference groups that Asian and white students tend to choose to gauge their own academic ability.

Racial differences in self-assessed ability in mathematics matter because they affect inequalities in later educational decisions and outcomes, such as whether to choose a college major in science, technology, engineering, and mathematics (STEM; Correll 2001; Xie and

Shauman 2003; Morgan et al. 2013; Weeden, Gelbgiser, and Morgan 2020; Liu and Weeden n.d.). For example, Liu and Weeden (n.d.) find that Asian college entrants, relative to their white counterparts, have lower self-assessment in mathematics at the end of high school, which reduces their likelihood of choosing a college major in STEM.

Asian students are over-represented among those who take mathematics courses, such as precalculus or calculus, in high school (Lee and Zhou 2015; Jiménez and Horowitz 2013), and public discourse surrounding Asian Americans' academic experience focuses mainly on those who take those courses. Often lost in this conversation is the diversity of Asian students' schooling experience and the relationship between position in a hierarchical curriculum of mathematics (ranging from no math to calculus) and the racial gap in self-assessed math ability between Asians and whites. Since the cultural expectation and stereotype is for Asian students to be found in advanced mathematics courses, those who do and do not conform to the expectation may experience divergent socio-psychological effects which could lead to a divergence in the objective measures of racial differences in math ability.

My second contribution is to provide explanations for Asian-white differences in self-assessment in mathematics among students who take advanced and nonadvanced math courses, conditional on objective measures of math ability. My theoretical model draws on the frog-pond perspective of academic self-evaluation, recent ethnographic research on the Asian American's academic achievement, and the social psychology literature on how status groups respond to group-based stereotypes. Specifically, it argues that Asian students are more likely than whites to be found in academically competitive schooling environments which could jeopardize their self-assessed math ability. However, the effect of schools' academic competitiveness in driving down Asian students' self-assessed math ability relative to whites is much diluted among students who do not take advanced math courses where Asian students' social surroundings have higher proportions of non-Asians than their counterparts who take advanced math courses.

In addition to heterogeneity across the level of math course-taking, I will also assess – to the extent allowed by a limited sample size – heterogeneity in Asian-white difference in mathematics self-assessment across Asian ethnic groups. This analysis is informed by the prior research documenting different parenting practices and parental expectations held by parents with different immigrant generational compositions or whose country of origin is Confucian or non-Confucian as well as different levels of academic achievement relative to whites among students of different ethnic groups of Asian Americans. It's important because ethnic heterogeneity is an essential feature characterizing Asian Americans' lived experiences in the United States (Kao and Thompson 2003; Goyette and Xie 1999).

In the remainder of the paper, I will first discuss the cultural expectation for Asian students to be found in advanced math courses in high school. I will then discuss how Asian-white differences in the objective measures of math ability would drive the Asian-white differences in self-assessed math ability among students who take advanced and nonadvanced math courses in high school. After that, I will discuss how schools' academic competitiveness, which is proxied by the level of Asian concentration, could help explain the Asian-white differences in self-assessed math ability after adjusting for objective measures of math ability in both strata of math course-taking.

Background

Asian students are more likely than whites to persist in the mathematics pipeline through precalculus or calculus in high school (Kelly 2009; Dalton et al. 2007; Lee and Zhou 2015; Jiménez and Horowitz 2013). Indeed, prior research suggests that there is a positive stereotype about Asian students' math ability (Ho, Driscoll, Loosbrock 1998; Cheryan and Bodenhausen 2000) and it is culturally expected that Asian students should take advanced math courses, which usually consist of students with high math ability (Lee and Zhou 2015; Jiménez and Horowitz 2013). In the sections that follow, I discuss whether Asian students conform to the cultural expectation could affect their average test scores relative to whites, which drives Asian-white differences in self-assessed math ability. Then, I develop an account of how reference group effects that is related to schools' academic competitiveness could potentially contribute to Asian-white differences in self-assessed math ability among students who do and do not take advanced math courses.

Positive Stereotype and the Effect of Mathematics Test Score

Since mathematics test score positively predicts students' mathematics self-assessment (Correll 2001; Xie and Shauman 2003), Asian-white differences in mathematics self-assessment may be driven by Asian-white differences in mathematics test score. However, Asian students' mathematics test score relative to whites may differ across mathematics course-taking strata.

Although there is a widespread belief of an Asian superiority in mathematics (Jiménez and Horowitz 2013; Lee and Zhou 2015), conditional on reaching advanced mathematics courses, such as calculus or precalculus, white students may be as academically well-prepared and motivated as their Asian counterparts. Thus, one may not find significant Asian-white gap in cognitive ability in mathematics among students who enroll in those courses.

However, in nonadvanced mathematics courses, the situation is different. Past socio-psychological studies show that individuals from both in-group and out-group have strong unconscious tendencies to recognize only instances that are consistent with group-based stereotypes and have strong incentives to act in accordance with those stereotypes in public settings in order to keep social interactions smooth (Fiske, Lin, and Neuberg 1999; Ridgeway 2011). Since formed stereotypes are hard to be challenged, members of the positively stereotyped group who fail to live up to the positive expectations may experience negative consequences (Ho, Driscoll, Loosbrock 1998; Cheryan and Bodenhausen 2000). Specifically, prior research shows that Asian students who perform poorly on a test in mathematics are evaluated more negatively than white students who perform equally poorly when evaluators are not held accountable to evaluate with accuracy or are not intrinsically motivated to do so (Ho, Driscoll, and Loosbrock (1998). Apprehension about failure to meet the high expectations held for Asian students' ability in mathematics may in turn serve to undermine Asian students' performance on a mathematics test, especially when those expectations are made salient (Cheryan and Bodenhausen 2000). Asian students enrolling in nonadvanced mathematics courses are especially vulnerable to the fear of falling short of the high expectations, since they tend to be under-represented in nonadvanced mathematics courses and their mere presence in nonadvanced mathematics courses violates cultural expectations and stereotypes of taking advanced mathematics courses held for Asian students as a whole. As such, results from psychological lab studies suggest that, in survey data, we may observe Asian students in nonadvanced mathematics courses to have lower test score in mathematics than their white counterparts.

Asian and white students may also differ in the responsiveness of their mathematics self-assessment to changes in objective measures of their ability in mathematics. Among those who take advanced mathematics courses, Asian students will tend to measure their academic success against their highest-achieving co-ethnics. As such, their self-assessment in mathematics will be less sensitive to their test scores in mathematics as compared to their white counterparts'. Among those who take nonadvanced mathematics courses, I also expect Asian students' mathematics self-assessment to be less sensitive to their mathematics achievement as compared to whites'. In the social psychology literature on "stereotype threat," black students who fear to confirm the negative stereotypes of their academic inferiority may chronically adapt to a psychological state where their academic achievement is less relevant as a basis of their academic self-assessment relative to whites (Crocker, Major, and Steele 1998; Morgan and Mehta 2004). By the same token, In the same light, I argue that Asian students in nonadvanced mathematics courses may adopt coping strategies to adapt to their predicament of failing to live up to the positive stereotype about Asian students' ability in mathematics, which, over the long run, would result in a weaker connection between their mathematics test scores and their self-evaluation of their ability in mathematics relative to white students.

Reference Group of Comparison and the Effect of Schools' level of Asian Concentration

Asian and white students with comparable level of mathematics achievement may have different levels of mathematics self-assessment because they use different reference groups to gauge their academic success. The "frog-pond" perspective of academic self-assessment suggests that students make assessments of their own academic ability against their specific schooling context, without taking into account how competitive their schooling environment is relative to other schools (Marsh and Hau 2003; Crosnoe 2009).As such, students in academically more competitive environments tend to have lower academic self-assessment, since students in those environments feel like a small frog in a large pond (Marsh and Hau 2003). Qualitative research suggests that Asian parents, relative to their white counterparts, tend to attach more importance to the instructional quality of academic courses as compared to non-academic factors when making school choice for their children (Lee and Zhou 2015). As a result, it is often observed that schools with a high percentage of Asian students tend to have a highly competitive academic environment (Jiménez and Horowitz 2013). This suggests that Asian students may have lower self-assessment in mathematics than their white counterparts by virtue of being more likely to be exposed to a more competitive academic environment.

Another reference group factor that may contribute to Asian students' lower self-assessment in mathematics than whites' is that Asian students tend to compare their own academic achievement to the ideal-typical Asian student, a fictive student who, presumably, has a stellar academic record. In order to demonstrate that the "success frame" is realizable, Asian parents pass on stories of co-ethnics who successfully followed the path stipulated in the "success frame" and push their children to treat those co-ethnics as role models (Lee and Zhou 2015). Asian students who try to live up to the "success frame" think of "B" in high school as a failing grade; for them, gaining admission to an elite college and entering a high-status occupation is worth celebrating, but nothing less (Jiménez and Horowitz 2013; Lee and Zhou 2015). Since the bar for "success" is so high in this frame, Asian students in general may not feel as successful as white students with comparable levels of academic achievement.

I expect that the Asian-white gap in mathematics self-assessment as driven by reference group factors is more pronounced among those who take advanced mathematics courses. Previous research shows that for Asian students, only those who buy into the high standard of academic success tend to measure their success "up" against a bar of success unattainable even for most Asians (Lee and Zhou 2015). In contrast, Asian students who do not buy into the high standard of academic success tend to compare their academic achievement with a more heterogeneous reference group which has a more diverse set of worldviews of success (Lee and Zhou 2015). These Asians feel more successful than their co-ethnic peers who buy into the "success frame," although they generally seem to attain less (Lee and Zhou 2015). To the extent that nonadvanced mathematics courses consist of Asian students who do not buy into the high standard of academic success, we may find a smaller gap in mathematics self-assessment between Asian and white students in nonadvanced mathematics courses than in advanced mathematics courses in high school.

Moreover, given that the proportion of Asian students who reached precalculus or calculus is much higher than students of other racial or ethnic groups (Dalton et al. 2007), I expect the more proximate academic environment for Asian students to be more heterogeneous in terms of racial or ethnic composition in nonadvanced mathematics courses than in advanced mathematics courses. To the extent that Asian students' lower mathematics self-assessment than whites is driven by the high Asian representation in their academic environment, I also expect that the Asian disadvantage in mathematics self-assessment is less pronounced in nonadvanced mathematics courses relative to advanced mathematics courses in high school.

Should we expect white students' self-assessment in mathematics to be as responsive to the percentage of Asian students in school as their Asian counterparts? Asian parents are not the only actors to shape high schools' Asian representation (Goyette, Farrie, and Freely 2014). With an increase in the percentage of Asian students in a school, white parents may resist the "hyper-achievement" norm that the Asian population carries in order not to overtax their children by deliberately sending or transferring their children to a less competitive high school (Jiménez and Horowitz 2013). In other words, white parents' tastes and behaviors also have implications for a school's level of Asian representation. White parents who otherwise send their children to high schools with a high Asian representation should have a high level of tolerance towards the Asian population's achievement norm. As a result, there may not be significant Asian-white difference in their responsiveness to the level of Asian representation in high school.

Heterogeneity across Asian Ethnic Groups

The theorization above treats Asian American as a monolithic pan-ethnicity. However, based on findings reported by previous research, I anticipate intra-Asian variations in Asian-white difference in mathematics self-assessment.

First, the reference group effect on mathematics self-assessment as induced by the tendency to always measure one's own academic success against co-ethnics with stellar academic records may be the most pronounced among Asian national or regional groups originated from countries heavily impacted by Confucianism (China, Japan, Korea, Vietnam) -- since Confucianism emphasizes the malleability of individuals' intelligence and the never-failing improvability of one's outcome in any area through increased effort, a mindset of achievement that is not as widely accepted in non-Confucian cultures (Lee and Zhou 2015; Xie and Goyette 2003; Hsin and Xie 2014). Moreover, the same reference group effect may be less pronounced among Asian national or regional groups with higher proportions of third or higher immigrant generation (e.g., Japanese, Filipino) – since previous research shows that third- or higher-generation Asian parents give their children more leeway if they do not put forth enough effort into their school work and allow their children to make their own choice of lifepath based on their passion, just like what most native white parents do (Jiménez and Horowitz 2013).

Second, previous research has reported intra-Asian variation in the Asian-white difference in mathematics test score (Liu and Xie 2016; Hsin and Xie 2014). For example, Liu and Xie (2014) divide the Asian pan-ethnicity into "East Asian" and "other Asian" and find that only East Asians have higher average tenth-grade mathematics test score than whites. However, I know of no prior research that offers estimates of differences in mathematics test scores between Asian ethnic groups and whites for students in different mathematics course strata.

This discussion is only speculative. With the limitation of the data I use, it is beyond the scope of this study to formally assess the potential mechanisms that give rise to intra-Asian variations in the Asian-white difference in mathematics self-assessment. Instead, I focus on offering analyses to discern patterns of these variations.

Methodology

Data

I base my analyses on the baseline (2002) and the first follow-up (2004) waves of the ELS (National Center for Education Statistics [NCES]). The baseline wave of the ELS contains a two-stage stratified random sample of approximately 16,200 students in 10th grade in 2002 nested within 750 schools. It oversamples Asian students. I restrict my analytic sample to Asian and white students who participated in both the 2002 and the 2004 waves of the study. I further restrict my sample to students who were high school seniors as of Spring 2004, have high school transcript information and have no missing values on 12th grade self-assessed ability in mathematics or mathematics test score. My final analytic sample includes 7,120 students. (The restricted access data license covering this study requires me to round unweighted sample sizes to the nearest 10.)

To account for the potential bias in my analyses caused by sample attrition and missing data, I used a custom panel weight created by multiplying the 2002-04 panel weight supplied by the data distributors by the inverse probability of being a high school senior in Spring 2004 with valid transcript information and no missing values on 12th grade self-assessed ability in mathematics or mathematics test score (see also Morgan et al 2013; Weeden et al 2020). This probability is estimated from a logit model that includes all demographic and family background covariates. This procedure assigns proportionally higher weight to the 2002-04 respondents who have lower propensity of being retained in the analytic sample. To account for the design effect of the clustered sample, I report robust Taylor series standard errors clustered by school.

Measures

I draw on data collected from students, parents, and school administrators to construct my measures.

Advanced and nonadvanced mathematics stratum

The theory predicts that the Asian-white comparisons in self-assessed ability in mathematics differ across mathematics stratum. I rely on an ELS-supplied eight-ordered variable indicating students' mathematics course-taking pipeline in high school to define students' mathematics course-taking stratum. The mathematics course-taking pipeline variable is constructed based on the Classification of Secondary School Course (CSSC) codes (Burkam and Lee 2003). I classify students who reached pre-calculus or calculus by the end of high school as being in *advanced mathematics stratum* and those who did not as in *nonadvanced mathematics stratum.*

To further adjust for the effect of students' mathematics course-taking heterogeneity on self-assessed mathematics ability within each stratum, I include a dichotomous indicator of whether students reached calculus for students in the advanced mathematics stratum and whether students never went beyond low academic mathematics for students in the nonadvanced mathematics stratum.

12th grade self-assessed ability in mathematics

My dependent variable is 12th grade self-assessed ability in mathematics, a standardized factor variable based on responses to five questions in the first follow-up wave. The questions ask students to assess whether they can (1) understand difficult mathematics texts, (2) understand difficult mathematics courses, (3) master mathematics skills, (4) do an excellent job on mathematics tests, and (5) do an excellent job on mathematics assignments. Responses were recorded on a four-point scale with 1 indicating "always disagree" and 4 indicating "always agree." Standardized factor loadings of the five component items are 0.84, 0.83, 0.82, 0.82, and 0.81, respectively, from a confirmatory factor analysis assuming one underlying concept.

Race and ethnicity

I distinguish between Asian and white students based on students' self-reports in the based-year survey. Students who self-identify as "Asian" were further asked to choose their national or regional origin from Chinese, Filipino, Japanese, Korean, Southeast Asian (Vietnamese, Laotian, Cambodian or Kampuchean, Thai, or other southeast Asian), and South Asian (Indian, Bangladeshi, Pakistani, Sri Lankan, or other South Asian). I coded students who self-identified as white and not Hispanic, black, or Asian as white and students who self-identified as both Asian and white as Asian. I coded students who identify as both Asian and black or Hispanic as Asian; sensitivity analysis in which I exclude all "mixed-race" individuals yield similar results.

Other covariates

One key predictor is senior year mathematics achievement test score, measured as an item response theory (IRT) estimated number correct on the mathematics achievement test. To measure context, I construct a variable estimating the percentage of the student body that is Asian in each student's high school. To estimate of the number of students of the ELS cohort in each school, I calculate the inverse probability of a student being sampled conditional on their school being sampled by dividing the base-year student weight by school weight ("conditional student weight"), then aggregate this weight by school ID. To estimate the number of Asian students in each school, I aggregate the count of Asian students by school ID with the conditional student weight applied. The two estimates are obtained using information from all base-year respondents before I apply sample restrictions.[9]

My regression models also include self-reported gender, family socioeconomic status (SES), two-parent family structure, and sibship size, all of which come from the base-year surveys. Family SES is an ELS-supplied composite measure obtained by aggregating, with equal weight, standardized measures of students' family income, female and male guardians' education, and the socioeconomic index (SEI) of female and male guardians' occupation. The information mainly comes from the parent survey, supplemented with students' responses about their parents when their parents do not provide valid responses. If neither parents nor students provided valid responses to a component of the SES variable, the ELS obtain students' family SES by equally weighting the components with valid responses.

I also introduce two measures indicating school socioeconomic composition. The first is the school average of students' family SES, obtained from the weighted average of students' family SES within each school. The calculation is also done with all base-year respondents included. The second measure is the percentage of students eligible for free or reduced-price lunch which comes from the Common Core of Data (CCD) through ELS's school survey.

Plan of Analyses

[9] I used the same method to estimate the percentage of minority students (including black, Hispanic, Native American) in each school and obtained a mean of 33.2% across all schools. The mean of percentage minority students in all schools as reported in the school administration survey is 34.1% for the 2001-02 school year and 33.8% for the 2003-04 school year, suggesting that estimates obtained based on the student survey is comparable with school officials' report.

I conduct separate analyses predicting 12th grade self-assessed mathematics ability for students in the two math strata. I begin by presenting the descriptive statistics for the dependent and independent variables of interest by race and math stratum. Then, I fit OLS regression models to examine Asian-white differences in 12th grade self-assessed mathematics ability and evaluate the extent to which they are explained by 12th grade mathematics test score and the percentage of Asian students in school. I also examine whether the effects of the percentage of Asian students in school would be affected after adjusting for school socioeconomic composition. Next, I include interaction terms of race and 12th grade mathematics test score and of race and percentage Asian in school. I also graphically illustrate whether the Asian-white differences in self-assessed mathematics ability vary across representative locations of the distributions of the two key predictors. Finally, I disaggregate the Asian pan-ethnicity into the six national or regional groups identified in the ELS student survey and run analogous regression analyses to see whether the patterns for Asian-white comparisons in self-assessed mathematics ability would obtain for students of all Asian subgroups relative to whites.

Results

Descriptive Analyses of Asian-white Difference in Mathematics Self-Assessment and Its Predictors by Mathematics Strata

About half (55 percent) of the Asian students complete pre-calculus or calculus in high school, compared to 39 percent of white students, a difference that is significant under standard thresholds.[10] This implies that 45% of Asian students do not take higher-level math courses in high school, which contradicts stereotypical beliefs about Asian students' math ability and

[10] Percentages are calculated directly from the sample sizes by race and mathematics course stratum presented in Table 1. Weights are not applied. If weights are applied, the percentage for Asian students becomes 49% and the percentage for white students becomes 36%.

orientation.

Table 1 presents the descriptive statistics of all relevant variables by race and mathematics strata, along with significance tests of racial differences within each stratum. Asian students in the advanced mathematics stratum have lower level of 12th grade self-assessed mathematics ability than white students (0.26 vs. 0.39). Asian students in the nonadvanced mathematics stratum have much lower self-assessed math ability than the advanced math students, but higher self-assessed mathematics ability than their white counterparts (-0.11 vs. -0.20). Adjusting for gender , Asian-white difference in self-assessed mathematics ability is statistically significant ($p<.01$) only among students in the advanced mathematics stratum. Asian students are significantly more likely than white students to have reached calculus in the advanced mathematics stratum (58.28% vs. 44.64%); however, there is no significant racial difference in whether students never went beyond low academic mathematics in the nonadvanced mathematics stratum (7.7% vs. 9.9%). There is no Asian-white difference in 12th grade mathematics test score in the advanced mathematics stratum (64.0 vs. 64.7); however, Asian students have significantly lower 12th grade mathematics test score than white students in the nonadvanced mathematics stratum (46.0 vs. 42.7).[11]

In terms of the student body composition of schools, the average percentage of Asian students in the school is significantly higher for Asian students than their white counterparts (27.4% vs. 3.8% in the advanced mathematics stratum; 24.0% vs. 3.3% in the nonadvanced mathematics stratum). School average family SES is comparable for Asian and white students among those in the advanced mathematics stratum (0.14 vs. 0.20); however, school average family SES is significantly lower for Asian students than their white counterparts among those in

[11] When pooled across math strata, Asian students' average 12th grade mathematics test score is higher than white students. However, the racial gap is only statistically significant at the 0.10 level.

the nonadvanced mathematics stratum (-0.05 vs. 0.03). The average percentage of students eligible for free or reduced-price lunch is significantly higher for Asian students than their white counterparts regardless of mathematics course stratum (17.2% vs. 13.04% in the advanced mathematics stratum; 23.3% vs. 16.8% in the nonadvanced mathematics stratum). These patterns suggest Asian students are less likely than white students to enroll in “resource-rich” schools.

Finally, Asian students in both strata have significantly lower family SES than white students. Asian students in the lower math stratum, also have significantly more siblings than their white counterparts, although the percentage of students from a two-parent family is similar. These patterns suggest that Asian students have relatively disadvantaged family backgrounds than their white counterpart.

Regression Analyses of Asian-white Difference in Mathematics Self-Assessment by Mathematics Stratum

Tables 2 and 3 present results of parallel sets of regression models predicting 12th grade self-assessed math ability for students in the advanced and nonadvanced mathematics stratum, respectively. I first discuss the results for students in the advanced mathematics stratum (Table 2), then results for students in the nonadvanced mathematics stratum (Table 3).

Asian-white difference in the advanced mathematics stratum

Model 1 of Table 2 shows that there is a statistically significant Asian-white gap in 12th grade mathematics self-assessment among Asian and white students in the advanced mathematics stratum. After adjusting for gender and family background, the magnitude of the Asian-white gap is -0.151 ($p<.05$). I treat Model 1 as the baseline model for subsequent regression analyses.

In Model 2, I add 12th grade mathematics test scores. This only alters the estimated

Asian-white difference in 12^{th} grade mathematics self-assessment by around 4%, relative to Model 1. This is not surprising, given that the lack of a significant Asian-white difference in 12^{th} grade mathematics test score (see Table 1). In Model 3, I add the estimated percentage of Asian students in the school. This reduces the Asian-white difference in self-assessed math ability by around 85%, compared to Model 2, such that this difference is no longer significantly different from zero. The association between school composition and self-assessed math ability is negative (and significant), suggesting that for students in the advanced math courses, having more Asian students in school (and, presumably, in those courses) tends to reduce self-assessed ability, even conditional on test scores. In Model 4, I add the school socioeconomic composition measures (i.e., school average family SES and the percentage of students who are eligible for free or reduced-price lunch), which reduces the association of demographic composition and SA ability by around 16% (from -0.006 to -0.005), although it remains statistically significant; the school socioeconomic composition measures do not, however, have a strong association with self-assessed ability, suggesting the crucial dimension of school composition is demographic rather than socioeconomic.

The models above assume homogeneous effect of the predictors of 12^{th} grade self-assessed mathematics ability across racial groups. To test for racial differences in the association between the two key predictors and 12^{th} grade self-assessed mathematics ability, I interact 12^{th} grade mathematics test score and race and also the percentage of Asian students in school and race in Models 5 and 6, respectively. I do not find significant interaction terms. I also test for racial differences in 12^{th} grade self-assessed mathematics ability across the distribution of the two predictors where we can find enough common support for the two racial groups in the advanced mathematics stratum (see the left panel of Figures A1 and A2). As illustrated in the left panel of Figures 1 and 2, I do not find significant racial difference at any of the selected locations of 12th grade mathematics test score or the percentage of Asian students in school.

Asian-white difference in the nonadvanced mathematics stratum

Results shown in Table 3 are for students in the nonadvanced mathematics stratum. Similar to what is found in the right panel in Table 1, Model 1 of Table 3 shows that there is no statistically significant Asian-white gap in 12th grade mathematics self-assessment among Asian and white students after adding gender and family background variables as controls.

Noticeably, in Model 2, when 12th grade mathematics test score is added as a covariate, Asian students, on average, have significantly higher 12th grade mathematics self-assessment than white students. In Model 3, I add the percentage of Asian students in school as a covariate. the effect of the percentage of Asian students in school is not statistically different from zero, suggesting that schools' level of Asian concentration is not an important predictor mediating the relationship between race and 12th grade mathematics self-assessment for students in the nonadvanced mathematics stratum.

Models 5 and 6 in Table 3 formally test for effect heterogeneity of 12th grade mathematics test score and the percentage of Asian students in school across the two racial groups in the nonadvanced mathematics stratum. Unlike the results for students in the advanced mathematics stratum, results here indicate that the predictive power of 12th grade mathematics test score is significantly lower for Asian students than for white students, which is consistent with my hypothesis that Asian students' self-assessed math ability in nonadvanced math courses is less responsive to changes in their math test scores. On the other hand, there is no significant difference in the predictive power of the percentage of Asian students in school between Asian and white students.

Heterogeneity across Asian Ethnic Groups

To unpack the potential ethnic variations among Asian students, I present results from descriptive and regression analyses analogous to the analyses above but with six different Asian national or regional groups comparing with white.

Descriptive statistics by race/ethnicity and math stratum are presented in Table A2 in the appendix. As Table A2 shows, in the advanced mathematics stratum, Chinese and Southeast Asian students have significantly lower 12th grade mathematics self-assessment than whites, but Korean, Japanese, Filipino and South Asian do not, after gender and more specific levels of students' mathematics course-taking are adjusted for; in the nonadvanced mathematics stratum, South Asian students have significantly higher 12th grade mathematics self-assessment than whites, but the rest of the Asian ethnic groups do not, after gender and more specific levels of students' mathematics course-taking are adjusted for.

In terms of 12th grade mathematics test score, in the advanced mathematics stratum, the average of Chinese students is significantly higher than that of white students whereas the average of Southeast Asian is significantly lower than that of white students (see the upper panel of Table A2), while in the nonadvanced mathematics stratum, the averages of both Southeast Asian and South Asian students are significantly lower than that of white students (see the lower panel of Table A2). In terms of the percentage of Asian students in school, the averages of all Asian ethnic groups are significantly higher than that of white students regardless of mathematics stratum (see Table A2).

Table 4 presents the results of regression models assessing Asian ethnic-white differences in 12th grade mathematics self-assessment for students in the advanced mathematics stratum. Similar to what is reported in the descriptive statistics, Model 1 shows that among Asian ethnic groups, only Chinese and Southeast Asian students have significantly lower 12th grade mathematics self-assessment than white students, when the family background variables are also included as controls. Since Chinese students' average 12th grade mathematics test score is significantly larger than whites' while Southeast Asian students' is significantly lower, Model 2 in Table 4 shows that the inclusion of 12th grade mathematics test score enlarges the Chinese-white gap in 12th grade mathematics self-assessment by a considerable amount (around 49%) while reduces the Southeast Asian-white gap in 12th grade mathematics to the level of statistical insignificance and by around 34% in magnitude. Model 3 in Table 4 further adds the percentage of Asian students in school as a predictor. With the inclusion of the percentage of Asian students in school, the Chinese-white gap in 12th grade mathematics self-assessment is reduced by around 60% in magnitude as compared to the estimate presented in Model 2 and is no longer significantly different from zero. The Southeast Asian-white gap is reduced by around 78% as compared to the estimate presented in Model 2. However, since the Southeast Asian-white gap in Model 2 is also not significantly different from zero, in a model not shown here, I test how adding the percentage of Asian students in school to Model 1 without including 12th grade mathematics test score as a predictor would affect the Southeast Asian-white difference in 12th grade mathematics self-assessment. The results show that the inclusion of the percentage of Asian students in school alone also diminishes the Southeast Asian-white difference by a considerable amount and to the level of statistical insignificance. This suggests that the level of Asian concentration in school helps explain both the Chinese-White and the Southeast Asian-white difference in self-assessed mathematics ability for students in the advanced mathematics stratum. The inclusion of the school socioeconomic composition measures as additional controls (see Model 4) barely alters anything found in Model 3.

Models 5 and 6 in Table 4 formally test for effect heterogeneity of 12th grade mathematics test score and the percentage of Asian students in school between the Asian ethnic groups and white in the advanced mathematics stratum. Model 5 shows that the predictive power of 12th grade mathematics test score is significantly smaller for Southeast Asians than for whites, although it does not differ significantly between Chinese and white students. The left panel of Figure A3 shows the graphing of the Asian ethnic-white differences in 12th grade mathematics self-assessment across the distribution of 12th grade mathematics test score for students in the advanced stratum. It shows that there is psychological deficit in assessing one's own mathematics ability among Southeast Asian students relative to their white counterparts among those at the high end of the distribution of mathematics test score for students in the advanced mathematics stratum. Model 6 in Table 4 includes an interaction between each Asian ethnic group and the percentage of Asian students in school. None of these interaction terms is statistically different from zero. Graphs in the left panel of Figure A4 further confirm this.

Table 5 presents the results of regression models assessing Asian ethnic-white differences in 12th grade mathematics self-assessment for students in the nonadvanced mathematics stratum. Compared to the descriptive statistics shown in Table A3, Model 1 in Table 5 shows that the South Asian-white gap in 12th grade mathematics self-assessment becomes only marginally significant at the 0.10 level after the family background variables are also included as control. Since Southeast Asians and South Asians have significantly lower 12th grade mathematics test score than whites and 12th grade mathematics test score has a statistically significant and positive effect on 12th grade mathematics self-assessment, Model 2 shows that the inclusion of 12th grade mathematics test score enlarges both the Southeast Asian- and the South Asian-white gaps in 12th grade mathematics self-assessment (by 71% for the Southeast Asian-white gap and by 37% for the South Asian-white gap) and that the Southeast Asian-white gap becomes marginally significant at the 0.10 level and the South Asian-white gap becomes statistically significant at the 0.05 level. The inclusion of the percentage of Asian students in school in Model 3 enlarges the Southeast Asian-white gap and makes it significantly different from zero. However, in Model 4, the inclusion of the school socioeconomic composition measures as additional controls renders the Southeast Asian-white gap only marginally significant.

Models 5 and 6 in Table 5 formally test for effect heterogeneity of 12th grade mathematics test score and the percentage of Asian students in school between the Asian ethnic groups and white in the nonadvanced mathematics stratum. Model 5 shows that the predictive power of 12th grade mathematics test score is significantly lower for Chinese students relative to white students (at the 0.001 level) and that the predictive power of 12th grade mathematics test score is also lower for Southeast Asian students relative to white students, yet the difference is only marginally significant (at the 0.10 level). On the other hand, the predictive power of 12th grade mathematics test score is higher for Japanese students relative to white students, although the difference is only statistically significant at the 0.10 level. The right panel of Figure A3 shows the graphing of the Asian ethnic-white differences in 12th grade mathematics self-assessment across the distribution of 12th grade mathematics test score for students in the nonadvanced mathematics stratum. It shows that there is psychological premium in assessing one's own mathematics ability among Chinese students with relatively low 12th grade mathematics test score as compared to whites, while there is psychological deficit in assessing one's own mathematics ability among Chinese students at the high end of the 12th grade mathematics test score distribution as compared to whites. Similarly, there is also psychological premium in assessing one's own mathematics ability among Southeast Asian students with relatively low 12^{th} grade mathematics test score as compared to whites; however, at the high end of the 12^{th} grade mathematics test score distribution, the Southeast Asian-white difference in 12^{th} grade mathematics self-assessment is not significantly different from zero. Model 6 in Table 5 includes an interaction between each Asian ethnic group and the percentage of Asian students in school. None of these interaction terms is statistically different from zero. Graphs in the right panel of Figure A5 suggest the same.

Sensitivity Checks

Previous research investigating black-white differences in students' high school course-taking experience and mathematics achievement focuses mainly on public schools, on the argument that school course offerings and course-taking requirements vary drastically across school sectors (e.g., Riegle-Crumb and Grodsky 2010). I ran a sensitivity check by restricting my analyses to public schools and the results are comparable to what we report above. Moreover, my definition of *advanced mathematics stratum* is narrower than previous research focusing on the black-white comparisons. For example, Riegle-Crumb and Grodsky (2010) classifies students who "completed at least one course beyond algebra 2 including trigonometry, AP statistics, precalculus, or calculus" as being in *advanced mathematics stratum*, which is similar to a classification of reaching "advanced i" or beyond as *advanced math* using the ELS-supplied math course pipeline measure. I chose to use a narrower definition of *advanced mathematics stratum* because around two-thirds of the Asian students in my sample have reached "advanced i" or beyond and we hoped to keep the sample size of Asian students relatively balanced across the two math strata. I used the more liberal definition of advanced mathematics stratum of having reached "advanced i" or beyond as a sensitivity check. The general patterns are comparable to the results presented here. The only difference is that some of the estimates that I report as being "statistically significant" for students in the *nonadvanced mathematics stratum* become only marginally so at the 0.10 level. The results of my sensitivity checks are presented in the online supplementary tables.

Discussion and Conclusion

In this paper, I investigate Asian-white difference in 12th grade mathematics self-assessment among students reaching different strata of the mathematics curriculum in high school. My results suggest that adjusting for demographic background and more specific levels of mathematics courses that students take, the Asian-white difference in 12th grade mathematics self-assessment is only pronounced among students completing advanced courses. Moreover, the mechanisms explaining Asian-white difference in 12th grade mathematics self-assessment – or lack thereof – seem contingent upon students' mathematics course-taking stratum. I also observe substantial intra-Asian ethnic variations in the size and predictors of the Asian-white difference in 12th grade mathematics self-assessment.

Regarding 12th grade mathematics test score, I find that although the Asian-white difference is not statistically significant in the advanced mathematics stratum, Asian students have a significant disadvantage on this measure in the nonadvanced mathematics stratum. As such, 12th grade mathematics test score does not contribute much to the explanation of the Asian-white difference in 12th grade mathematics self-assessment among students in the advanced mathematics stratum; yet Asians show an advantage in 12th grade mathematics self-assessment in the nonadvanced mathematics stratum once 12th grade mathematics test score is controlled for. These results are consistent with the argument that white students taking advanced mathematics courses are as academically well-prepared and motivated as their Asian counterparts and that Asian students who do not reach the advanced mathematics stratum may be haunted by the specter of failure to meet the high expectation set for their racial group which may have negative consequences on their mathematics performance in cognitive tests.

In the advanced mathematics stratum, Asian students' mathematics self-assessment is as sensitive to changes in mathematics test score as their white counterparts'. However, in my analysis disaggregating Asians by ethnic group, I find that Southeast Asian students' mathematics self-assessment is less sensitive to changes in mathematics test score than that of their white counterparts in the advanced mathematics stratum – although it is not the case for the rest of the Asian ethnic groups. The pattern for the Southeast Asian-white comparison is consistent with the hypothesis that Southeast Asian students tend to assess their own mathematics achievement against a higher bar than whites. One plausible explanation for the patterns I find for the rest of the Asian ethnic groups in comparison to whites is that these Asian students become more realistic in assessing how well they do in mathematics and compare with other students with similar level of mathematics achievement regardless of whether they are Asian or white, once they reach the advanced mathematics stratum. Without appropriate variables measuring the standards against which students measure their success in my data, I am limited in my ability to formally assess these explanations.

In the nonadvanced mathematics stratum, Asian students' mathematics self-assessment is less sensitive to changes in mathematics test score than that of their white counterparts. Moreover, the lowest achieving Asians in this stratum have significantly higher mathematics self-assessment in 12th grade.

These findings are broadly consistent with my argument that Asian students who fail to conform to the high expectation set for Asian students' mathematics achievement tend to adopt coping strategies leading to a weaker connection between their mathematics test score and their self-assessment in mathematics over the long run.

Lee and Zhou (2015) mentioned those who do not buy into the “success frame” feel the most successful among the Asian Americans they interviewed. However, they only compared among Asian Americans without introducing another racial group as a reference. The results presented here suggest that Asian students who decouple from the course-taking expectation set for them enjoy a psychological premium in assessing their own mathematics ability as compared to whites and that such psychological premium is the most pronounced among the lowest-achieving in the nonadvanced mathematics stratum.

In addition to considering how mathematics test score contributes to Asian-white gap in mathematics self-assessment, I also consider the role of the level of Asian representation in the schools that students attend. I find that Asian students are more likely than whites to enroll in schools with a high percentage of Asian students. In the advanced mathematics stratum, Asian students’ higher likelihood of enrolling in high schools with a high percentage of their co-ethnics accounts for a substantial proportion of the Asian disadvantage relative to whites in 12^{th} grade mathematics self-assessment. To the extent that the level of Asian representation in a high school signals its academic competitiveness, this finding is consistent with the frog-perspective of academic self-assessment that I laid out in the theory section which suggests that a more competitive academic environment often suppresses students’ academic self-assessment. In an auxiliary analysis, I find that the percentage of Asian students in school is indeed positively associated with students’ 12^{th} grade mathematics test score, although it is more so for Asian than for white students. In the nonadvanced mathematics stratum, the percentage of Asian students in the school does not contribute much to the explanation of the Asian-white gap in 12^{th} grade mathematics self-assessment (regardless of whether 12th grade mathematics test score is controlled). This finding is consistent with the argument that high schools' Asian concentration contributes less to depressing Asian students' mathematics self-assessment if students do not enroll in advanced mathematics courses, since in nonadvanced mathematics courses, students' racial and ethnic composition is more diversified than those in advanced mathematics courses.

In neither of the mathematics stratum did I find a significant association between race and the percentage of Asian students in school. This finding is consistent with the argument that both Asian and white parents play a role in shaping the level of Asian representation in school and those white parents who send their children to schools with a high Asian representation have a high level of tolerance towards the Asians' achievement norm.

Last but not least, I show that in the advanced mathematics stratum, the Asian disadvantage in mathematics self-assessment relative to whites is mainly driven by Chinese and Southeast Asian students, while in the nonadvanced mathematics stratum, all Asian ethnic groups have comparable mathematics self-assessment as their white counterpart. Although Asian students of all ethnic groups are more likely than whites to enroll in schools with a high level of Asian representation regardless of mathematics stratum, there is substantial intra-Asian variation in mathematics test scores relative to whites across Asian ethnic groups in both mathematics strata. Notably, in the advanced mathematics stratum, Chinese students' mathematics test scores are significantly higher than that of whites whereas Southeast Asian students' mathematics test scores are significantly lower. In the nonadvanced mathematics stratum, only Southeast Asian and South Asian students have significantly lower mathematics test scores than whites. In the advanced mathematics stratum, only Southeast Asians' mathematics self-assessment is less sensitive than that of whites; in the nonadvanced mathematics stratum, only Chinese students' mathematics self-assessment is less sensitive than that of whites. Although limitations in the ELS data mean that I can’t tease out the sources of these intra-Asian variations, my findings suggest that it is misleading to speak of an “Asian” experience in high school as if it applies equally to all Asian ethnic groups.

Overall, although this article advances the literature on Asian students’ self-assessed math ability by identifying where students are at the hierarchy of the math curriculum conditions whether we would observe the average self-assessed math ability of Asian students to be higher or lower than whites with comparable math ability, it only identifies mechanisms that could help explain the gap among those who take advanced math courses. With appropriate data that could provide a better anchor of with whom Asian students compare their own math ability in both advanced and nonadvanced math courses, future scholars may be able to tease out the mechanisms behind Asian students’ higher self-assessed math ability than whites in nonadvanced math courses.

Tables and Figures

Table 1. Descriptive Statistics by Race

	Advanced Math Stratum			Nonadvanced Math Stratum		
	White	Asian	Asian-White Difference	White	Asian	Asian-White Difference
Self-assessed math ability (mean)	0.39	0.26	-0.13†	-0.20	-0.11	0.08
	(0.98)	(0.97)		(0.99)	(0.86)	
Female (%)	50.53	54.08	3.55	48.52	38.49	-10.03**
Family SES (mean)	0.45	0.23	-0.22***	0.02	-0.10	-0.12*
	(0.67)	(0.79)		(0.63)	(0.80)	
Two-parent family structure (%)	85.92	85.10	-0.82	78.83	80.70	1.87
Number of siblings (mean)	1.35	1.44	0.09	1.31	1.64	0.34***
	(1.01)	(1.13)		(0.99)	(1.47)	
Course-taking (advanced = calculus; nonadvanced = No math through low academic math) (%)	44.64	58.28	13.64***	7.72	9.88	2.16
12th grade math test score (mean)	63.99	64.67	0.68	45.96	42.74	-3.22**
	(9.14)	(10.47)		(12.54)	(14.56)	
Percentage Asian in school (mean)	3.79	27.40	23.61***	3.31	23.97	20.66***
	(5.79)	(27.38)		(5.91)	(21.94)	
School average family SES (mean)	0.20	0.14	-0.06	0.03	-0.05	-0.07*
	(0.39)	(0.45)		(0.34)	(0.38)	
Percentage free or reduced-price lunch eligible (mean)	13.04	17.24	4.20*	16.76	23.25	6.49***
	(13.77)	(17.32)		(13.42)	(17.18)	
Total N (unweighted)	2,324	631		3,647	516	

Note: Standard deviations are given in parentheses for continuous variables. Data are weighted. † denotes significant Asian-white difference in self-assessed math ability at the 0.01 level after adjusting for gender and high school math course-taking. Unweighted sample sizes are rounded to the nearest 10 per Institute of Education Sciences (IES) restricted-use guidelines.

Source: Educational Longitudinal Study (ELS) 2002-2004.

Table 2. Regression Analyses Predicting 12th Grade Self-assessed Math Ability for Asian Students in Comparison to White Students in Advanced Math Stratum

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Asian (*ref.* = white)	-0.151*	-0.157*	-0.024	-0.024	0.339	0.008
	(0.062)	(0.063)	(0.070)	(0.071)	(0.291)	(0.073)
12th grade math test score		0.036***	0.036***	0.036***	0.037***	0.036***
		(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Asian (*ref.* = white) * 12th grade math test score					-0.006	
					(0.004)	
Percentage Asian in school			-0.006**	-0.005**	-0.005**	-0.003
			(0.002)	(0.002)	(0.002)	(0.005)
Asian (*ref.* = white) * Percentage Asian in school						-0.003
						(0.005)
School average family SES				-0.064	-0.063	-0.069
				(0.076)	(0.076)	(0.077)
Percentage free or reduced-price lunch eligible				-0.001	-0.001	-0.001
				(0.002)	(0.002)	(0.002)
Female (*ref.* = male)	-0.209***	-0.113*	-0.109*	-0.106*	-0.106*	-0.105*
	(0.045)	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)
Family SES	0.087**	-0.004	-0.000	0.011	0.011	0.009
	(0.032)	(0.033)	(0.033)	(0.035)	(0.035)	(0.035)
Two-parent family structure	-0.008	0.005	0.003	0.003	0.002	0.004
	(0.064)	(0.061)	(0.060)	(0.060)	(0.060)	(0.061)
Sibship Size	0.081***	0.074***	0.075***	0.075***	0.073***	0.074***
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Calculus (*ref.* = pre-calculus)	0.329***	0.027	0.021	0.020	0.019	0.019
	(0.046)	(0.051)	(0.051)	(0.051)	(0.051)	(0.051)
Constant	0.206**	-1.942***	-1.950***	-1.930***	-1.975***	-1.944***
	(0.067)	(0.167)	(0.166)	(0.174)	(0.185)	(0.176)
R-squared	0.058	0.138	0.142	0.142	0.142	0.142

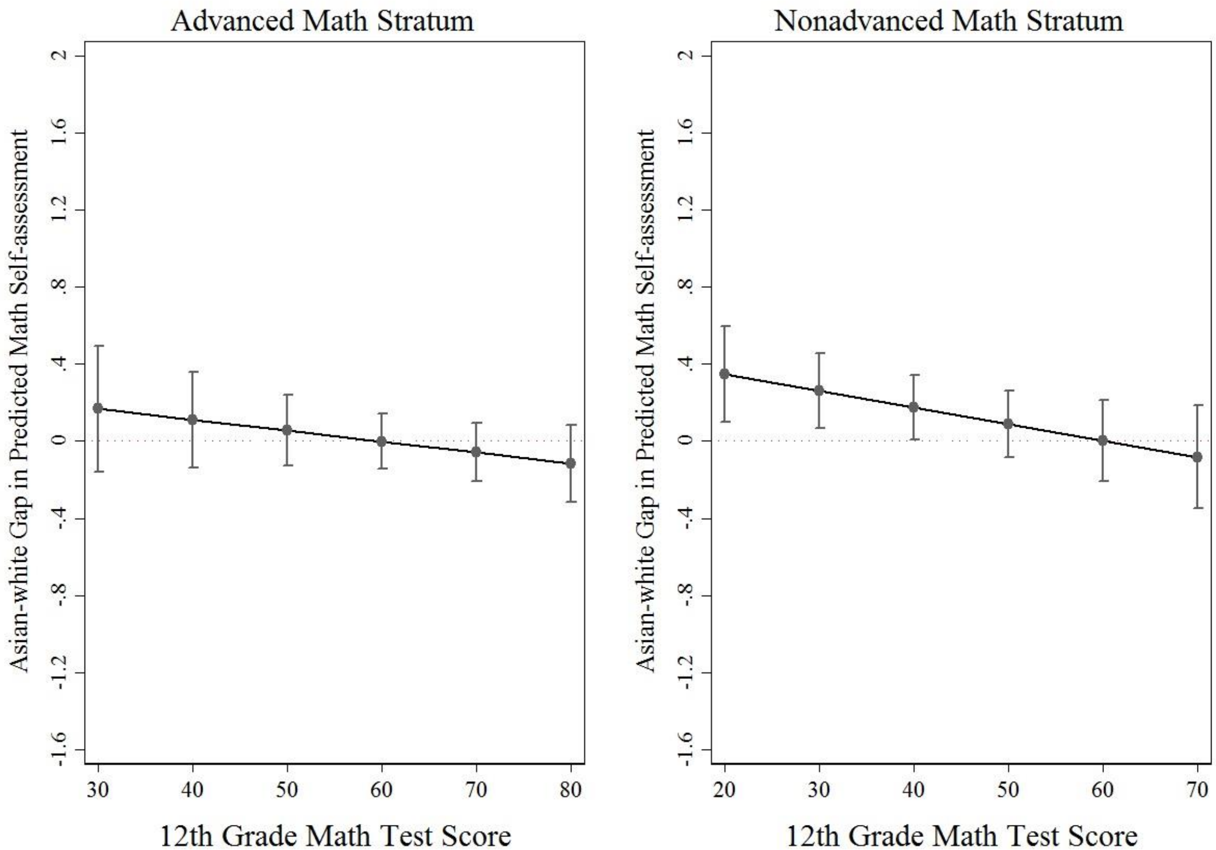
Note: *N*=2,955. Robust standard errors clustered by school in parentheses. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10
Source: Educational Longitudinal Study (ELS) 2002-2004.

Table 3. Regression Analyses Predicting 12th Grade Self-assessed Math Ability for Asian Students in Comparison to White Students in Nonadvanced Math Stratum

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Asian (*ref.* = white)	0.062	0.132*	0.178*	0.163*	0.520**	0.223**
	(0.064)	(0.061)	(0.083)	(0.082)	(0.194)	(0.081)
12th grade math test score		0.026***	0.027***	0.027***	0.028***	0.027***
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Asian (*ref.* = white) * 12th grade math test score					-0.009*	
					(0.004)	
Percentage Asian in school			-0.002	-0.002	-0.001	0.000
			(0.002)	(0.002)	(0.002)	(0.004)
Asian (*ref.* = white) * Percentage Asian in school						-0.004
						(0.004)
School average family SES				-0.032	-0.038	-0.040
				(0.090)	(0.090)	(0.091)
Percentage free or reduced-price lunch eligible				0.002	0.002	0.002
				(0.002)	(0.002)	(0.002)
Female (*ref.* = male)	-0.203***	-0.143***	-0.143***	-0.143***	-0.140***	-0.142***
	(0.039)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)
Family SES	0.027	-0.085**	-0.083**	-0.069*	-0.067*	-0.071*
	(0.030)	(0.031)	(0.032)	(0.032)	(0.032)	(0.033)
Two-parent family structure	0.035	0.037	0.036	0.033	0.033	0.034
	(0.049)	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)
Sibship size	0.025	0.020	0.021	0.021	0.019	0.020
	(0.020)	(0.018)	(0.018)	(0.019)	(0.018)	(0.018)
No math through low academic math (*ref.* = middle academic i / middle academic ii)	-0.225**	0.198**	0.198**	0.202**	0.201**	0.203**
	(0.070)	(0.072)	(0.072)	(0.072)	(0.072)	(0.072)
Constant	-0.141**	-1.414***	-1.412***	-1.455***	-1.484***	-1.465***
	(0.052)	(0.096)	(0.096)	(0.100)	(0.103)	(0.100)
R-squared	0.016	0.112	0.113	0.114	0.114	0.114

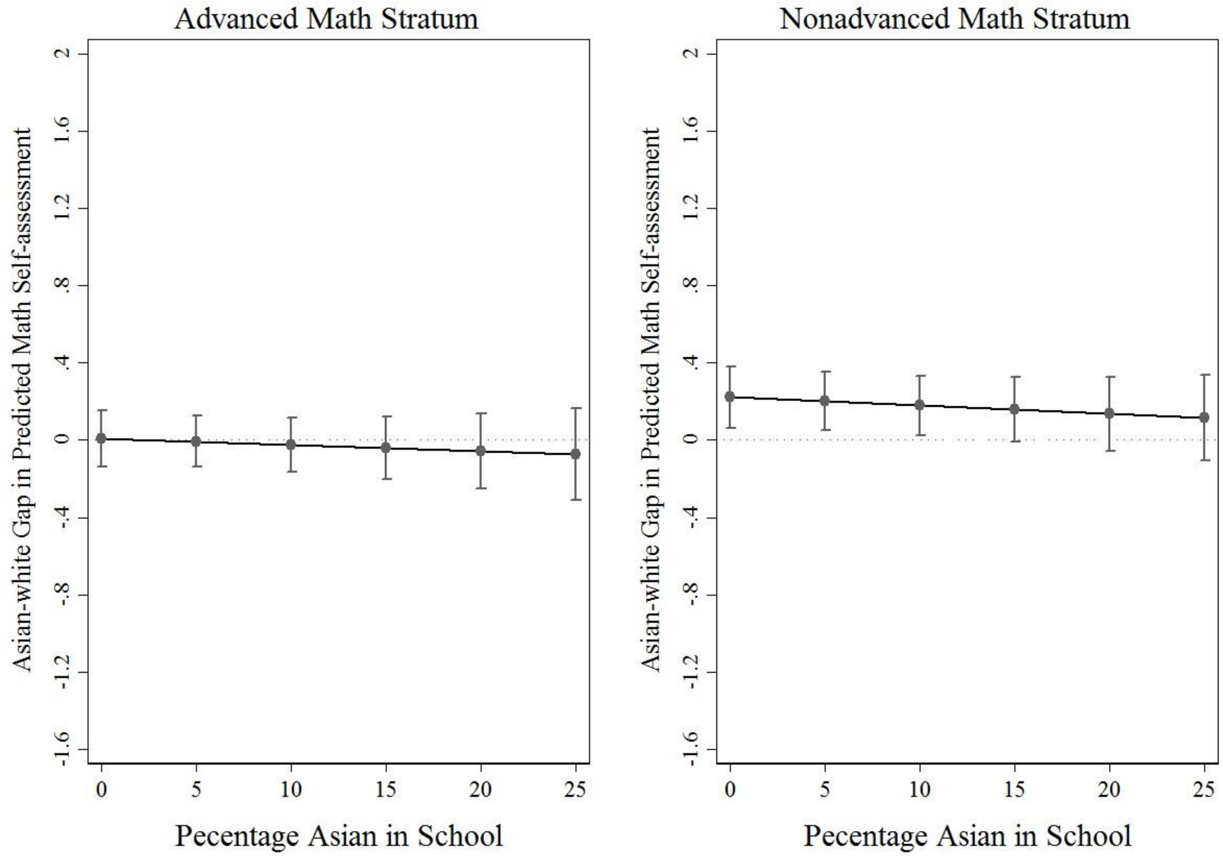
Note: *N*=4,163. Robust standard errors clustered by school in parentheses. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10
Source: Educational Longitudinal Study (ELS) 2002-2004.

Figure 1. Asian-white Difference in Predicted Self-assessed Math Ability at Different Locations of 12th Grade Math Test Score by Math Course-taking Stratum



Note: Calculation is based on Model 5 in Tables 2 and 3. The range of 12th grade math test score presented here is the region where Asian and white students have enough common support (as shown in Figure A1) in advanced math stratum and nonadvanced math stratum, respectively.
Source: Educational Longitudinal Study (ELS) 2002-2004.

Figure 2. Asian-white Difference in Predicted Self-assessed Math Ability at Different Locations of Percentage Asian in School by Math Course-taking Stratum



Note: Calculation is based on Model 6 in Tables 2 and 3. The range of percentage Asian in school presented here is the region where Asian and white students have enough common support (as shown in Figure A2) in advanced math stratum and nonadvanced math stratum, respectively.
Source: Educational Longitudinal Study (ELS) 2002-2004.

Table 4. Regression Analyses Predicting 12th Grade Self-assessed Math Ability for Ethnic Asian Students in Comparison to White Students in Advanced Math Stratum

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Race (*ref*. = white)						
Chinese	-0.191*	-0.284**	-0.115	-0.113	0.470	-0.101
	(0.089)	(0.094)	(0.107)	(0.109)	(0.448)	(0.131)
Korean	-0.133	-0.178	-0.077	-0.074	-0.158	-0.072
	(0.130)	(0.122)	(0.126)	(0.127)	(0.532)	(0.158)
Japanese	-0.165	-0.170	-0.034	-0.034	0.726	0.020
	(0.174)	(0.160)	(0.158)	(0.159)	(1.257)	(0.206)
Southeast Asian	-0.226*	-0.150	-0.033	-0.027	1.169*	-0.057
	(0.089)	(0.098)	(0.107)	(0.110)	(0.498)	(0.137)
Filipino	-0.206	-0.110	-0.006	-0.014	-0.862	0.195
	(0.169)	(0.175)	(0.165)	(0.165)	(0.886)	(0.194)
South Asian	0.036	0.051	0.156	0.152	0.035	0.132
	(0.144)	(0.107)	(0.106)	(0.108)	(0.561)	(0.125)
12th grade math test score		0.036***	0.036***	0.036***	0.037***	0.036***
		(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Chinese (*ref*. = white) * 12th grade math test score					-0.009	
					(0.007)	
Korean (*ref*. = white) * 12th grade math test score					0.001	
					(0.008)	
Japanese (*ref*. = white) * 12th grade math test score					-0.012	
					(0.019)	
Southeast Asian (*ref*. = white) * 12th grade math test score					-0.020*	
					(0.008)	
Filipino (*ref*. = white) * 12th grade math test score					0.014	
					(0.015)	
South Asian (*ref*. = white) * 12th grade math test score					0.002	
					(0.008)	
Percentage Asian in school			-0.005**	-0.005**	-0.005**	-0.003
			(0.002)	(0.002)	(0.002)	(0.005)
Chinese (*ref*. = white) * Percentage Asian in school						-0.002
						(0.005)

(To be continued)

Table 4. (Continued)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Korean (*ref.* = white) * Percentage Asian in school						-0.002
						(0.006)
Japanese (*ref.* = white) * Percentage Asian in school						-0.004
						(0.007)
Southeast Asian (*ref.* = white) * Percentage Asian in school						-0.001
						(0.006)
Filipino (*ref.* = white) * Percentage Asian in school						-0.011+
						(0.006)
South Asian (*ref.* = white) * Percentage Asian in school						-0.001
						(0.005)
School average family SES				-0.060	-0.060	-0.065
				(0.077)	(0.077)	(0.078)
Percentage free or reduced-price lunch eligible				-0.001	-0.001	-0.001
				(0.002)	(0.002)	(0.002)
Female (*ref.* = male)	-0.209***	-0.113*	-0.110*	-0.107*	-0.106*	-0.105*
	(0.045)	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)
Family SES	0.083*	-0.007	-0.003	0.008	0.008	0.006
	(0.032)	(0.033)	(0.033)	(0.035)	(0.035)	(0.036)
Two-parent family structure	-0.009	0.006	0.003	0.003	0.004	0.003
	(0.064)	(0.061)	(0.060)	(0.061)	(0.061)	(0.061)
Sibship size	0.081***	0.072***	0.073***	0.073***	0.072***	0.072***
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Calculus (*ref.* = pre-calculus)	0.330***	0.027	0.022	0.020	0.019	0.019
	(0.046)	(0.050)	(0.051)	(0.051)	(0.051)	(0.051)
Constant	0.209**	-1.954***	-1.956***	-1.938***	-1.979***	-1.953***
	(0.067)	(0.167)	(0.166)	(0.175)	(0.185)	(0.176)
R-squared	0.058	0.139	0.142	0.143	0.144	0.144

Note: *N*=2,955. Robust standard errors clustered by school in parentheses. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Source: Educational Longitudinal Study (ELS) 2002-2004.

Table 5. Regression Analyses Predicting 12th Grade Self-assessed Math Ability for Ethnic Asian Students in Comparison to White Students in Nonadvanced Math Stratum

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Race (*ref.* = white)						
Chinese	0.189	0.143	0.193	0.182	1.374***	0.459*
	(0.131)	(0.163)	(0.164)	(0.162)	(0.283)	(0.202)
Korean	-0.149	-0.093	-0.069	-0.072	-0.018	0.005
	(0.162)	(0.130)	(0.134)	(0.135)	(0.423)	(0.178)
Japanese	0.124	0.212	0.257	0.245	-0.432	0.003
	(0.191)	(0.155)	(0.177)	(0.176)	(0.375)	(0.261)
Southeast Asian	0.045	0.153+	0.186*	0.164+	0.603*	0.265+
	(0.082)	(0.083)	(0.094)	(0.093)	(0.307)	(0.147)
Filipino	-0.073	-0.032	0.017	0.001	0.186	0.083
	(0.109)	(0.112)	(0.122)	(0.120)	(0.289)	(0.149)
South Asian	0.410+	0.560*	0.581*	0.564*	0.832*	0.360*
	(0.212)	(0.220)	(0.229)	(0.232)	(0.335)	(0.154)
12th grade math test score		0.027***	0.027***	0.027***	0.028***	0.027***
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Chinese (*ref.* = white) * 12th grade math test score					-0.027***	
					(0.007)	
Korean (*ref.* = white) * 12th grade math test score					-0.001	
					(0.009)	
Japanese (*ref.* = white) * 12th grade math test score					0.015+	
					(0.008)	
Southeast Asian (*ref.* = white) * 12th grade math test score					-0.011+	
					(0.007)	
Filipino (*ref.* = white) * 12th grade math test score					-0.004	
					(0.007)	
South Asian (*ref.* = white) * 12th grade math test score					-0.007	
					(0.005)	
Percentage Asian in school			-0.002	-0.001	-0.001	0.000
			(0.002)	(0.002)	(0.002)	(0.004)
Chinese (*ref.* = white) * Percentage Asian in school						-0.010
						(0.007)

(To be continued)

Table 5. (Continued)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Korean (*ref.* = white) * Percentage Asian in school						-0.006
						(0.006)
Japanese (*ref.* = white) * Percentage Asian in school						0.007
						(0.006)
Southeast Asian (*ref.* = white) * Percentage Asian in school						-0.006
						(0.006)
Filipino (*ref.* = white) * Percentage Asian in school						-0.004
						(0.005)
South Asian (*ref.* = white) * Percentage Asian in school						0.012
						(0.016)
School average family SES				-0.041	-0.046	-0.046
				(0.090)	(0.090)	(0.091)
Percentage free or reduced-price lunch eligible				0.001	0.001	0.001
				(0.002)	(0.002)	(0.002)
Female (*ref.* = male)	-0.201***	-0.140***	-0.140***	-0.140***	-0.138***	-0.139***
	(0.039)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)
Family SES	0.028	-0.084**	-0.082**	-0.067*	-0.066*	-0.069*
	(0.031)	(0.032)	(0.032)	(0.032)	(0.032)	(0.033)
Two-parent family structure	0.036	0.038	0.037	0.034	0.036	0.035
	(0.049)	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)
Sibship size	0.024	0.018	0.019	0.019	0.017	0.018
	(0.020)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
Calculus (*ref.* = pre-calculus)	-0.227**	0.199**	0.199**	0.203**	0.192**	0.201**
	(0.070)	(0.072)	(0.072)	(0.072)	(0.073)	(0.073)
Constant	-0.141**	-1.419***	-1.417***	-1.455***	-1.478***	-1.464***
	(0.053)	(0.096)	(0.096)	(0.101)	(0.104)	(0.101)
R-squared	0.018	0.115	0.115	0.116	0.118	0.117

Note: *N*=4,163. Robust standard errors clustered by school in parentheses. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10
Source: Educational Longitudinal Study (ELS) 2002-2004.

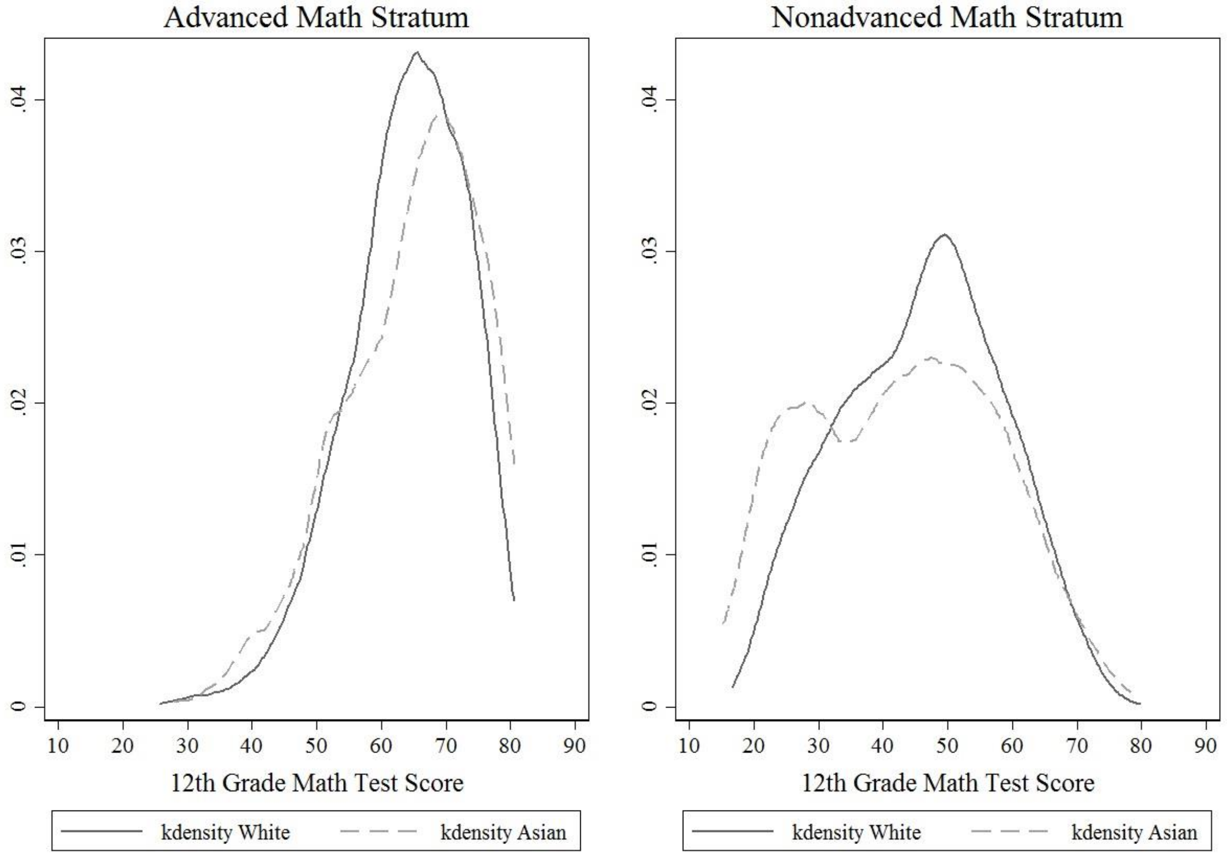
Appendix

Table A1. Regression Analyses Predicting 12th Grade Math Test Score for Asian and White Students

	All Students			Advanced Math Stratum			Nonadvanced Math Stratum		
	White & Asian	White	Asian	White & Asian	White	Asian	White & Asian	White	Asian
Asian (*ref.* = white)	-2.282***			-0.508			-3.868***		
	(0.647)			(0.617)			(0.986)		
Percentage Asian in school	**0.064****	**-0.000**	**0.099*****	**0.035***	**-0.022**	**0.058*****	**0.087****	**0.008**	**0.160*****
	(0.020)	**(0.038)**	**(0.019)**	**(0.016)**	**(0.037)**	**(0.017)**	**(0.032)**	**(0.050)**	**(0.029)**
School average family SES	2.283**	2.466**	2.290+	2.235**	2.056**	4.837***	2.479*	2.960*	0.954
	(0.802)	(0.860)	(1.321)	(0.712)	(0.789)	(1.361)	(1.189)	(1.269)	(2.101)
Percentage free or reduced-price lunch eligible	-0.073***	-0.064**	-0.124***	-0.056**	-0.059**	-0.003	-0.081**	-0.064*	-0.208***
	(0.018)	(0.020)	(0.036)	(0.020)	(0.022)	(0.040)	(0.025)	(0.026)	(0.046)
Female (*ref.* = male)	-2.373***	-2.500***	-1.391+	-2.712***	-2.692***	-3.158***	-2.238***	-2.408***	0.314
	(0.326)	(0.345)	(0.765)	(0.348)	(0.369)	(0.840)	(0.460)	(0.478)	(1.334)
Family SES	2.527***	2.567***	2.523***	1.624***	1.672***	1.562*	3.127***	3.118***	3.216**
	(0.282)	(0.304)	(0.686)	(0.287)	(0.324)	(0.624)	(0.424)	(0.446)	(1.192)
Two-parent family structure	-0.012	0.001	-1.063	-0.401	-0.396	-0.804	0.151	0.152	-1.204
	(0.424)	(0.447)	(1.174)	(0.543)	(0.582)	(1.150)	(0.553)	(0.573)	(1.778)
Sibship size	0.148	0.244	-0.089	0.183	0.326+	-0.665+	0.160	0.208	0.243
	(0.150)	(0.164)	(0.354)	(0.170)	(0.181)	(0.391)	(0.224)	(0.247)	(0.486)
Control for math course-taking	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Unweighted N	7,118	5,971	1,147	2,955	2,324	631	4,163	3,647	516
R-squared	0.165	0.162	0.235	0.320	0.312	0.406	0.202	0.189	0.364

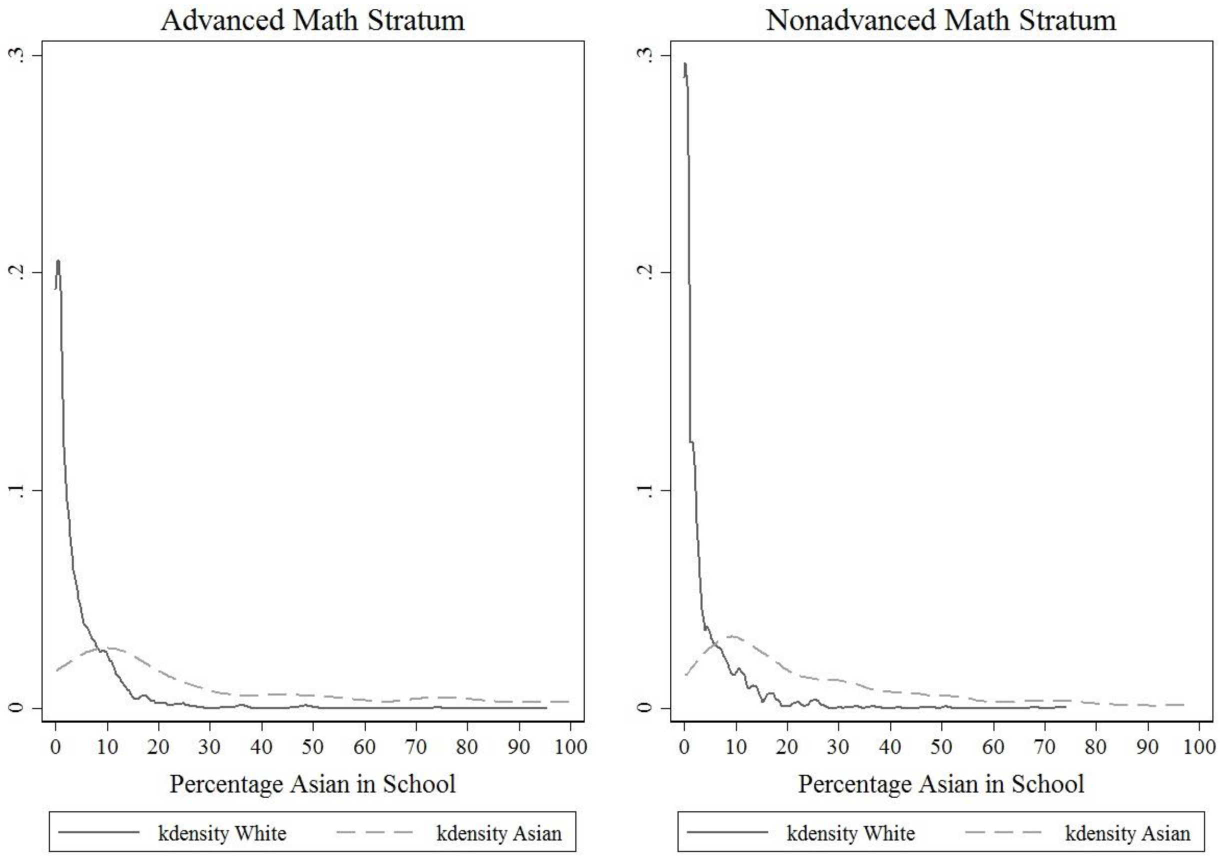
Note: Robust standard errors clustered by school in parentheses. The categories of the math course-taking variable include (1) no math through low academic math, middle academic i/middle academic ii, pre-calculus and calculus for the pooled model, (2) pre-calculus and calculus for the model for students in advanced math stratum, (3) no math through low academic math and middle academic i/middle academic ii for the model for students in nonadvanced math stratum. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10
Source: Educational Longitudinal Study (ELS) 2002-2004.

Figure A1. Kernel Density Plot of 12th Grade Math Test Score for Asian and White Students, by Math Course-taking Stratum



Source: Educational Longitudinal Study (ELS) 2002-2004.

Figure A2. Kernel Density Plot of Percentage Asian in School for Asian and White Students, by Math Course-taking Stratum



Source: Educational Longitudinal Study (ELS) 2002-2004

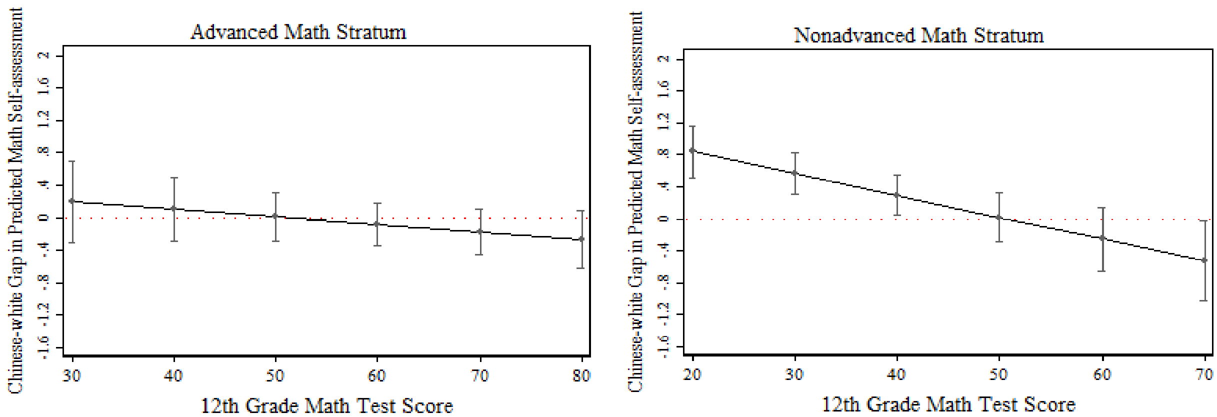
Table A2. Descriptive Statistics by Asian Ethnicity

	Advanced Math Stratum						
	White	Chinese	Korean	Japanese	Southeast Asian	Filipino	South Asian
Self-assessed math ability (mean)	0.39	0.23†	0.29	0.26	0.16†	0.20	0.47
	(0.98)	(0.99)	(1.03)	(0.88)	(0.90)	(0.98)	(0.94)
Female (%)	50.53	52.65	48.33	58.75	56.28	52.78	59.99
Family SES (mean)	0.45	0.25*	0.37	0.46	-0.52***	0.38	0.54
	(0.67)	(0.88)	(0.73)	(0.53)	-0.7	(0.55)	(0.62)
Two-parent family structure (%)	85.92	90.23	76.82	87.79	81.14	80.8	92.70*
Number of siblings (mean)	1.35	1.22	1.20	1.25	2.16***	1.23	1.68
	(1.01)	(0.91)	0.84	0.98	1.72	0.74	1.02
Course-taking (advanced = calculus; nonadvanced = No math through low academic math) (%)	44.64	64.69***	59.58	63.43	50.62	54.58	54.21
12th grade math test score (mean)	63.99	67.71***	66.40	65.51	60.01**	61.90	64.42
	(9.14)	(10.14)	(10.38)	(7.61)	(11.41)	(7.93)	(11.42)
Percentage Asian in school (mean)	3.79	35.44***	22.70*	29.35***	25.15***	23.21***	23.87***
	(5.79)	(30.84)	(28.44)	(29.67)	(21.19)	(23.32)	(25.08)
School average family SES (mean)	0.20	0.16	0.30	0.25	-0.11***	0.05**	0.19
	(0.39)	(0.49)	(0.44)	(0.49)	(0.46)	(0.31)	(0.37)
Percentage free or reduced-price lunch eligible (mean)	13.04	18.65	12.58	14.06	27.46***	15.23	12.99
	(13.77)	(19.08)	(15.43)	(14.37)	(19.88)	(13.90)	-12.58
Total N (unweighted)	2,324	186	108	50	123	72	92
	Nonadvanced Math Stratum						
	White	Chinese	Korean	Japanese	Southeast Asian	Filipino	South Asian
Self-assessed math ability (mean)	-0.20	-0.02	-0.34	-0.04	-0.15	-0.23	0.27†
	(0.99)	(0.74)	(0.94)	(1.00)	(0.73)	(0.86)	(0.90)
Female (%)	48.52	34.98	51.49	44.26	42.08	33.55*	24.52**
Family SES (mean)	0.02	-0.07	0.23	0.28	-0.59***	0.03	-0.05
	(0.63)	(0.96)	(0.74)	(0.72)	-0.67	(0.66)	(0.77)
Two-parent family structure (%)	78.83	71.58	85.29	84.85	80.01	80.34	82.45
Number of siblings (mean)	1.31	1.42	1.53	1.49	1.98***	1.31	1.96**
	(0.99)	(1.24)	(1.76)	(1.26)	-1.72	(1.10)	(1.30)
Course-taking (advanced = calculus; nonadvanced = No math through low academic math) (%)	7.72	24.48	8.80	1.47***	11.35	4.99	9.23
12th grade math test score (mean)	45.96	44.95	44.54	44.91	39.06***	45.25	40.43
	(12.54)	(17.11)	(15.05)	(14.85)	-13.49	(13.46)	-13.91
Percentage Asian in school (mean)	3.31	31.66***	16.91***	29.51***	21.21***	31.53***	15.09***
	(5.91)	(28.10)	(18.34)	(26.66)	-16.12	(24.97)	(12.57)
School average family SES (mean)	0.03	-0.01	0.11	0.04	-0.18***	-0.07	-0.03
	(0.34)	(0.42)	(0.40)	(0.37)	-0.33	(0.34)	(0.40)
Percentage free or reduced-price lunch eligible (mean)	16.76	18.75	16.74	18.69	30.89***	20.26	27.50*
	(13.42)	(15.44)	(14.30)	(14.46)	(15.36)	(16.33)	(21.27)
Total N (unweighted)	3,647	65	77	47	156	106	65

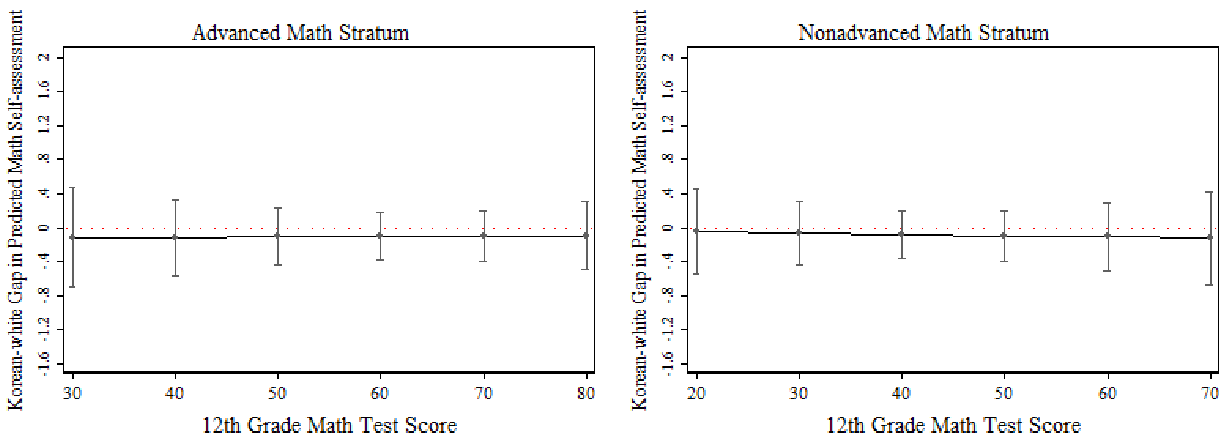
Note: Standard deviations are given in parentheses for continuous variables. Data are weighted. † denotes significant Ethnic Asian-white difference in self-assessed math ability at 0.01 level after adjusting for gender and high school math course-taking. Unweighted sample sizes are rounded to the nearest 10 per Institute of Education Sciences (IES) restricted-use guidelines.
Source: Educational Longitudinal Study (ELS) 2002-2004.

Figure A3. Asian Ethnic-white Difference in Predicted Math Self-assessment at Different Locations of 12th Grade Math Test Score by Math Course-taking Stratum

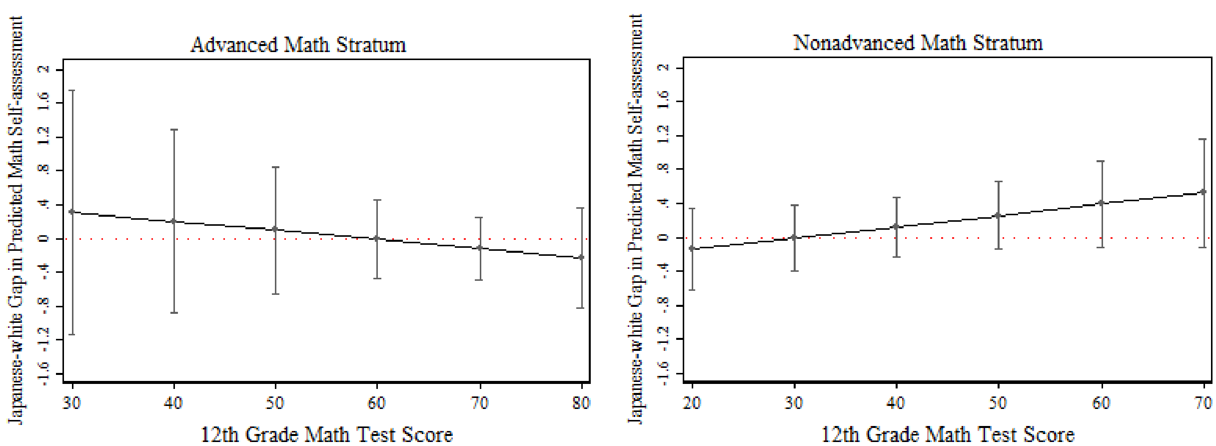
Panel A. Chinese-White Difference



Panel B. Korean-White Difference



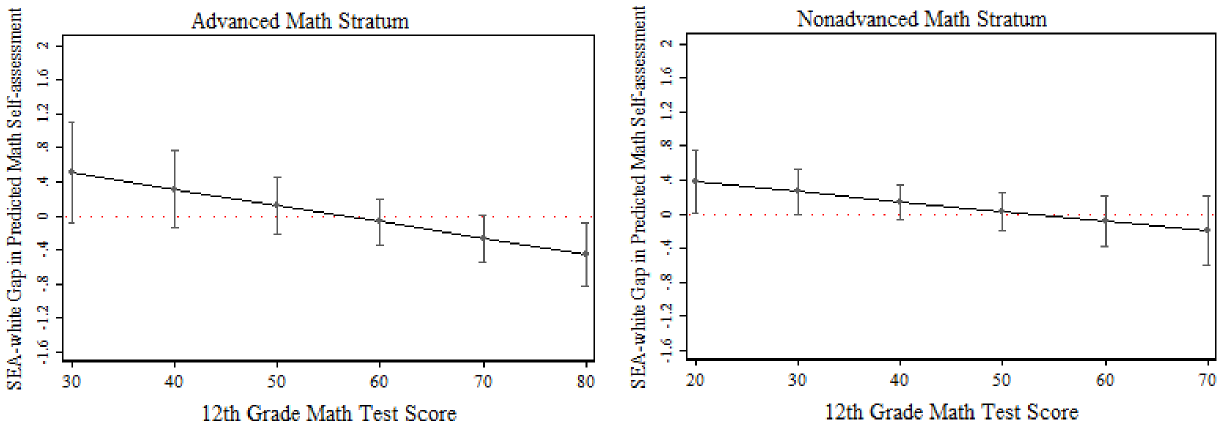
Panel C. Japanese-White Difference



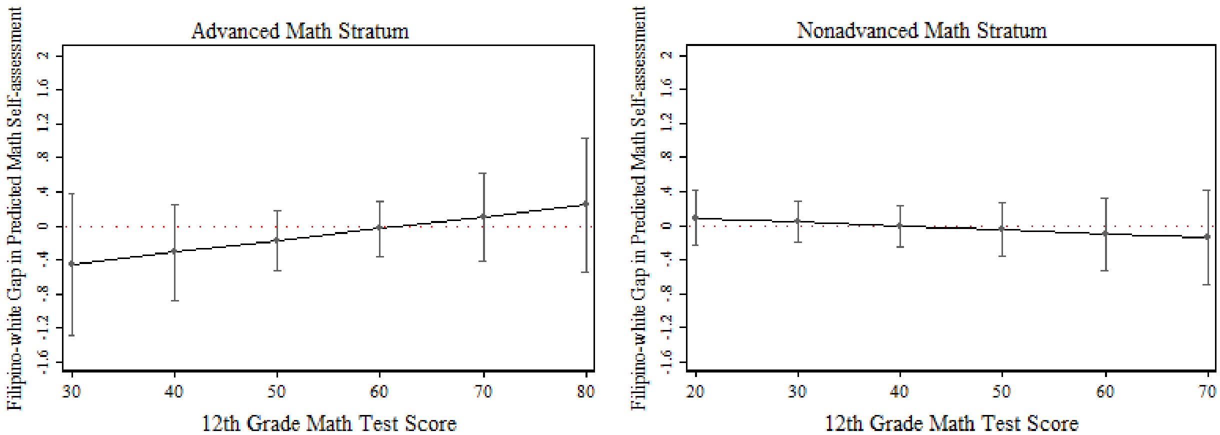
(To be continued)

Figure A3. (Continued)

Panel D. Southeast Asian-White Difference



Panel E. Filipino-White Difference



Panel F. South Asian-White Difference

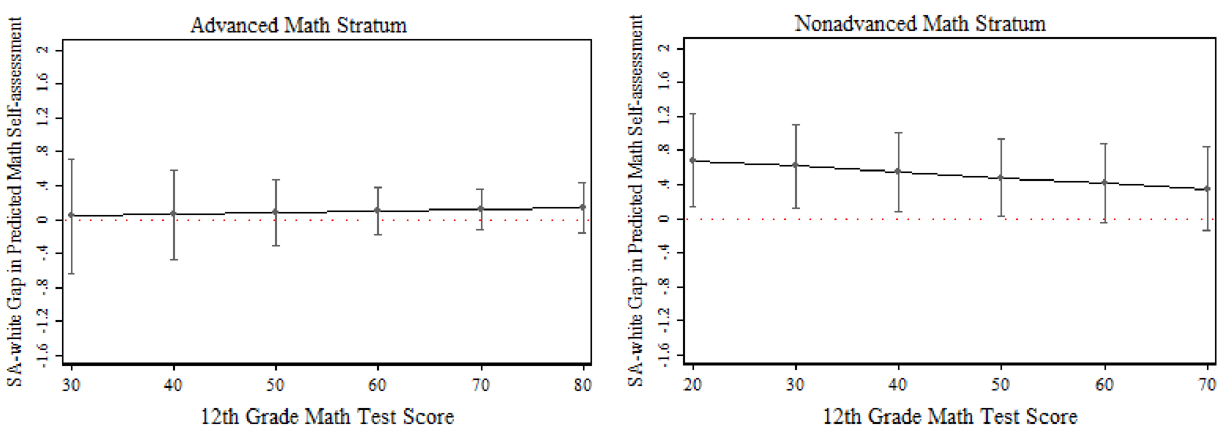
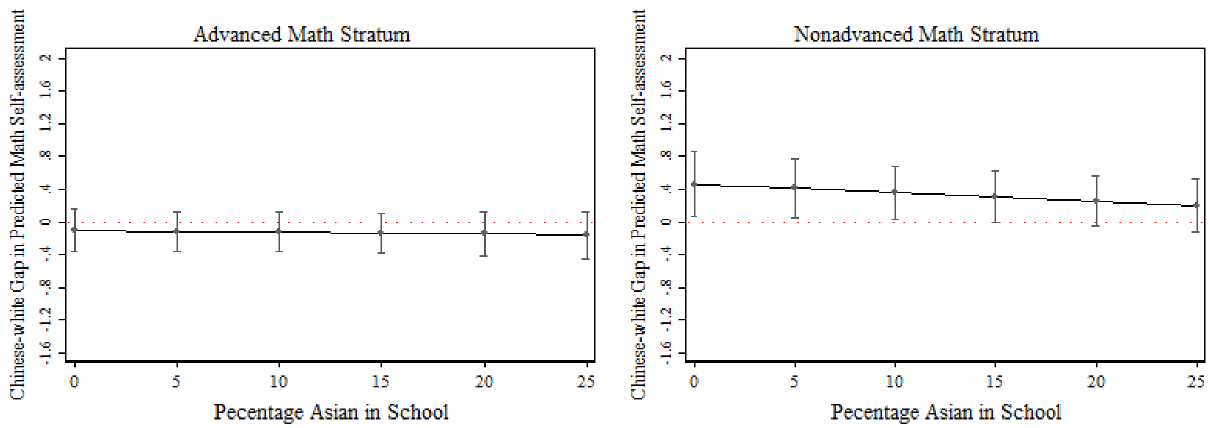
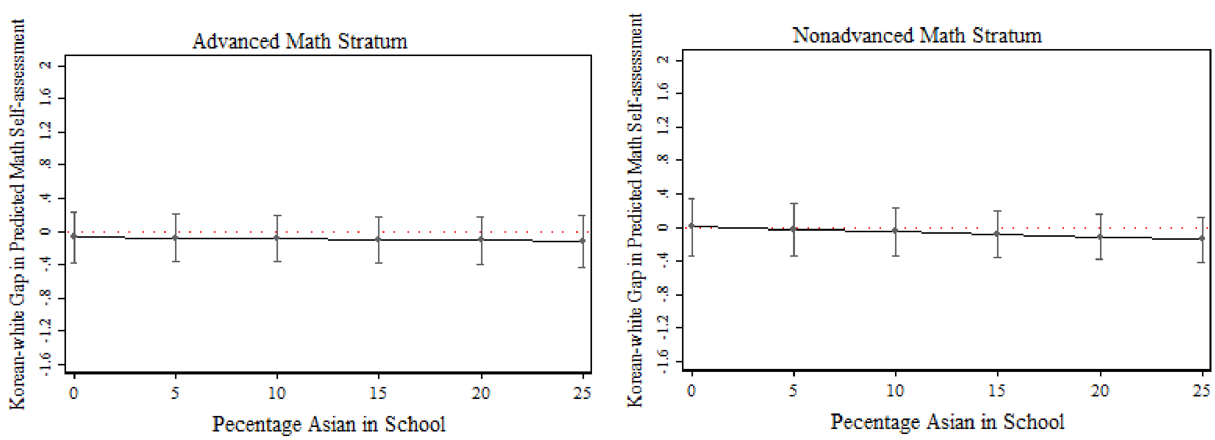


Figure A4. Asian-white Difference in Predicted Math Self-assessment at Different Locations of Percentage Asian in School by Math Course-taking Stratum

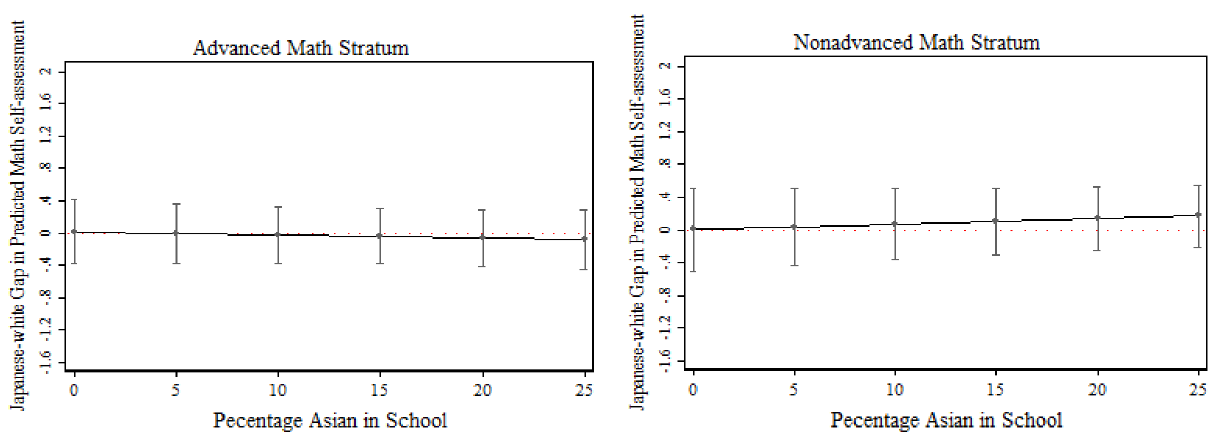
Panel A. Chinese-White Difference



Panel B. Korean-White Difference



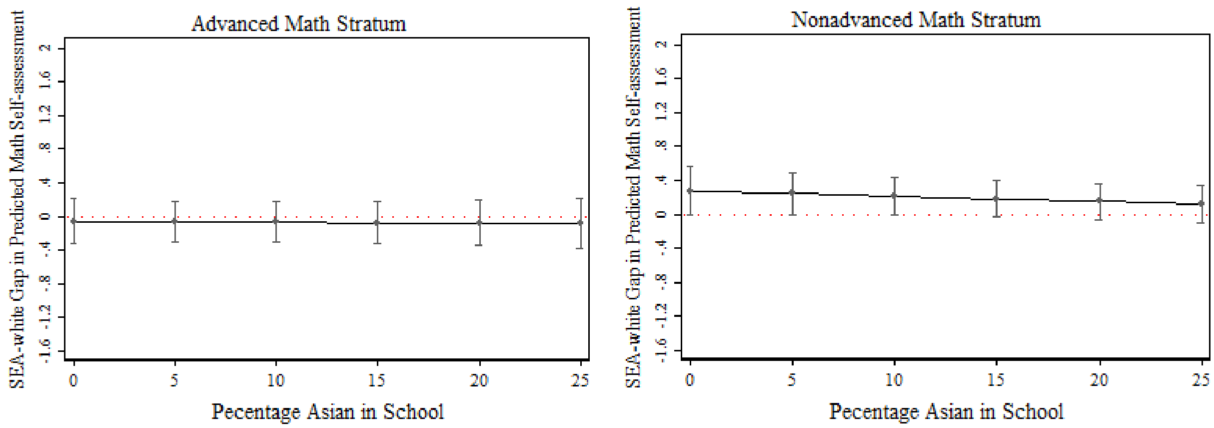
Panel C. Japanese-White Difference



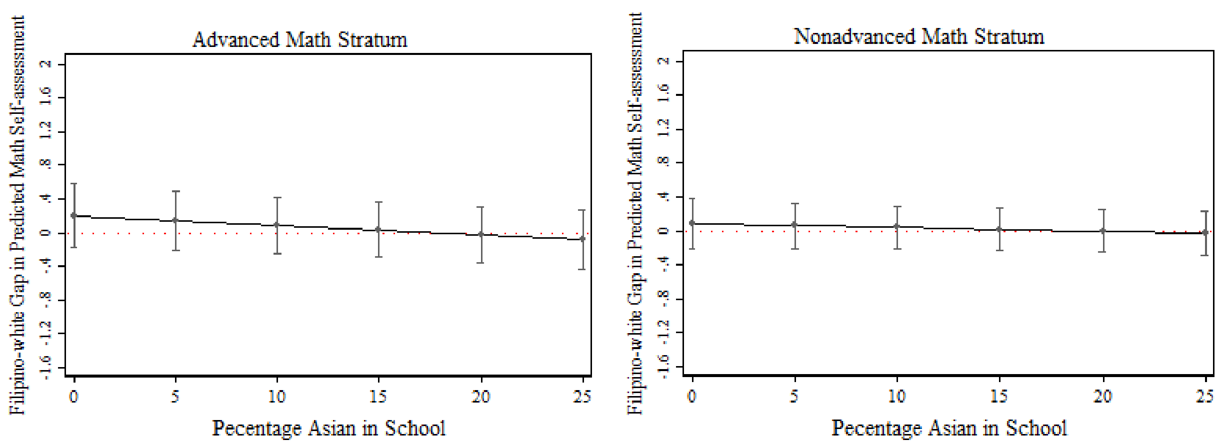
(To be continued)

Figure A4. (Continued)

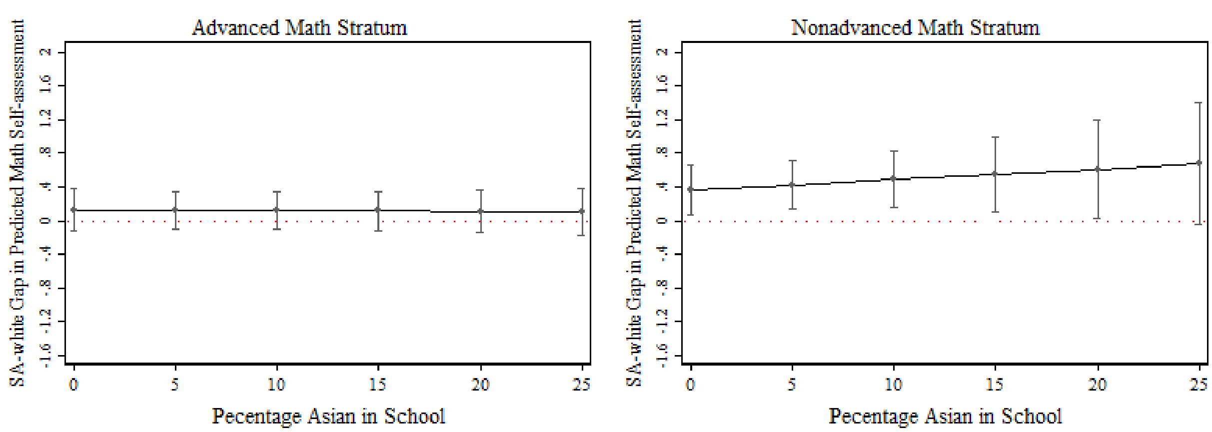
Panel D. Southeast Asian-White Difference



Panel E. Filipino-White Difference



Panel F. South Asian-White Difference



CHAPTER IV. Neighborhood and School District Segregation of Poor Asian Households with School-Age Children

Asian Americans, on average, have higher average socioeconomic attainment than other racial groups, but also show more variance in attainment (Sakamoto, Goyette, and Kim 2009; Zeng and Xie 2003). Indeed, Asian children are more likely to be in poverty than White children (Sakamoto, Goyette, and Kim 2009). At the same time, Asian children from low-income families are more likely to move up the income ladders, relative to low-income children from other racial or ethnic groups (Chetty et al. 2020).

To account for these racial differences in attainment and mobility, research has generally focused on behaviors of parents, including the greater pressure Asian parents put on their children to achieve academically (Fishman 2020; Goyette and Xie 1999; Liu and Xie 2016; Sun 1998) and the emphasis of Asian parents on the quality of local schools in deciding where to live (Lee and Zhou 2015). Specifically, Lee and Zhou (2015) argue that poor Asian parents leverage their co-ethnic networks to live near more economically advantaged Asian households as a way to facilitate the educational achievement of their own children. Although this argument, which is based on qualitative research in California, offers testable hypotheses about inter-racial differences in patterns of segregation, both across race and within race but across poverty status, very little research has explicated these patterns to show *how* the residential segregation patterns of poor Asian families differ from the residential segregation patterns of poor households of other racial groups. This chapter begins to fill this void.

Building on the literature of residential segregation, racial and class differences in the preferences of school choice, and Asian families' strategies for increasing their children's chances of upward mobility, my investigation answers three research questions:

1. To what extent are poor Asian households residentially segregated from nonpoor White households and their nonpoor, coethnic counterparts?
2. To what extent is the residential segregation experienced by poor Asian households attributable to sorting across school district boundaries?
3. Do households with school-age children experience the same residential segregation pattern as households without school-aged children?

In the sections that follow, I introduce established findings on Asian households' residential segregation patterns, most of which focuses on neighborhood segregation. I then discuss how patterns of racial and poverty segregation differ (a) across and within school districts, and (b) across metropolitan statistical areas (MSAs) that differ along several theoretically relevant dimensions including the size of the Asian population and the overall level of neighborhood segregation. I then describe my research design, hypotheses, and data. Using data from the 2008-2012 American Community Survey, I show neighborhood and school district segregation patterns for poor Asian households and compare them with corresponding patterns for poor Black, Hispanic and White households. I conclude with a discussion of the implications of the empirical findings for our understanding of Asian American educational attainment and mobility prospects.

Background

Residential segregation is key to understanding poverty and mobility in the United States (Massey 2016; Pettigrew 1979). Early research on residential segregation focuses mainly on the experiences of Black and White households (Massey and Denton 1993). With the strong momentum of growth of immigrants from Asian and Latin American countries since immigration reforms in the 1960s, contemporary American society has become increasingly racial and ethnically diverse, wherein the “racial relations” are no longer simply between Black and White Americans (Lee and Bean 2010). As such, more recent research focuses on documenting the residential segregation patterns of Asian and Hispanic families, not just Black and White families.

Asian households show distinct residential segregation patterns from both Hispanics and Black households. Over the past three decades, Asian households are less segregated from White households (across census tracts in metropolitan areas) than either Hispanic-White and Black-White households (Lichter, Parisi, and Taquino 2012; D. S. Massey, Rothwell, and Domina 2009). However, with the continued influx of the foreign-born population, Asian-White neighborhood segregation increased in most metropolitan areas over the past decades, a trend also observed for the Hispanic-White segregation (Logan and Stults 2011; Logan, Stults, and Farley 2004).

In addition to residential segregation by race, residential segregation by income has emerged as an important source of disparities in life chances, especially in educational attainment (Reardon and Bischoff 2011). Indeed, some estimates suggest that income segregation is becoming more pronounced than racial segregation (Reardon and Bischoff 2011). And, of course, residential segregation by race and by income intersect, with middle-class Black and Hispanic households more likely to live in high-poverty neighborhoods than middle-class White households (Massey and Denton 1993; Quillian 2012). However, fewer studies examine segregation by income among Asian households. In this paper, I will describe the residential segregation patterns of poor Asian households from both Whites and their nonpoor coethnics.

The Role of School Districts in Residential Segregation

Although the neighborhood is the most common spatial unit in segregation research, recent scholarship drawing from the theoretical perspective of a new "political economy of place" (Lichter, Parisi, and Taquino 2012; Massey, Rothwell, and Domina 2009; Rugh and Massey 2010) suggests that the traditional research practice of treating neighborhood segregation within metropolitan areas as if it reflects the social distances between the groups in question are inadequate, because between-group sorting across spatial units can occur at different geographic scales. The level of segregation across larger spatial units and the level of neighborhood segregation within larger spatial units may reinforce or offset each other in producing the overall level of neighborhood segregation. Moreover, sorting across geographic units of different scales can reflect distinct mechanisms. Segregation across larger geographic units, such as school districts, counties, or states, may reflect local or state-level political decisions, while segregation across smaller geographic units, which are rarely covered by distinct laws, may reflect dynamics in local housing markets, discrimination, or indirect political decisions such as "NIMBY-ism" (Bischoff 2008; Lichter, Parisi, and Taquino 2012; Massey, Rothwell, and Domina 2009).

Households' residential choices are influenced by many factors including the cost of housing, air quality, crime rate, access to public transportation and shopping centers, and, of relevance to this paper, the quality of local schools (Bayer, McMillan, and Rueben 2004; Li and Brown 1980). Households with or anticipating school-age children, in particular, are likely to consider school district boundaries when choosing where to live (Bischoff 2008; Clotfelter 1999; Urquiola 2005). In particular, households with school-aged children should be more likely to pay the additional costs of housing in districts with better schools (Owens 2017; 2016). Indeed, previous research shows that sorting across school district boundaries plays a larger part in explaining residential segregation by race and income among households with school-age children than among households without school-aged children (Owens 2016; 2017).

Although school district boundaries are important for the quality of education that students receive, high-income and low-income households may not give school options equal weight when searching for housing. In addition to not being able to afford some of the housing options associated with high quality schools, low-income parents often face limited search time and may prioritize neighborhood safety and proximity to their own employment over their children's school options (Rhodes and DeLuca 2014). Moreover, they are less likely than their high-income counterparts to have access to information on schools' academic records (Hastings, Van Weelden, and Weinstein 2007) and to incorporate this information into their residential decisions. On the other hand, very high-income parents may be more likely to send their children to a private school or to an out-of-neighborhood public school with selective admissions, making the quality of neighborhood schools less of a factor in residential decisions. This suggests that among the subpopulation that uses the public education system, high-income and low-income households tend to be segregated across school district boundaries with high-income households being more likely to be found in school districts with high quality schools.

Parents' preferences for the racial composition of schools and districts also shape the sorting of different racial groups across school district boundaries. In general, White parents prefer lower proportions of Black and Hispanic students when choosing a school for their children, even conditioning on the schools' academic records (Billingham and Hunt 2016). This may be due to overt racial animus or to the erroneous belief that schools with a high proportion of Black and Hispanic students are of low academic quality (Krysan 2002; Saporito and Lareau 1999). By contrast, Black and Hispanic parents prefer schools that are more racially diverse and prioritize a sense of belonging and school culture, even over schools' academic record (Wells 1996).

Compared to low-income White and other racial minority students, students from poor Asian families have greater academic achievement, on average (Chetty et al. 2020; Fishman 2020; Lee and Zhou 2015). One possible explanation is that poor Asian students may be more likely than students from other racial and ethnic groups to attend the same schools as their wealthier counterparts (Lee and Zhou 2015). One possible mechanism is that Asian parents may adopt housing search strategies that help them overcome their financial and information constraints. Moreover, White parents show greater tolerance toward high proportions of Asian students in their children's schools than Black and Hispanic students (Krysan 2002), which may mean that school districts with a high share of poor Asian students are less likely to experience "White flight" than school districts with equivalent shares of poor Black or poor Hispanic students. This, in turn, implies poor-nonpoor segregation among Asian households at the school district level will be lower than for Hispanic and Black households (but not White households).

The Current Study

The aim of this study is to describe poor Asian households' residential patterns across neighborhoods and school districts. I first evaluate the neighborhood and school district segregation of poor Asian households from nonpoor White households, estimating both the overall level of segregation and then decomposing it into the component occurring between school districts within an MSA and the component occurring across neighborhoods within school districts. To put these patterns into context, I will compare poor Asian-nonpoor White neighborhood segregation and share of neighborhood vs. school district segregation to equivalent measures of poor Black-nonpoor White segregation, poor Hispanic-nonpoor White segregation, and poor White-nonpoor White segregation.

My specific hypotheses are as follows. First, because White households have higher tolerance toward Asian neighbors compared to Black and Hispanic neighbors (Abascal and Baldassarri 2015; Lichter, Parisi, and Taquino 2012), I hypothesize that neighborhood segregation from nonpoor White households is lower for poor Asian households than for poor Black and Hispanic households ***(Hypothesis 1a)***. However, because all racial groups prefer to live closer to their in-groups (Abascal and Baldassarri 2015; Lichter, Parisi, and Taquino 2012), all three groups of poor nonWhite households will be more segregated from non-poor White households than poor White households (***Hypothesis 1a***). Similarly, since White parents show greater tolerance toward their children having Asian schoolmates than schoolmates who are Black or Hispanic (Krysan 2002), I hypothesize that the share of neighborhood segregation from nonpoor White households that occurs across school district boundaries is lower for poor Asian households than for poor Black and Hispanic households. As before, the share of neighborhood segregation occurring across school district boundaries will be lowest for poor Whites, again reflecting racial ingroup preferences (***Hypothesis 1b***).

I also assess how the poor-nonpoor segregation among Asian households compares to the income segregation patterns of households from other racial or ethnic groups: in other words, within-race comparisons. Prior research suggests that all levels of government, as well as the real estate, lending, and construction industries, play important roles in creating and maintaining a dual housing market, which lowered the residential "returns" to income among minority populations, especially among Blacks and Hispanics (Lichter et al. 2010). "White flight" in the face of a growing of minority population also acts to intensify residential segregation between Whites and other racial or ethnic groups (Crowder, Hall, and Tolnay 2011; Pais, South, and Crowder 2009). On the other hand, Asian households that experienced increase their income generally have a smoother transition to neighborhoods with more amenities and higher proportions of the native-born White populations than Black and Hispanic households (Lichter, Parisi, and Taquino 2015). As such, I hypothesize that the within-race neighborhood segregation by poverty status is higher among Asian households than among Black and Hispanic households (***Hypothesis 2a***).

In terms of the proportion of poor-nonpoor neighborhood segregation within each racial or ethnic group attributable to sorting across school district boundaries, qualitative research suggests that poor and working-class Asian parents pay closer attention to school quality than poor and working-class parents of other racial or ethnic groups (Lee and Zhou 2015) and mobilize resources from their densely connected coethnic networks to obtain information about schools' performance that they need in order to exercise this preference (Lee and Zhou 2015). Even if they cannot afford to buy homes in districts with good schools, they may instead choose to rent in these districts rather than buy in a district with worse schools (Lee and Zhou 2015). Thus, the proportion of poor-nonpoor neighborhood segregation among Asian households attributable to sorting across school district boundaries may be quite low, relative to other racial or ethnic groups (***Hypothesis 2b***).

Since school options matter more to families with school-age children, I expect that the proportions of neighborhood segregation attributable to sorting across school district boundaries – both between and within racial groups – are larger for households with school-age children than for households without school aged children (***Hypothesis 3***).

I also identify segregation levels in the top 5 and bottom 5 metropolitan areas in terms of Asian population size and segregation level to see if my hypotheses hold true for specific metropolitan areas in the United States.

Data and Measures

I use tract-level household population counts data from the U.S. Census Bureau's Summary File 5b of the 2008-2012 American Community Survey (ACS). I consider segregation for U.S. metropolitan areas, as defined by the Census Bureau (2012), and restrict the sample to metropolitan areas (excluding those in Puerto Rico) that have populations of at least 1,000 members in each household type (with or without children) among each racial/ethnic group. This results in 277 metropolitan areas for the analyses of Black-White segregation, 239 for Hispanic-White segregation, and 117 for Asian-White segregation.

Consistent with previous research, I operationalize neighborhoods as tracts (e.g., Friedman, Tsao, and Chen 2013; Iceland, Weinberg, and Steinmetz 2002; Massey and Denton 1988). Within each metropolitan area, I identify school district boundaries using the 2010 Census TIGER/line files. Because around 50 percent of census tracts straddle two or more school districts, I use the MABLE/Geocorr Geographic Correspondence Tool for 2010 elementary and unified district boundaries (Missouri Census Data Center 2012) to partition tracts to school districts based on the proportion of each tract weighted by population that lies within a school district.

Measuring and Estimating Segregation

To measure segregation, I use the Theil Index (H), which captures the unevenness of the distribution of groups across spatial units and which can be easily decomposed into between- and within-school district components (Massey and Denton 1988; Theil 1972). For each metropolitan area, I estimate H to capture (1) overall neighborhood segregation between poor Asian, Hispanic, and Black households (separately) and nonpoor White households; (2) overall within-race neighborhood segregation between poor and nonpoor households; (3) school district segregation between poor Asian, Hispanic, or Black households and nonpoor White households; and (4) within-race school district segregation between poor and nonpoor households. The additive decomposability of H allows me to easily assess the proportion of the overall neighborhood segregation between poor Asian, Hispanic, or Black households and nonpoor White households attributable to sorting across school district boundaries and the proportion attributable to sorting within district boundaries. I also estimate H for households with and without children separately to identify whether households with children are more unevenly sorted across neighborhoods by race and poverty status.

H measures the average difference of the racial or economic diversity between each tract and the larger metropolitan area (Reardon and O'Sullivan 2004). It ranges from 0 to 1, with 0 indicating no segregation, meaning all tracts have identical racial compositions or poverty shares, and 1 indicating complete segregation, meaning each tract has residents of only one racial or income group. The building block of H is the entropy-based concept of group diversity of a specific geographic unit (Theil 1972). The entropy score is calculated as

$$E = \sum_{r=1}^{n} Q_r \, ln \frac{1}{Q_r} ,$$

where Q_r is the proportion of the population comprised of group r in a geographic unit. In my analysis, n=2 always holds since I only estimate pairwise entropy scores. E varies from 0 when only one racial group is present to ln (2) when the two groups in question are equally represented in the population of the unit for which E is calculated. H is calculated as

$$H = \frac{\sum_{i=1}^{k} \frac{t_i}{T}(E - E_i)}{E},$$

where T represents the population of the metropolitan area, t_i represents tract *i*'s total population, E represents the entropy score for the metropolitan area, E_i represents the entropy score for tract *i*, and *k* represents the total number of census tracts in the metropolitan area.

For a given metropolitan area, H can be rewritten as the linear combination of the between-school district segregation and the weighted average of between-tract segregation within each school district:

$$H = H_D + \sum_{d=1}^{D} \frac{T_d E_d}{TE} H_d,$$

where H_D represents the segregation index calculated based on school districts within the metropolitan area, H_d represents the segregation index calculated based on census tracts within the d^{th} school district; E_d, E, T_d, and T are the entropy scores and the total populations of the d^{th} school district and the metropolitan area, respectively; and *D* represents the number of school districts in the metropolitan area. To estimate the share of segregation that occurs across districts, I calculate the average H_D over the average H.

My analysis of segregation relies on data at the household level, under the assumption that this is the level at which residential decisions are made. The race and ethnicity of the population is based on the race and ethnicity of the household head. Since children usually do not start formal schooling until age five, I define households with school-age children as households with one or more members aged between 5 and 17.

Results

Table 1 presents the population size and the percentage of households in poverty for each racial and ethnic group in the metropolitan areas represented in the study. The number of metropolitan areas for non-Hispanic White in this table (i.e., 355) includes the union of all metropolitan areas for the pairwise comparisons involving non-Hispanic Whites. Panel A presents the statistics for households without school-age children, whereas Panel B presents the statistics for households with school-age children. Panel A shows that a much higher percentages of Black and Hispanic households are in poverty (21.9% and 22.7%, respectively) as compared to White households (5.9%). The poverty rate for Asian households is also higher than White households, but by a smaller margin than for Hispanic or Black households. Panel B shows that for all racial and ethnic groups, households with school-age children have higher poverty rates than households without children (see also Sakamoto et al. 2009). However, the rank order across racial and ethnic groups in terms of poverty rate is the same, regardless of household composition.

Table 2 presents the average pairwise neighborhood segregation index (H) in metropolitan areas of poor Asian, Hispanic, and Black households from nonpoor White households, as well as the proportion of H occurring between and within school district boundaries. Panel A presents the results for households without school-age children, while Panel B presents the results for households with school-age children. Both Panel A and Panel B show that the three racial minority groups show comparable level of segregation from nonpoor White households, regardless of whether the households have school-age children. Racial disparities are small, but poor Hispanic households have slightly lower level of segregation from nonpoor White households than poor Asian and Black households. This is a complementary finding to

Jargowsky (2014), who shows that poor Hispanic households have slightly lower of segregation from "affluent" White households (defined as a household income above four times the poverty line). This pattern is not consistent with ***Hypothesis 1a***. However, consistent with ***Hypothesis 1a***, I find that the poor-nonpoor segregation among White households (shown in Table 3) is much smaller than any of the poor minority groups' segregation from nonpoor White households, regardless of whether households have school-age children.

Panel B of Table 2 shows that among households with school-age children, the proportion of neighborhood segregation from nonpoor White households that occurs between school district boundaries from nonpoor White is lower for poor Asian households (25.9%) than for poor Hispanic households (32.1%) or poor Black households (33.7%). In addition, Panel B of Table 3 shows that the proportion of neighborhood segregation occurring between school district boundaries from nonpoor White is higher for poor Asian households (25.9%) than for poor White households (19.8%). These results are consistent with ***Hypothesis 1b***. Among households without school-age children, unlike households with school-aged children, there are no discernable differences across racial minority groups in the between-district share of neighborhood segregation from non-poor White households (see Panel A of Table 2). The share of between-district segregation from non-poor WhiteWhite households is lowest for poor WhiteWhite households (16.6%).

Table 3 presents the average pairwise neighborhood segregation index (H) in metropolitan areas between poor and nonpoor for each racial and ethnic group, again decomposing segregation into between-district and within-district components. In Table 3, like in Table 2, Panel A presents the results for households without school-age children, while Panel B presents the results for households with school-age children. Both Panel A and Panel B show that (1) the within-race economic segregation is substantially higher for Asian households than for Black and Hispanic households, and lower for White households; and (2) the proportion of the within-race economic segregation attributable to sorting across school district boundaries is the highest for Asian households among all four racial and ethnic groups. These results are consistent with ***Hypothesis 2a***, but not with ***Hypothesis 2b,*** which says that the proportion of segregation attributable to sorting across school district boundaries should be very low for Asian households.

It is notable that within-race economic segregation is the lowest among White households, regardless of whether the households have school-age children or not. Previous research shows that estimates of economic segregation using census tract level count data from the ACS is systematically biased upward, since the income data contained in ACS come from a much smaller sample than the income data coming from the decennial censuses (Logan et al. 2020). Moreover, with much smaller sample size of the racial and ethnic minority groups, the upward bias is likely larger in estimates of economic segregation among Black, Hispanic, and Asian households (Logan et al. 2020). Could these biases explain why the White households show the lowest economic segregation? I cannot assess the bias directly. However, using the 1990 and 2000 census, Jargowsky (2014) also reports that the poor-affluent segregation is the highest for Asian households, followed by Hispanic, Black and then White households, a pattern similar to my ACS-based findings. Although the magnitude of segregation may differ, the census-based results suggest that the rank order of racial and ethnic groups likely obtains even if estimates were not biased by the relatively small sample sizes of the ACS (Logan et al. 2020).

Finally, consistent with ***Hypothesis 3***, I find that the proportions of neighborhood segregation attributable to sorting across school district boundaries are larger for households with school-age children than for households without children. This holds for all of the pairwise segregation estimates in this study, although the discrepancies in the proportion of segregation from non-poor White households across households with and without school-age children are largest for poor Hispanic and poor Black households, not for poor Asian households. WhitePut differently, the parental status gap is lowest for Asian households.

MSA differences in segregation

The preceding results show that the proportion of the within-race economic segregation attributable to sorting across school district boundaries is highest for Asian households than for any of the other three racial and ethnic groups. This is inconsistent with the qualitative results of Lee and Zhou (2015), who found that poor Asian households with school-age children tend to live in close proximity to their wealthier counterparts and have similar access to high quality schooling for their children as their wealthier counterparts. To help unpack this disparity, I report results for the overall level of within-race poor-nonpoor segregation (H) of Asian American households with school-age children and the proportion of H attributable to sorting across school-district boundaries for select metropolitan areas. Panel A in Table 4 presents the top 5 most segregated metropolitan areas and the bottom 5 least segregated metropolitan areas, both at the census tract level. Panel B presents the top 5 metropolitan areas with the largest share of Asian households in the population as well as the bottom 5 metropolitan areas with the lowest share of Asian households in the population. The metropolitan area of **"Los Angeles-Long Beach-Santa Ana, CA,"** where Lee and Zhou (2015)'s field research takes place, stands out as the metropolitan area with the largest Asian population and with the second lowest level of overall segregation at the census tract level. The proportion of segregation occurring at the school district level – that is, between districts, rather than across neighborhoods within districts

– is also much lower for **“Los Angeles-Long Beach-Santa Ana, CA”** (15.6%) relative to the average across the 117 metropolitan areas covered in the descriptive analysis (22.7%).

Does this mean that Lee and Zhou (2015)’s finding applies more to metropolitan areas with a large Asian population size and low level of overall segregation at the census tract level? The metropolitan area of **“New York-Northern New Jersey-Long Island, NY-NJ-PA”** have the second largest Asian population, but the proportion of the overall segregation occurring at the school district level in this metropolitan area (34.3%) is much higher than the average of the 117 metropolitan areas studied (22.7%). Moreover, in metropolitan areas with extremely high levels of overall segregation at the census tract level, **“North Port-Bradenton-Sarasota, FL”, “Greenville-Mauldin-Easley, SC”, “Lexington-Fayette, KY”, and “Albuquerque, NM”,** the proportions of the overall segregation occurring at the school district level are much lower (2.5% to 10.5%) than what is observed in **“Los Angeles-Long Beach-Santa Ana, CA”** (15.6%). These results suggest that the observation offered in Lee and Zhou (2015) may be specific to the location of their field work and may not be generalizable to other metropolitan areas in the United States.

Discussion

Asian students from disadvantaged family backgrounds experience more socioeconomic mobility than disadvantaged students of other racial or ethnic groups, a result that some scholars attribute to low-income Asian parents’ unique ability to live near high-quality schools (Lee and Zhou 2015). This paper provides a quantitative description of the extent to which poor Asian households are segregated from nonpoor White and Asian households and compares these estimates to analogous estimates for Black and Hispanic households. It also estimates the extent to which the segregation of poor Asian households from better-off Asian households or from non-poor White households maps onto school district boundaries.

I find, firstly, that although the level of overall segregation from nonpoor Whites are comparable for poor Asian, Black and Hispanic households, regardless of whether the households have school-age children, the proportion of poor Asian households' neighborhood segregation from nonpoor Whites attributable to sorting across school district boundaries is smaller than the share for poor Black and Hispanic households. This is partly consistent with the hypothesis that White parents have greater tolerance toward Asian schoolmates than Black or Hispanic schoolmates (Krysan 2002). White parents, although more tolerant of Asian classmates than other groups, may deliberately avoid schools with very high concentration of Asian students in order to shield their children from a "hyper-achievement" norm (Jiménez and Horowitz 2013). As a result, non-poor White parents may prefer school districts with high shares of poor White students, even over school districts with high shares of Asian students – whether in poverty or not. This is, of course, mere speculation: the ACS lacks information on the factors that contribute to any given household's residential decisions. However, the aggregate patterns suggest that among White households, racial preferences trump income preferences.

Second, I find that the within-race economic segregation and the proportion of within-race economic segregation occurring between school districts are also greater among Asian households than among Black, Hispanic and White households. Although these patterns are consistent with the hypothesis that Asian households enjoy higher residential returns to income than other racial minority households, they are not consistent with the notion that poor Asian parents are able to mobilize resources in their ethnic communities so that their children have similar access to schooling resources as their wealthier counterpart (Lee and Zhou 2015). My analysis of the segregation patterns for specific metropolitan areas suggests that the argument presented in Lee and Zhou (2015) may apply only to their site of field work (in or near Los Angeles, California) and is not generalizable to other metropolitan areas with similar size of the Asian community or with similar level of overall segregation. This suggests that resources offered in poor Asian households' ethnic community may not explain why poor Asian children have higher academic achievement. In Sakamoto and Wang (2021)'s critique of Lee and Zhou (2015), the authors argue that the "ethnic capital" embedded in the Asian coethnic community emphasized in Lee and Zhou (2015) may be "largely a spurious aggregate characteristic deriving from Asian American family processes" [12][13](Sakamoto and Wang 2020, p. 23). The current study suggests that such a "spurious aggregate characteristic" may only be found in a small number of metropolitan areas in the United States.

My analysis is limited in several other ways. First, this study only takes into account the racial or ethnic identity of household heads, without adjusting for the fact that some households may involve inter-racial unions. Since the rate of forming inter-racial unions with one White partner are lower among Black Americans than among Asian or Hispanic Americans (Qian and Lichter 2007), and inter-racial households involving a foreign-born Asian or Hispanic partner and native-born White partner have less residential segregation from native-born White households (Iceland and Nelson 2010), the level of residential segregation that I estimated in this paper may be lower than the level of residential segregation between Asian-only and White-only households and Hispanic-only and White-only households.

[12] Sakamoto and Wang, "Deconstructing Hyper-Selectivity."
[13] Sakamoto and Wang.

Second, racial labels like “Hispanic” and “Asian” often mask substantial differences among the “Asian” panethnic label. Research has shown that there is a considerable amount of variation in the level of residential segregation from Whites among the ethnic groups that make up the same panethnic categories (Hall 2012), although ethnic groups under the same panethnic label do live closer to each other than from other panethnic groups (Kim and White 2010). Since prior research report heterogeneity in the level of upward educational mobility across Asian ethnic groups (Fishman 2020), future research should continue examining whether there is heterogeneity in the patterns of residential segregation in relation to school options experienced by different Asian ethnic groups.

Overall, the findings presented in this chapter suggest that although children from poor Asian households may enjoy better schooling opportunities than children from other poor minority households, their higher likelihood of upward socioeconomic, on average, relative to poor Black, Hispanic and White children is unlikely due to their unique capital embedded in their coethnic community.

Tables and Figures

Table 1. Population by poverty status in metropolitan America, 2008-2012

Racial/Ethnic Group	Proportion of population		Population Size
	Poor	Non-poor	
Panel A: Without School-Age Children			
White	4.20%	95.80%	25,841,550
Black	14.70%	85.30%	3,994,881
Asian	7.10%	92.90%	1,850,022
Hispanic	13.50%	86.50%	4,175,200
Panel B: With School-Age Children			
White	9.10%	90.90%	13,926,474
Black	29.00%	71.00%	4,035,238
Asian	10.90%	89.10%	1,360,520
Hispanic	27.20%	72.80%	5,405,531

Source: Calculation is based on household level counts from American Community Survey 2008-2012.

Note: Metropolitan areas with at least 1000 of the relevant racial and ethnic groups with and without school-age children are included. School-age children are children aged between 5 and 17.

Table 2. Percentage decomposition of poor minority households' mean segregation from nonpoor White households (H) occurring between and within school districts among households with or without school-age Children in metropolitan America, 2008-2012

	Panel A: Without School-Age Children			Panel B: With School-Age Children			
	Total H	Between-School District Proportion	Within-School District Proportion	Total H	Between-School District Proportion	Within-School District Proportion	Number of CBSAs
Poor Asian vs. Nonpoor White	0.46	25.00%	75.00%	0.52	25.90%	74.10%	117
Poor Hispanic vs. Nonpoor White	0.41	25.40%	74.60%	0.45	32.10%	67.90%	239
Poor Black vs. Nonpoor White	0.44	25.90%	74.10%	0.51	33.70%	66.30%	277

Source: Calculation is based on household level counts from American Community Survey 2008-2012.

Note: Metropolitan areas with at least 1000 of the relevant racial and ethnic groups with and without school-age children are included. School-age children are children aged between 5 and 17.

Table 3. Percentage decomposition of within-race poor-nonpoor households' mean segregation (H) occurring between and within school districts among households with or without school-age Children in metropolitan America, 2008-2012

	Panel A: Without School-Age Children			Panel B: With School-Age Children			
	Total H	Between-School District Proportion	Within-School District Proportion	Total H	Between-School District Proportion	Within-School District Proportion	Number of CBSAs
Poor Asian vs. Nonpoor Asian	0.59	20.70%	79.30%	0.62	22.70%	77.30%	117
Poor White vs. Nonpoor White	0.17	16.60%	83.40%	0.22	19.80%	80.20%	
Poor Hispanic vs. Nonpoor Hispanic	0.41	16.00%	84.00%	0.34	17.00%	83.00%	239
Poor White vs. Nonpoor White	0.15	15.40%	84.60%	0.20	17.30%	82.70%	
Poor Black vs. Nonpoor Black	0.30	13.60%	86.40%	0.29	15.70%	84.30%	277
Poor White vs. Nonpoor White	0.14	14.80%	85.20%	0.18	17.20%	82.80%	

Source: Calculation is based on household level counts from American Community Survey 2008-2012.

Note: Metropolitan areas with at least 1000 of the relevant racial and ethnic groups with and without school-age children are included. School-age children are children aged between 5 and 17.

Table 4. Decomposition of within-race poor-nonpoor segregation of Asian Americans for select metropolitan areas for Households with school-age children, 2008-2012

	Total H	Between-School District Proportion	Within-School District Proportion	Asian populatio n size
Panel A. MSAs by tract-level segregation				
Top-5 Most Segregated MSAs at Census Tract Level				
Dayton, OH	0.9560	46.8%	53.2%	3,986
North Port-Bradenton-Sarasota, FL	0.9498	10.4%	89.6%	2,351
Greenville-Mauldin-Easley, SC	0.9475	6.2%	93.8%	2,701
Lexington-Fayette, KY	0.8920	2.5%	97.5%	2,537
Albuquerque, NM	0.8486	10.5%	89.5%	3,868
Bottom-5 Least Segregated MSAs at Census Tract Level				
San Francisco-Oakland-Fremont, CA	0.3829	21.8%	78.2%	242,830
Yuba City, MA	0.3381	25.8%	74.2%	3,908
Stockton, CA	0.3134	23.7%	76.3%	21,828
Los Angeles-Long Beach-Santa Ana, CA	0.3102	15.6%	84.4%	458,045
San Jose-Sunnyvale-Santa Clara, CA	0.2609	14.1%	85.9%	144,579
Panel B. MSAs by the Size of the Asian Population				
Top-5 MSAs with the Largest Asian Population				
Los Angeles-Long Beach-Santa Ana, CA	0.3102	15.6%	84.4%	458,045
New York-Northern New Jersey-Long Island, NY-NJ-PA	0.4139	34.3%	65.7%	455,258
San Francisco-Oakland-Fremont, CA	0.3829	21.8%	78.2%	242,830
San Jose-Sunnyvale-Santa Clara, CA	0.2609	14.1%	85.9%	144,579
Chicago-Joliet-Naperville, IL-IN-WI	0.5169	27.2%	72.8%	130,002
Bottom-5 MSAs with the Least Asian Population				
Beaumont-Port-Arthur, TX	0.6947	16.7%	83.3%	2,353
North Port-Bradenton-Sarasota, FL	0.9498	10.4%	89.6%	2,351
Lincoln, NE	0.5701	10.4%	89.7%	2,253
Ogden-Clearfield, UT	0.7097	7.1%	93.0%	2,169
Killeen-Temple-Fort Hood, TX	0.6974	9.8%	90.2%	2,143

Source: Calculation is based on household level counts from American Community Survey 2008-2012.

BIBLIOGRAPHY

Abascal, Maria, and Delia Baldassarri. “Love Thy Neighbor? Ethnoracial Diversity and Trust Reexamined.” *American Journal of Sociology* 121, no. 3 (2015): 722–82. https://doi.org/10.1086/683144.

Adelman, Clifford. *Women and Men of the Engineering Path: A Model for Analyses of Undergraduate Careers.* Washington, D.C.: National Institute on Postsecondary Education, Libraries, and Lifelong Learning, 1998.

Bozick, Robert, Eric Lauff, and John Wirt. *Education Longitudinal Study of 2002 (ELS:2002): A First Look at the Initial Postsecondary Experiences of the High School Sophomore Class of 2002*. Washington, D.C.: National Center for Education Statistics, 2007. https://eric.ed.gov/?id=ED498655.

Bozick, Robert, Tiffany Lytle, Peter H. Siegel, Steven J. Ingels, James E. Rogers, Erich Lauff, Michael Planty, and John Wirt. *Education Longitudinal Study of 2002: First Follow-up Transcript Component Data File Documentation (NCES 2006-338)*. Washington, D.C.: National Center for Education Statistics, 2006.

Brand, Jennie E., and Yu Xie. “Who Benefits Most from College?: Evidence for Negative Selection in Heterogeneous Economic Returns to Higher Education.” *American Sociological Review* 75, no. 2 (April 2010): 273–302. https://doi.org/10.1177/0003122410363567.

Bruch, Elizabeth, and Fred Feinberg. “Decision-Making Processes in Social Contexts.” *Annual Review of Sociology* 43, no. 1 (July 31, 2017): 207–27. https://doi.org/10.1146/annurev-soc-060116-053622.

Burkam, David T., and Valerie E. Lee. *Mathematics, Foreign Language, and Science Coursetaking and the NELS:88 Transcript Data (NCES 2003-01)*. Washington, D.C.: National Center for Education Statistics, 2003. https://eric.ed.gov/?id=ED566861.

Byun, Soo-yong, and Hyunjoon Park. "The Academic Success of East Asian American Youth the Role of Shadow Education." *Sociology of Education* 85, no. 1 (January 1, 2012): 40–60. https://doi.org/10.1177/0038040711417009.

Cheryan, Sapna, and Galen V. Bodenhausen. "When Positive Stereotypes Threaten Intellectual Performance: The Psychological Hazards of 'Model Minority' Status." *Psychological Science* 11, no. 5 (September 1, 2000): 399–402. https://doi.org/10.1111/1467-9280.00277.

Correll, Shelley J. "Gender and the Career Choice Process: The Role of Biased Self-assessments." *American Journal of Sociology* 106, no. 6 (May 2001): 1691–1730. https://doi.org/10.1086/321299.

Crocker, Jennifer, Brenda Major, and Claude Steele. "Social Stigma." In *The Handbook of Social Psychology, Edited by Daniel T. Gilbert, Susan T. Fiske, and Gardner Lindzey*, 4th ed. Vol. 2. Boston: McGraw-Hill, 1998.

Crosnoe, Robert. "Low-Income Students and the Socioeconomic Composition of Public High Schools." *American Sociological Review* 74, no. 5 (October 1, 2009): 709–30. https://doi.org/10.1177/000312240907400502.

Dalton, Ben, Steven J. Ingels, Jane Downing, Robert Bozick, and Jeffrey Owings. "Advanced Mathematics and Science Coursetaking in the Spring High School Senior Classes of 1982, 1992, and 2004 (NCES 2007-312).," 2007, 148.

———. *Advanced Mathematics and Science Coursetaking in the Spring High School Senior Classes of 1982, 1992, and 2004. NCES 2007-312.* Washington, D.C.: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, 2007.

Eccles, Jacquelynne S. "Gendered Educational and Occupational Choices: Applying the Eccles et al. Model of Achievement-Related Choices." *International Journal of Behavioral Development* 35, no. 3 (May 2011): 195–201. https://doi.org/10.1177/0165025411398185.

———. "Understanding Women's Educational and Occupational Choices: Applying the Eccles et al. Model of Achievement-Related Choices." *Psychology of Women Quarterly* 18, no. 4 (December 1, 1994): 585–609. https://doi.org/10.1111/j.1471-6402.1994.tb01049.x.

Fishman, Samuel H. "Educational Mobility among the Children of Asian American Immigrants." *American Journal of Sociology* 126, no. 2 (September 1, 2020): 260–317. https://doi.org/10.1086/711231.

Fiske, Susan T., Monica Lin, and Stephen Neuberg. "The Continuum Model: Ten Years Later." In *Dual-Process Theories in Social Psychology, Edited by Shelly Chaiken and Yaacov Trope*. New York: Guilford, 1999.

Gamoran, Adam. "Tracking and Inequality: New Directions for Research and Practice." In *The Routledge International Handbook of the Sociology of Education*, 1st ed., 213–28. Routledge, 2010. https://doi.org/10.4324/9780203863701.

Gelbgiser, Dafna, and Sigal Alon. "Math-Oriented Fields of Study and the Race Gap in Graduation Likelihoods at Elite Colleges." *Social Science Research* 58 (July 1, 2016): 150–64. https://doi.org/10.1016/j.ssresearch.2016.03.005.

Goyette, Kimberly A., Danielle Farrie, and Joshua Freely. "This School's Gone Downhill: Racial Change and Perceived School Quality among Whites." *Social Problems* 59, no. 2 (2014): 155–76. https://doi.org/10.1525/sp.2012.59.2.155.

Goyette, Kimberly, and Yu Xie. "Educational Expectations of Asian American Youths: Determinants and Ethnic Differences." *Sociology of Education* 72, no. 1 (1999): 22–36. https://doi.org/10.2307/2673184.

Hainmueller, Jens, Jonathan Mummolo, and Yiqing Xu. "How Much Should We Trust Estimates from Multiplicative Interaction Models? Simple Tools to Improve Empirical Practice." *Political Analysis* 27, no. 2 (April 2019): 163–92. https://doi.org/10.1017/pan.2018.46.

Hsin, Amy, and Yu Xie. "Explaining Asian Americans' Academic Advantage over Whites." *Proceedings of the National Academy of Sciences* 111, no. 23 (June 10, 2014): 8416–21. https://doi.org/10.1073/pnas.1406402111.

Jiménez, Tomás R., and Adam L. Horowitz. "When White Is Just Alright: How Immigrants Redefine Achievement and Reconfigure the Ethnoracial Hierarchy." *American Sociological Review* 78, no. 5 (October 1, 2013): 849–71. https://doi.org/10.1177/0003122413497012.

Kao, Grace. "Asian Americans as Model Minorities? A Look at Their Academic Performance." *American Journal of Education* 103, no. 2 (1995): 121–59.

Kao, Grace, and Jennifer S. Thompson. "Racial and Ethnic Stratification in Educational Achievement and Attainment." *Annual Review of Sociology* 29 (2003): 417–42. https://doi.org/10.1146/annurev.soc.29.010202.100019.

Kelly, Sean. "The Black-White Gap in Mathematics Course Taking." *Sociology of Education* 82, no. 1 (January 2009): 47–69. https://doi.org/10.1177/003804070908200103.

Kim, ChangHwan, and Arthur Sakamoto. “Have Asian American Men Achieved Labor Market Parity with White Men?” *American Sociological Review* 75, no. 6 (December 1, 2010): 934–57. https://doi.org/10.1177/0003122410388501.

Kim, ChangHwan, Christopher R. Tamborini, and Arthur Sakamoto. “Field of Study in College and Lifetime Earnings in the United States.” *Sociology of Education* 88, no. 4 (October 2015): 320–39. https://doi.org/10.1177/0038040715602132.

Kim, ChangHwan, Christopher Tamborini, and Arthur Sakamoto. “The Sources of Life Chances: Does Education, Class Category, Occupation, or Short-Term Earnings Predict 20-Year Long-Term Earnings?” *Sociological Science* 5 (2018): 206–33. https://doi.org/10.15195/v5.a9.

Kim, ChangHwan, and Yang Zhao. “Are Asian American Women Advantaged? Labor Market Performance of College Educated Female Workers.” *Social Forces* 93, no. 2 (December 1, 2014): 623–52. https://doi.org/10.1093/sf/sou076.

Lee, Jennifer, and Min Zhou. *The Asian American Achievement Paradox*. New York: Russell Sage Foundation, 2015.

———. *The Asian American Achievement Paradox*. New York: Russell Sage Foundation, 2015.

Lichter, Daniel T., Domenico Parisi, and Michael C. Taquino. “The Geography of Exclusion: Race, Segregation, and Concentrated Poverty.” *Social Problems* 59, no. 3 (August 1, 2012): 364–88. https://doi.org/10.1525/sp.2012.59.3.364.

Liu, Airan, and Yu Xie. “Why Do Asian Americans Academically Outperform Whites? – The Cultural Explanation Revisited.” *Social Science Research* 58 (July 1, 2016): 210–26. https://doi.org/10.1016/j.ssresearch.2016.03.004.

Liu, Yuanyuan, and Kim A. Weeden. "Assessing Asian American Exceptionalism in STEM Major Selection and Completion," 2016.

Ma, Yingyi. *Ambitious and Anxious: How Chinese College Students Succeed and Struggle in American Higher Education*. New York: Columbia University Press, 2020.

———. "Model Minority, Model for Whom? An Investigation of Asian American Students in Science/Engineering." *AAPI Nexus: Policy, Practice and Community* 8, no. 1 (January 1, 2010): 43–74. https://doi.org/10.17953/appc.8.1.aj7768606766xt01.

Markus, Hazel Rose, and Shinobu Kitayama. "Culture and the Self: Implications for Cognition, Emotion, and Motivation." *Psychological Review* 98, no. 2 (1991): 224–53.

Marsh, Herbert. "The Big-Fish-Little-Pond Effect on Academic Self-Concept." *Journal of Educational Psychology* 79, no. 3 (1987): 280–95.

Marsh, Herbert, and Kit Tai Hau. "Big-Fish-Little-Pond Effect on Academic Self-Concept: A Cross-Cultural (26 Country) Test of the Negative Effects of Academically Selective Schools." *American Psychologist* 58, no. 5 (2003): 364–76. https://doi.org/10.1037/0003-066X.58.5.364.

Marsh, Herbert W., Marjorie Seaton, Ulrich Trautwein, Oliver Lüdtke, K. T. Hau, Alison J. O'Mara, and Rhonda G. Craven. "The Big-Fish–Little-Pond-Effect Stands Up to Critical Scrutiny: Implications for Theory, Methodology, and Future Research." *Educational Psychology Review* 20, no. 3 (September 1, 2008): 319–50. https://doi.org/10.1007/s10648-008-9075-6.

Massey, Douglas S., Camille Z. Charles, Mary J. Fischer, and Garvey Lundy. *The Source of the River: The Social Origins of Freshmen at America's Selective Colleges and Universities*. Princeton University Press, 2003.

Morgan, Stephen L. *On the Edge of Commitment: Educational Attainment and Race in the United States*. Palo Alto, CA: Stanford University Press, 2005.

Morgan, Stephen L., Dafna Gelbgiser, and Kim A. Weeden. "Feeding the Pipeline: Gender, Occupational Plans, and College Major Selection." *Social Science Research* 42, no. 4 (July 2013): 989–1005. https://doi.org/10.1016/j.ssresearch.2013.03.008.

Morgan, Stephen L., Theodore S. Leenman, Jennifer J. Todd, and Kim A. Weeden. "Occupational Plans, Beliefs about Educational Requirements, and Patterns of College Entry." *Sociology of Education* 86, no. 3 (July 1, 2013): 197–217. https://doi.org/10.1177/0038040712456559.

———. "Stutter-Step Models of Performance in School." *Social Forces* 91, no. 4 (June 2013): 1451–74. https://doi.org/10.1093/sf/sot037.

Morgan, Stephen L., and Jal D. Mehta. "Beyond the Laboratory: Evaluating the Survey Evidence for the Disidentification Explanation of Black-White Differences in Achievement." *Sociology of Education* 77, no. 1 (January 1, 2004): 82–101. https://doi.org/10.1177/003804070407700104.

National Science Foundation. "Higher Education in Science and Engineering." In *Science and Engineering Indicators 2014*. Arlington, VA: National Science Foundation, 2014. https://www.nsf.gov/statistics/seind14/index.cfm/chapter-2.

———. "Nsf.Gov - S&E Indicators 2014 - Overview - US National Science Foundation (NSF)," 2014. https://www.nsf.gov/statistics/seind14/index.cfm/overview.

Owens, Ann. "Inequality in Children's Contexts: Income Segregation of Households with and without Children." *American Sociological Review* 81, no. 3 (June 1, 2016): 549–74. https://doi.org/10.1177/0003122416642430.

———. “Racial Residential Segregation of School-Age Children and Adults: The Role of Schooling as a Segregating Force.” *RSF: The Russell Sage Foundation Journal of the Social Sciences* 3, no. 2 (February 1, 2017): 63–80. https://doi.org/10.7758/RSF.2017.3.2.03.

Peng, Samuel S., and Deeann Wright. “Explanation of Academic Achievement of Asian American Students.” *The Journal of Educational Research* 87, no. 6 (July 1, 1994): 346–52. https://doi.org/10.1080/00220671.1994.9941265.

Reardon, Sean F., and Kendra Bischoff. “Income Inequality and Income Segregation.” *American Journal of Sociology* 116, no. 4 (January 1, 2011): 1092–1153. https://doi.org/10.1086/657114.

Ridgeway, Cecilia L. *Framed by Gender: How Gender Inequality Persists in the Modern World*. Oxford University Press, 2011.

Riegle-Crumb, Catherine, and Eric Grodsky. “Racial-Ethnic Differences at the Intersection of Math Course-Taking and Achievement.” *Sociology of Education* 83, no. 3 (July 1, 2010): 248–70. https://doi.org/10.1177/0038040710375689.

Riegle-Crumb, Catherine, Barbara King, and Yasmiyn Irizarry. “Does STEM Stand Out? Examining Racial/Ethnic Gaps in Persistence Across Postsecondary Fields.” *Educational Researcher* 48, no. 3 (April 1, 2019): 133–44. https://doi.org/10.3102/0013189X19831006.

Sakamoto, Arthur, Kimberly A. Goyette, and ChangHwan Kim. “Socioeconomic Attainments of Asian Americans.” *Annual Review of Sociology* 35 (2009): 255–76.

Sakamoto, Arthur, ChangHwan Kim, and Isao Takei. “The Japanese American Family.” *Ethnic Families in America: Patterns and Variations*, 2012, 252–76.

Sakamoto, Arthur, and Sharron Xuanren Wang. “Deconstructing Hyper-Selectivity: Are the Socioeconomic Attainments of Second-Generation Asian Americans Only Due to Their Class Background?” *Chinese Journal of Sociology* 7, no. 1 (January 2021): 3–21. https://doi.org/10.1177/2057150X20973802.

Schneider, Barbara, and David Stevenson. *The Ambitious Generation: America’s Teenagers, Motivated but Directionless*. New Haven, CT: Yale University Press, 1999.

Sewell, William H., Archibald O. Haller, and Alejandro Portes. “The Educational and Early Occupational Attainment Process.” *American Sociological Review* 34, no. 1 (1969): 82–92. https://doi.org/10.2307/2092789.

Shih, Margaret, Todd L. Pittinsky, and Nalini Ambady. “Stereotype Susceptibility: Identity Salience and Shifts in Quantitative Performance.” *Psychological Science* 10, no. 1 (January 1, 1999): 80–83. https://doi.org/10.1111/1467-9280.00111.

Sidanius, James, Shana Levin, Colette Van Laar, and David O. Sears. *The Diversity Challenge: Social Identity and Intergroup Relations on the College Campus*. New York: Russell Sage Foundation, 2008.

Simpson, Jacqueline C. “Segregated by Subject: Racial Differences in the Factors Influencing Academic Major between European Americans, Asian Americans, and African, Hispanic, and Native Americans.” *The Journal of Higher Education* 72, no. 1 (2001): 63–100. https://doi.org/10.2307/2649134.

Snyder, Thomas D., and Sally A. Dillow. *Digest of Education Statistics 2013. NCES 2015-011*. National Center for Education Statistics, 2015. http://eric.ed.gov/?id=ED556349.

Song, Chunyan, and Jennifer E. Glick. “College Attendance and Choice of College Majors among Asian-American Students.” *Social Science Quarterly* 85, no. 5 (December 1, 2004): 1401–21. https://doi.org/10.1111/j.0038-4941.2004.00283.x.

Sun, Yongmin. “The Academic Success of East-Asian–American Students—An Investment Model.” *Social Science Research* 27, no. 4 (December 1998): 432–56. https://doi.org/10.1006/ssre.1998.0629.

Tao, Vivienne Y. K., and Ying-yi Hong. “When Academic Achievement Is an Obligation: Perspectives From Social-Oriented Achievement Motivation.” *Journal of Cross-Cultural Psychology* 45, no. 1 (January 2014): 110–36. https://doi.org/10.1177/0022022113490072.

Thijs, Jochem, Maykel Verkuyten, and Petra Helmond. “A Further Examination of the Big-Fish–Little-Pond Effect: Perceived Position in Class, Class Size, and Gender Comparisons.” *Sociology of Education* 83, no. 4 (October 2010): 333–45. https://doi.org/10.1177/0038040710383521.

Torche, Florencia. “Is a College Degree Still the Great Equalizer? Intergenerational Mobility across Levels of Schooling in the United States.” *American Journal of Sociology* 117, no. 3 (November 2011): 763–807. https://doi.org/10.1086/661904.

Wang, Xueli. “Why Students Choose Stem Majors: Motivation, High School Learning, and Postsecondary Context of Support.” *American Educational Research Journal* 50, no. 5 (October 2013): 1081–1121. https://doi.org/10.3102/0002831213488622.

Weeden, Kim A., Dafna Gelbgiser, and Stephen L. Morgan. “Pipeline Dreams? Gender Differences in Occupational Plans and STEM Major Completion among a Recent Cohort of US College Entrants.” *Sociology of Education*, 2020.

Xie, Yu, and Alexandra Achen. “Science on the Decline? Educational Outcomes of Three Cohorts of Young Americans.” *Population Studies Center Research Report* 9, no. 684 (2009): 1–30.

Xie, Yu, and Kimberly Goyette. *A Demographic Portrait of Asian Americans*. New York: Russell Sage Foundation, 2004.

———. “Social Mobility and the Educational Choices of Asian Americans.” *Social Science Research* 32, no. 3 (September 1, 2003): 467–98. https://doi.org/10.1016/S0049-089X(03)00018-8.

Xie, Yu, and Alexandra A. Killewald. *Is American Science in Decline?* Cambridge, MA, and London, England: Harvard University Press, 2012.

Xie, Yu, and Kimberlee A. Shauman. *Women in Science: Career Processes and Outcomes*. Cambridge, MA, and London, England: Harvard University Press, 2003.