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Examining Sex and Ethnoracial Differences in Graduate School Enrollment

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Abstract

The study examines enrollment disparities in graduate education enrollment among students of differing sex and ethnoracial identities. In doing so, we analyze a national sample of students who successfully completed their undergraduate education to understand the individual and institutional factors that influence their likelihood of enrolling in graduate school within the first few years of finishing college. Results from our general model emphasized the importance of educational aspirations, academics, college involvement, and institutional metrics in understanding the propensity to enroll in graduate school. The results across sex and ethnoracial identity reveal the complexity of the graduate enrollment process, and the importance of understanding how individual and institutional factors operate across these demographic classifications.

Keywords: Graduate Degree Enrollment, Race/Ethnicity, Sex, ELS

EXAMINING SEX AND ETHNORACIAL DIFFERENCES IN GRADUATE SCHOOL ENROLLMENT

Along with income and occupation, education attainment is a fundamental determinant of an individual's socioeconomic status (SES), and is essential for understanding social mobility (Blau & Duncan, 1967; Haller & Portes, 1973; NAEP, 2012; Posselt & Grodsky, 2017). As the U.S. higher education system becomes increasingly accessible to larger numbers of students from more varied backgrounds, and as bachelor's degree completion rates have risen (Kena, et al., 2015), the attainment of a graduate-level education has become a more important indicator of status in the years following college. In fact, a master's degree is worth \$457,000 more than a bachelor's degree, on average, and the difference is even greater when comparing professional and doctoral degrees to bachelor's degrees (Carnevale, Smith, & Strohl, 2012). While the benefits of graduate degrees in relationship to labor market outcomes are well-documented, significant disparities exist in graduate enrollment by sex, race, and ethnicity (Allum & Okahana, 2015; Okahana, Feaster, & Allum, 2016). Understanding more about these gaps and why they exist represents an important social justice consideration. This problem is gaining critical importance based on the combined influence of two concomitant trends.

First, as recent reports by Carnevale (2016a, 2016b) highlight, ethnoracial disparities in undergraduate outcomes directly lead to disparities in access to graduate education, and that only after individuals attain a graduate degree do outcomes gaps converge in areas such as labor market success and earnings. Carnevale argues that the disproportionate concentration of ethnoracial minorities in open-access colleges, which spend considerably less per student and amass substantially lower graduation rates compared to the nation's most selective colleges and universities, fuels this phenomenon. However, empirical evidence is needed to both validate

these claims and to recommend ways to ameliorate those factors that contribute to ethnoracial- and sex-based disparities in graduate education.

Second, growth in graduate student enrollment is being driven by international students, fueled by the proliferating practice among U.S. colleges and universities to hire international recruitment agencies to expand and strengthen international markets of prospective graduate students (Goff & Snowden, 2015). These practices are institutional responses to concerns over declining domestic enrollments and highlight the need for a better understanding of college students' pathways into and through graduate education. While institutions have looked to new markets to attract students into graduate programs, we seek to identify factors that influence domestic students' likelihoods of enrolling in graduate and advanced professional programs, particularly as it relates to disparities across sex and ethnoracial classifications.

Study Rationale

The study examines enrollment disparities in graduate education among students of differing sex and ethnoracial identities. In so doing, we examine a national sample of students who successfully completed their undergraduate education to understand the individual and institutional factors that influence their likelihood of enrolling in graduate school. There are three key reasons why this study holds significance.

First, achieving a better understanding of students' pathways into graduate and advanced professional degree programs is a significant issue for the national economy. The 2012 *Pathways Through Graduate School and into Careers* report estimated that by 2018 the U.S. will be home to 2.5 million new jobs requiring an advanced degree (Wendler, Bridgeman, Markle, Cline, Bell, McAllister, & Kent, 2012), emphasizing that the U.S. workforce depends on the higher education system to produce enough individuals with advanced degrees (Goff & Snowden, 2015).

Second, education attainment, a critical determinant of socioeconomic status (SES), is essential for individual social mobility (Blau & Duncan, 1967; NAEP, 2012). As bachelor's degree completion rates have risen in recent years (Kena, et al., 2015), the attainment of a graduate degree has become a more important indicator of status in the years following college and an important mechanism whereby individuals positively differentiate themselves in the labor market. While variation exists by areas of study, graduate degree holders experience considerably lower unemployment and higher earnings relative to bachelor's degree holders (Carnevale, et al., 2012; Mayhew, Rockenbach, Bowman, Seifert, & Wolniak, 2016).

The third reason is rooted in social justice. The study is significant in that we know little about the intersection of students' backgrounds and their pathways into graduate education. Graduate school enrollment is not equally distributed across students from different backgrounds. For example, according to recent Council of Graduate Schools reports (Allum & Okahana, 2015; Okahana, et al., 2016), women remain underrepresented in science- and engineering-related fields. Ethnoracial disparities are also prevalent, where, among U.S. citizens and permanent residents, only one in four first-time fall 2015 graduate students were underrepresented minority students (including 12% Black/African American, and 10% Hispanic/Latino).

Together, these trends provide powerful rationale for inquiry into the factors associated with students' pathways into graduate education, particularly among traditionally underrepresented graduate student populations. We have designed this study specifically to address this problem by asking the following research questions:

Research Question 1. In what ways do students' ascribed characteristics, academic achievement, and educational experiences influence their propensity to enroll in graduate school, controlling for institutional and regional characteristics?

Research Question 2. To what extent does this influence of these factors differ by students' sex and/or ethnoracial identity? In other words are the factors that influence students' propensity to enroll in graduate school conditional on sex and/or ethnoracial identity?

Theory & Evidence

To study graduate education outcomes requires the synthesis of multiple theoretical perspectives. First, Breneman (1976) provided a useful foundation for understanding the Ph.D. production process that has proven influential to the study of graduate school outcomes. Breneman's model builds on aspects of human capital theory (Becker, 1993) while incorporating institutional dimensions such as control and quality. Central to graduate education production models is recognition of the differences in graduate education and the decision-making process by field of study. According to this framework, analytic models aimed at understanding aspects of the graduate education should incorporate measures that affect rates of return on the educational investment, including, most notably, student demographic characteristics (sex, race/ethnicity), field of study, and institutional characteristics.

Second, Weidman, Twale, and Stein's (2001) work on student socialization suggests that academic and career development are determined by knowledge and skill acquisition, as well as students' dispositions towards the graduate school experience. By highlighting student dispositions, Weidman's model reinforces the social-psychological perspective that places educational aspirations at the center of models depicting social mobility (Jencks, Crouse, & Mueser, 1983; Haller & Portes, 1973; Sewell, Haller, & Portes, 1969; Sewell & Hauser, 1980),

as well as higher education research on college choice and completion (Stage & Hosser, 1989; Wells, et al., 2011). From the perspective of social reproduction theory, lower educational aspirations are a key determinant of social and gender inequality (Alexander & Eckland, 1974; Kerckhoff, 1976). Other explanations point to the social capital students acquire from their family and community, as well as socioeconomic status (SES), to explain their educational aspirations, subsequent career choices, and additional education attainment (Reynolds & Burge, 2008).

Given our aims to uncover sex and ethnoracial differences in models of graduate enrollment, we were also motivated by the critical quantitative perspective (Stage, 2007), rooted in critical theory (Kincheloe & McLaren, 1994; Solorzano, 1997). The critical quantitative perspective builds upon the idea that researchers should use data to question and illuminate potential shortcomings of traditional theories and methods, rather than simply confirming them, particularly when past approaches may mask distinctions across segments of the population. With the present study we incorporate tenets of the critical quantitative perspective by examining sex- and ethnoracial-specific models.

Drawing on these broad conceptual relationships, the empirical evidence demonstrates the numerous factors that influence graduate education, which we review below and highlight studies that have demonstrated relationships between variables may differ by sex and ethnoracial identities. Specifically, these include students' ascribed characteristics, educational aspirations, undergraduate academic performance, and undergraduate institutional quality. Additionally, recent research indicates that the extent to which students engage with their undergraduate academic environment and the total amount of undergraduate loan debt they accrue may also play important roles in graduate school enrollment decisions.

Ascribed Factors

For decades, research has established that ascribed factors are important determinants of education attainment in general, and graduate school enrollment in particular (Horvat, 2001; Paulsen & St. John, 2002; Perna, 2004). However, within this broader understanding, there are complexities to consider with respect to academic discipline and the type of graduate education pursued (Ethington & Smart, 1986; Mullen, Goyette, & Soares, 2003; Perna, 2004). For example, women are currently enrolling in graduate school and attaining graduate degrees at a greater frequency than they were even as recently as 2000, but women are less likely than men to attend research universities, and they represent a smaller proportion of enrollments in doctoral and first-professional programs (Perna, 2004; Posselt, 2016). Women are also more likely to enroll in post-baccalaureate programs at the master's level or below (Perna, 2004). Gender gaps also exist in graduate disciplines pursued. While women are currently overrepresented in graduate biological science programs, they remain underrepresented in disciplines like physics, astronomy, and economics (Perez-Felkner, Nix, & Thomas, 2017; Posselt, 2016; Sax, 2001).

Considering race and ethnicity, Black/African American and Latino/a students are enrolling in higher numbers, but similar to women, disparities between master's and doctoral degree attainment are striking (Posselt, 2016). African American and Latino/a students received only 6 percent and 7 percent, respectively, of the doctorates awarded in 2010, despite comprising 13 percent and 16 percent of the United States population, respectively (Posselt, 2016). Native American doctoral degree attainment is also at its lowest point since the 1990s (Posselt, 2016).

Apart from race and gender, evidence further suggests that first-generation status, family resources, and family income can all be important predictors of graduate school enrollment. As to the former, Zhang (2005) found that first-generation students do not participate in graduate

education as frequently as their counterparts. Similar to women and those students underrepresented by race and ethnicity, even when first-generation students enroll in graduate school, there is a lower probability that they will enroll in doctoral programs or attend research universities (Zhang, 2005). These factors, in turn, are related to first-generation students earning less money in the labor market (Thomas & Zhang, 2001; Zhang, 2005).

Related to SES and family income, Ethington and Smart (1986) found that socioeconomic background does influence a student's decision to enroll in graduate school, specifically because that background influences undergraduate institution choice and the level of success of integrating into that institution. In other words, students from higher-SES backgrounds are more likely than their low-SES counterparts to attend more selective undergraduate institutions, and to more successfully engage academically and socially at those institutions, which then carries over to graduate school enrollment decisions (Ethington & Smart, 1986). These results are supported by Zhang (2005), who found that higher family income is positively associated with graduate school enrollment. However, it is notable that higher family income is negatively associated with doctoral program enrollment, possibly because those students are more likely to attend professional programs (Zhang, 2005).

Educational Aspirations

A student's aspirations to attend graduate school are meaningful because of the utility of aspirations in forecasting graduate school enrollment, and research has established that there is a pointed relationship between students' plans to enroll in graduate school and their actual enrollment (Eagan, et al., 2013; Heller, 2001; Mullen, et al., 2003; Xu, 2016). Xu's (2016) examination of a nationally representative sample of college graduates in STEM majors found aspirations to be a crucial factor in understanding degree attainment and eventual job status. The

influence of one's aspirations on their subsequent graduate education may also vary both in terms of ascribed background characteristics and achieved academic performance (Davis, Ameline, Hirt, & Miyazki's, 2012). For example, Black students generally demonstrate higher aspirations for graduate education than White students (Baum & O'Malley, 2003; Kaltenbaugh, St. John, & Starkey, 1999; St. John, Paulsen, & Carter, 2005), though there are important distinctions to understand regarding sex and other background variables. Chung, Loeb, and Gonzo (1996) found that Black college males had lower advanced educational aspirations than Black college females. They also found that those Black college students who valued career autonomy, who expected more community and political involvement, and who lacked personal or family financial resources were more likely to aspire for advanced education (Chung, et al., 1996).

Additionally, Walpole (2003) found that lower SES students were more likely to aspire to complete a master's degree while those from higher SES backgrounds were more likely to aspire to an advanced or professional degree such as a doctorate, and Xu (2016) determined that those from families of medium income levels were the least likely to aspire for graduate education. Interestingly, however, Xu observed no significant differences in the educational aspirations of people from wealthy and low-income families.

Academic Achievement

Undergraduate academic achievement, as measured by grade point average, has been demonstrated to correlate positively with graduate school enrollment (Hathaway, Nagda, & Gregerman, 2002; Mullen, et al., 2003). Students with higher undergraduate GPAs are significantly more likely to enroll in graduate programs and complete their degrees than are students with lower GPAs (Bedard & Herman, 2008; Sibulkin & Butler, 2015). Additionally,

Sibulkin and Butler (2015) found that GPA was not only the key predictor of graduate school enrollment but also the most powerful determinant of graduate school completion. What can be reasonably concluded, then, is that undergraduate academic performance, as measured by GPA, is an important and reliable means of gauging both graduate school aspirations and eventual graduate school enrollment.

Undergraduate Institution

The selectivity of one's undergraduate institutional has consistently been shown to be an important predictor of graduate school enrollment trends (Ethington & Smart, 1986; Mullen, et al., 2003). Zhang (2005) found that students who graduate from high-quality undergraduate institutions are more likely to enroll in graduate school, and that those who enroll are more likely to be enrolled in higher quality graduate schools, doctoral programs, and research institutions. Parenthetically, these students are also more likely to complete their graduate degrees within four to five years of college graduation. Similarly, Tinto (1980) and Ethington and Smart (1986) demonstrate the positive association between college quality and graduate school enrollment. Perna (2004) determined that an institution's Carnegie classification has an influence on enrollment in a first-professional degree program, especially for women. Moreover, students graduating from elite private undergraduate institutions are not only more likely to enroll in graduate school, but are more likely to do so at prominent research institutions (Eide, Brewer, & Ehrenberg, 1998).

Academic Engagement

Academic engagement has also been shown to exhibit a direct, positive effect on graduate school enrollment, particularly as the concept relates to integration into the academic and social community (Davis, et al., 2012; Hathaway, et al., 2002; Micari & Pazos, 2012). Tinto (1997)

established the important connections between positive formal and informal academic undergraduate experiences and a student's sense of academic integration. This integration, along with other variables, contributes to persistence and undergraduate degree completion, and also has a direct positive effect on graduate school enrollment (Hathaway, et al., 2002). Numerous factors contribute to whether a student experiences academic integration, but much of the literature has demonstrated that faculty-student interaction is perhaps the most important (Micari & Pazos, 2012; Hathaway, et al., 2002; Hearn, 1987; Ethington & Smart, 1986; Tinto, 1975; Umbach & Wawrzynski, 2005). This interaction can occur informally, such as when students connect with professors outside of class and receive encouragement, help, and advice about a variety of topics (Arrendondo, 1995; Davis, et al., 2012; Micari & Pazos, 2012; Pascarella, Terenzini, & Hibel, 1978).

As to formal indicators of engagement/integration, undergraduate research programs are gaining in prominence, not only for their relationship with improved student success outcomes, but also because they have been shown to contribute favorably to a student's sense of academic integration and propensity to enroll in graduate school (Hathaway, et al., 2002). Undergraduate students who demonstrate a commitment to the scientific process and to scientific inquiry are more likely to enroll in STEM graduate programs, and undergraduate research programs often help nurture that commitment (Hathaway, et. al, 2002; Sax, 2001). Participation in undergraduate research programs can be particularly meaningful for Students of Color in enhancing their science knowledge and comprehension, developing their science and research self-efficacy, and defining and realizing their graduate school plans (Adedokun, Bessenbacher, Parker, Kirkham, & Burgess, 2013; Chang, Sharkness, Hurtado, & Newman, 2014; Hurtado, Cabrera, Lin, Arellano, & Espinosa, 2009).

Additional Influences

Other variables known to influence educational and post-college career behavior include family characteristics, including marital status and dependent children (Alon, Donahoe, & Tienda, 2001; Becker, 1974), as well financial debt, though the evidence is mixed with respect to if, or how, financial constraints are associated with graduate school enrollment. For example, Malcolm and Dowd (2012) found that cumulative undergraduate debt has a negative influence on graduate school enrollment in the STEM fields, while Fox's (1992) and Weiler's (1991) results suggest that school debt does not clearly influence graduate education and that the direction of that influence is clear.

Conceptual Framework

As Ethington and Smart (1986), Zhang (2005), and other relevant studies have established, numerous factors are significant in predicting graduate school enrollment. Ascribed factors (Horvat, 2001; Paulsen & St. John, 2002; Perna, 2004), educational aspirations (Eagan, et al., 2013; Heller, 2001; Mullen, et al., 2003), academic achievement (Hathaway, et al., 2002; Mullen et al., 2003), undergraduate institution attended (Ethington & Smart, 1986; Mullen, et al., 2003), and academic engagement (Davis et al., 2012; Hathaway, et al., 2002; Micari & Pazos, 2012) have all been shown to play a significant role in the decision to attend graduate school. One's family and financial circumstances also influence educational and career decisions, such that marital status, dependent children, and overall debt represent important confounds that lack clear causal order in relation to graduate education. Taken together, these predictors of graduate school attendance provide an important framework for the current study in better understanding the graduate enrollment decisions of a representative sample of students who were seniors in high school in 2004. Additionally, these factors, when viewed examined through separate sex

and ethnoracial models, illuminate the complexities of graduate enrollment decisions and how these factors may facilitate or constrain the enrollment decisions of students across critical social identity characteristics. Figure 1 illustrates a conceptual framework for the factors influencing students' progression into graduate education.

[Figure 1]

Methods

Data

This study used data collected through the Education Longitudinal Study (ELS) of 2002, a survey research project funded by U.S. Department of Education designed to explore students' transitions from secondary school into postsecondary education and subsequently into the workforce. The third and final follow-up of the ELS occurred in 2012 when the average age of the sample population was 26. The third follow-up also included variables that measured graduate and labor market outcomes, including graduate school attendance. Additional information was provided through the Postsecondary Education Transcript Study (PETS), including college GPA and major.

Our analytic sample included students who participated in the first follow-up in 2004 (G12COHRT=1) through the third follow-up in 2012 (WEIGHT=F3F1PNLWT), and who completed their undergraduate education. The resultant sample consisted of 4,820 students (rounded to the nearest ten per NCES Restricted data guidelines) and a weighted sample of 1,065,031 respondents. Female students represented 55.3% of the sample, and the ethnoracial breakdown included the following: 72.7% White, 8.4% Black, 8.7% Hispanic, 6.4% Asian, and 3.8% multi-racial/other racial categories. Approximately 57% of the sample indicated graduate school aspirations during their senior year in high school (first follow-up in 2004) and 62% of

the sample indicated similar aspirations at the time of the second follow-up in 2006. The average standardized test score (based on the SAT or converted ACT scores) was 1081 and the average cumulative college grade point average was 3.22.

In terms of college major, 23.4% of the sample was social science majors, 17.3% STEM majors, 18.5% Business majors, 11.7% Arts/Humanities, 8.5% Health/Human Services majors, and 6.1% Education majors. Approximately 28% of the sample indicated they had no student debt at the time of the third follow-up, with 24% indicating debt at or below \$20,000, 21% between \$20,001 and \$40,000, 11% between \$40,001 and \$60,000, 7% between \$60,001 and \$80,000, and 9% greater than \$80,000. In addition, approximately 58% of the sample anticipated having student loans at the time of the second follow-up survey. Finally, 33.6% of the sample population was enrolled in graduate school at the time of the third follow-up survey (see Table 1 for descriptive statistics).

Measures

Dependent Variables. The dependent variable was participants' self-reported graduate enrollment, represented as a binary (0/1) variable with graduate enrollment assigned a value of 1.

Independent Variables. We used several independent variables in our analytical model, conceptualized as five variable groups, or blocks. First, we included a block of socio-demographic and precollege variables, including sex, race, SES, and students' high school senior year aspirations for future degree attainment. We dummy coded the sex and race variables, using males and White students as the referent groups. The SES measure was a standardized, composite variable created in the ELS dataset that included information on parent income, parent educational attainment, and parent occupational attainment. The educational aspiration variable was transformed into a set of five dummy codes corresponding to undecided, less than college, a

baccalaureate degree, a master's degree, and a doctoral degree, with the latter category serving as the referent group.

Our second block of variables included students' academic achievements and aspects of undergraduate involvement, including: highest standardized score on the SAT (or ACT converted score), college GPA, a college involvement index, and a variable capturing academic engagement. The SAT composite score was divided by 100 to ease the interpretation of model coefficients. Student's college GPA was based on the PETS college transcript data and was measured on a standard four-point scale. The college involvement index was comprised of five "high impact practices" (all binary yes/no variables), including the following: internships, co-ops, and field/teaching/clinical experiences; out-of-class research projects; study abroad; community-based projects; and culminating senior experiences or capstone projects. In order to create the index, we summated students' involvement across all five high impact practices. In addition, we utilized a single-item, Likert-type variable to capture how often students "talk with faculty about academic matters outside of class," which ranged from never, to sometimes, to often.

The third block of variables included students' college major as reported on their college transcript in the PETS data. We included a set of seven dummy-coded variables indicating college major categories (STEM, Social Science, Education, Business, Arts/Humanities, Health/Human Services, and Other Major) as well as a missing category indicator, using the Education category as the referent group (see the Appendix, Table A-1, for a description of the majors included within each category).

The final block of variables included institutional control and selectivity. We included a set of dummy variables for institutional control (public, private, for-profit, missing sector), using

public institutions as the referent group. Additionally, we utilized the Carnegie Classification system to create four dummy variables representing different levels of selectivity (highly selective, moderate, inclusive, unknown), with high selectivity as the referent group. In addition to the variables in these four blocks, we included additional controls for students who were married and had dependents (both were binary yes/no variables) at the time of the third follow-up survey. We also included a control for total accumulated loan debt at the time of the third follow-up survey based on a categorical variable that ranged from no student loan debt to loan debt greater than \$80,000.

[Table 1]

Analyses

To answer the study's research questions, we utilized descriptive and multivariate approaches. First, we began by conditioning the data, examining the frequency distributions and central tendencies of our categorical and continuous variables, respectively. In addition to variable transformations, we ran a missing data analysis that revealed that missing data did not exceed 10% for any one variable. We then employed a multiple imputation technique for missing data based on a fully conditional specification procedure that utilizes the Markov chain Monte Carlo (MCMC) iterative method (Li et al. 1991; Schafer 1997). We ran a total of five imputations and used the pooled results when reporting on multivariate analyses.

Next, we ran logistic regression models, using the complex samples module in SPSS, to examine the main and conditional effects of the different independent variables on graduate degree enrollment.

The modeling strategy took the following form:

$$\mathbf{Y} = a_0 + a_1\mathbf{X} + a_2\mathbf{A} + a_3\mathbf{M} + a_4\mathbf{I} + a_5\mathbf{C} + e, \quad (\text{Eq.1})$$

$$\mathbf{Y}_d = b_0 + b_1\mathbf{X}' + b_2\mathbf{A} + b_3\mathbf{M} + b_4\mathbf{I} + b_5\mathbf{C} + u, \quad (\text{Eq.2})$$

Where: \mathbf{Y} represents graduate enrollment; \mathbf{X} represents socio-demographic variables (i.e., sex, ethnoracial identities, and SES); \mathbf{A} represents academic and college involvement variables (i.e., standardized test score, college GPA, college involvement, and academic engagement); \mathbf{M} represents college major variables; \mathbf{I} represents institutional measures (i.e., institutional control and selectivity); and \mathbf{C} represents controls for marriage, dependents, and total accumulated loan debt).

To answer the first research question, we utilized logistic regression to regress each of the independent variable blocks on the graduate enrollment dependent variable (Eq. 1). To answer our second research question, we re-reran the model on sub-samples defined according to each individual's sex and ethnoracial identification. This provided a means to examine whether the influence of our independent variables were conditional on sex and/or ethnoracial identity. These sex- and ethnoracial-specific models are represented by Eq. 2, where the subscript " d " represents the different sex and ethnoracial groupings, and \mathbf{X}' is the vector of demographic variables, absent either sex (in the sex conditional models) or ethnoracial identification (in the ethnoracial conditional models).

Limitations

There were several notable important limitations to the study. First, the dependent variable, graduate enrollment, was captured during the third follow-up survey in 2012, and this only includes a period of approximately four years for students to have made graduate enrollment decisions. We recognize that students make decisions to continue their education

outside of this time period, and therefore the results can only be generalized to students who enroll in a graduate program within a relatively short period of time after earning their undergraduate degrees.

Second, we chose to examine graduate enrollment as a binary variable (graduate enrollment versus not) rather than as a categorical variable (master's, doctoral, etc.). We view a multinomial examination of different graduate school enrollment outcomes as an important direction for future research. However, given the lack of existing evidence that explains graduate enrollment, and particularly in terms of ethnoracial differences (e.g., Posselt & Grodsky, 2017), we have designed this study as a means of providing important initial evidence on the factors that influence students' likelihood of graduate school enrollment across sex and ethnoracial groups. We strongly encourage future inquiry to uncover if different models explain students' pathways into different types of graduate degree programs.

Third, the financial variable measuring total undergraduate loan volume was self-reported by students during the third follow-up survey. As such, the loan information was not adjudicated by any institutional or financial authorities and may be subject to error. However, we felt that given the research on the associations between loan accumulation and educational plans, it was important to include a measure of loan debt, even if it was a somewhat imperfect measure.

Fourth, as this study is based on secondary data analysis, we recognize that there may be other important variables, particularly variables that capture more nuanced aspects of a students' educational experience, that exert a significant influence on graduate enrollment. We did utilize the available college involvement and engagement information collected on the ELS survey, and this was important in capturing aspects of students' involvement in different high impact activities as well as their engagement with faculty outside of the classroom.

Fifth, although we did control for total accumulated loan debt, we chose to utilize this as a control variable in the model based on both the mixed results for student debt found in the literature and the interpretational challenges in utilizing a variable that accompanies two-way causality given that the measure represents all loan debt (both undergraduate and graduate loan debt). Finally, while we thought it was critical to investigate the conditional effects of our findings across sex and ethnoracial classifications, we recognize that these categories do not capture important differences that may occur within these larger classifications. Our hope is that future research can explore these models within more nuanced gender classifications or across the variations that occur within more omnibus ethnoracial classifications utilized by the ELS survey.

Results

General effects

We began our multivariate analyses by running a logistic regression model on the full sample. Our aim was to understand the influence on graduate school enrollment of students' ascribed background characteristics, educational aspirations, academic achievement, and a host of college experiences, such as college major, institutional characteristics, and debt load. We report parameter estimates (B) and Odds Ratios ($OR = \text{Exp}(B)$) for each independent variable. B represents the change in the log-odds of enrolling in graduate school associated with a one-unit change in an independent variable; we discuss estimates among continuous independent variables using this metric. Alternatively, an OR represents the factor change in the odds that a student enrolled in graduate school and is useful for interpreting the effects of belonging to one group versus a reference group for dichotomous variables. These results address Research Question 1 and are presented in Table 2.

[Table 2]

In examining students' ascribed background characteristics, two significant results were uncovered. First, holding constant all other variables in the model, Black students were approximately 1.5 times more likely than their White counterparts to report having enrolled in graduate school ($OR=1.572, p<0.01$). Second, the likelihood of enrolling in graduate school is significantly higher for students from higher socioeconomic backgrounds ($B=0.202, p<0.01$). While females appeared slightly more likely than males to enroll, the differences were not statistically significant.

Precollege educational aspirations yielded a strong and significant influence on graduate school enrollment, where the higher the student's educational aspirations prior to college, the more likely they were to eventually enroll in graduate school. In fact, students who aspired to complete a doctoral degree were significantly more likely to enroll than each of the other educational aspiration categories, with the greatest difference relative to those who aspired to less than a college degree ($OR=0.306, p<0.01$) or those who had uncertain aspirations ($OR=0.380, p<0.01$). Students' SAT composite scores were also associated with a significant and positive influence on graduate enrollment ($OR=1.097, p<0.01$). These results point to the lasting influence of early educational attitudes, even after taking into account a host of academic measures.

Academic achievement and forms of involvement proved to be strong predictors of a student's likelihood of graduate school enrollment. Specifically, having a higher college GPA was a particularly strong predictor of graduate enrollment ($B=1.061, p<0.01$). This result supports the notion that students who perform better in college are more probable applicants and better candidates for graduate school. Greater involvement during college outside of class in

such things as internships, research projects, and study abroad ($B=0.107, p<0.001$), as well as increased out-of-class academic contact with faculty ($B=0.134, p<0.05$), were both positively associated with graduate school enrollment.

College major was not largely predictive of graduate school enrollment. The only exception to this finding was among business majors who, relative to education majors, were significantly less likely to enroll ($OR=0.531, p<0.001$).

Finally, the characteristics of students' undergraduate institutions appear to influence the likelihoods of graduate school enrollment. Specifically, those who attended a private college or university were somewhat more likely than those who attended public institutions to subsequently pursue a graduate education ($OR=1.220, p<0.10$), whereas students who attended a for-profit college were nearly two-times more likely to enroll ($OR=1.748, p<0.05$). The selectivity of undergraduate institution also had a significant influence on subsequent graduate enrollment, though the direction of the relationship may be counter-intuitive; students who attended moderately selective ($OR=1.425, p<0.01$) and inclusive ($OR=1.511, p<0.05$) undergraduate institutions were more likely to enroll in graduate school than their counterparts from highly selective institutions.

Conditional effects

Our next set of results centered on understanding if and how our general model of graduate enrollment differed across sex and ethnoracial groups. This line of inquiry addressed our second research question. We re-ran the model on sub-samples defined according to each individual's sex and ethnoracial identification and utilized z -tests to detect differences between coefficients estimated from two independent samples ($B_i=B_j$), based on the formula

$z=(B_i - B_j)/[(SE_{B_i})^2 + (SE_{B_j})^2]^{1/2}$. See Clogg, Petkova, and Haritou (1995) for discussion and justification of this test.

Ethnoracial Identification

Table 3 presents the results from models estimated within each ethnoracial classification. In terms of overall model fit (based on Nagelkerke- R^2 as a proxy for the amount of variance accounted for by the variables in the model, but calculated using a log-likelihood function), values ranged from 0.263 for the White sub-sample, to 0.535 among the Multiracial/Other sub-sample, indicating the models performed comparatively better at explaining the likelihood of graduate enrollment among Multiracial/Other student than among White students. Each of the other groups fell within this range.

In terms of student background characteristics, the findings point to the intersectionality of individual identity groups. Recall that among the full sample, the general effects reported above showed that females and males did not significantly differ in their likelihood of enrolling in graduate school. However, our conditional models highlight that sex exerts a significant influence among Asian students, where females are 1.8 times more likely than their male counterparts to enroll in graduate school ($OR=1.823, p<0.05$). In addition, the significant positive general effect of SES discussed above appears to be driven primarily by White students ($B=0.251, p<0.01$); White students were the only group in which family SES affected the likelihood of graduate enrollment above and beyond the academic and other variables in the model.

The other precollege measures captured educational aspirations, for which we found the most consistent pattern of influence among White and Black students. Education aspirations appeared to have little influence on graduate enrollment among Asian and Hispanic students, and

no significant influence among Multiracial/Other students. In terms of pre-college academics achievement, we found SAT scores, the earliest measure of academic achievement in our model, to have a lasting and significant positive influence among Asian ($B=0.246, p<0.01$) and White ($B=0.087, p<0.10$) students.

Turning now to the college measures, undergraduate GPA was the most consistent predictor across ethnoracial groups. The only exception was found for Multiracial/Other students, for whom GPA did not have a significant influence.

The two measures of undergraduate engagement yielded interesting differences by ethnoracial identity. In particular, involvement outside of class had a significantly positive influence on the likelihood of graduate school enrollment only among Black ($B=0.428, p<0.01$) and Multiracial/Other ($B=0.643, p<0.05$) students, whereas faculty academic contact was significantly and positively associated with graduate enrollment only among White students ($B=0.203, p<0.01$) and negatively associated among Multiracial/Other students ($B=-1.470, p<.01$). The positive general effects we previously discussed appear highly conditional on ethnoracial identity.

In terms of undergraduate major, the general effect we uncovered indicated business majors were less likely to enroll in graduate school compared to education majors. This was largely replicated among each ethnoracial group, with the exception of Black and Multiracial/Other students, for whom the relationship was not statistically significant. Interestingly, undergraduate major appears to have the largest influence on graduate enrollment among Asian and Hispanic students – the most significant differences were found across undergraduate fields of study for these two student populations. In all instances where we found

significant differences, the results pointed to education majors being more likely to enter graduate school.

With respect to undergraduate institutions, each of the general effects reported above appeared conditional on ethnoracial identity. Specifically, attending a private (versus public) college or university significantly increased the likelihood of graduate enrollment among Asian ($OR=1.630, p<0.05$) and Black ($OR=2.114, p<0.01$) students, whereas attending a for-profit institution appeared to be a gateway to graduate school among Hispanic students ($OR=4.602, p<0.05$). In terms of the selectivity of undergraduate institution, White students were 1.6 times more likely to enter graduate school if they attended a moderately selective versus highly selective college ($OR=1.652, p<0.01$), whereas Hispanic students were less likely—only 0.4 times as likely—to enroll in graduate school ($OR=0.426, p<0.10$). For Asian students, attending an inclusive (versus highly selective) undergraduate institution led them to be 3 times more likely to subsequently enroll in a graduate program ($OR=3.061, p<0.01$).

[Table 3]

Sex

Turning attention to the estimated effects among female and male sub-groups, several findings emerged (see Table 4). The sex-specific models were somewhat similar at explaining the overall likelihood of graduate school enrollment (Nagelkerke- $R^2 = 0.310$ and 0.271 for female and male subsamples, respectively). Looking beyond model fit, several differences emerged.

When examining the influence of ascribed background characteristics, the general effect uncovered between Black and White students was consistent for both sex-specific models, while the positive general effect of SES appeared only among female students; for females, stemming from a higher SES household significantly increased the likelihood of subsequent graduate

school enrollment ($B=0.211, p<0.05$). For the measures of precollege educational aspirations, a similar pattern of influence on graduate enrollment was found for both sexes, with slightly more pronounced associations among females. However, when examining students' composite SAT scores, we uncovered a more significant relationship for males ($OR=1.131, p<0.05$) versus females ($OR=1.085, p<0.10$), although higher composite SAT scores were associated with increased odds of graduate enrollment for both sexes.

Across the undergraduate academic measures, the significant general effects we reported for college involvement and faculty academic engagement were more evident among the male sample ($B=0.171, p<0.01$; $B=0.251, p<0.05$, respectively). Alternatively, the only statistically significant influence of undergraduate major on the likelihood of graduate enrollment appeared among females, where, versus education majors, those who studied business ($OR=0.364, p<0.01$) or arts and humanities ($OR=0.613, p<0.10$) were less likely to enroll.

Sex differences were associated with the type undergraduate institution attended and institutional selectivity. Attending a for-profit school, for instance, was a catalyst to graduate school only among females ($OR=3.711, p<0.01$). Institutional selectivity also yielded a somewhat stronger influence on graduate enrollment among females, mirroring the general effects previously discussed.

[Table 4]

Discussion

The study explored the factors associated with graduate school enrollment within the first few years of college graduation, with a particular focus on the extent to which these factors differ by students' sex and ethnoracial identities. In response to the changing landscape of higher education in the U.S., where access is expanding among students from more varied backgrounds

and where graduate education is increasingly important predictor of later status attainment (Carnevale, et al., 2012; Kena, et al., 2015), we sought new empirical evidence on how students' socio-demographic and educational backgrounds influence their likelihoods of enrolling in graduate school. Given reports illustrating gaps in graduate enrollment by sex and race/ethnicity (Allum & Okahana, 2015; Okahana, et al., 2016), an improved understanding of the background characteristics and undergraduate experiences that affect graduate school enrollment is an important step towards identifying empirically-based strategies for reducing inequality by broadening the pipeline to graduate school.

Drawing on nationally representative ELS data that longitudinally followed students into and through college, and captured data on such things as careers and graduate school attainment within the first few years of undergraduate completion, our analyses addressed two research questions. The first question examined factors that influence graduate school enrollment. The second research question examined the conditionality of the factors influencing graduate enrollment based on students' sex and ethnoracial identities. Our results point to several key findings.

First, students' sex and ethnoracial identities, with few exceptions, did not significantly influence the odds of graduate enrollment within the first few years of finishing college. As others have observed (e.g., Posselt, 2016), college educated women are, on average, enrolling in graduate programs at higher rates than men. The most recent wave of ELS data, specifically the analytic sample we have examined for the present study, attests to this trend: within the first few years of completing college, rates of graduate enrollment were 36.5% among women versus 30.0% among men. However, once we accounted for ethnoracial identity, SES, a host of undergraduate academic and institutional characteristics, and controlled for other factors such as

marital status and having dependent children, we found no significant difference between women and men in their likelihoods of entering graduate school. Moreover, when we estimated our models independently among only females and only males, few differences appeared, suggesting the factors that predict graduate enrollment are only marginally conditional on sex. One conclusion to draw from this finding is that the overall higher rates of women entering graduate programs is accounted for (can be explained by) other aspects of their backgrounds, educational aspirations, academics performance and decision-making, such as what to study, where to attend college, and level of engagement. Such factors may in fact mediate the relationship between sex and graduate enrollment, providing an important area for future inquiry. In addition, we found some evidence of the intersectionality of identities: among Asian students, females were significantly more likely to enroll in graduate school, even after controlling for all the factors previously mentioned.

In terms of ethnoracial differences, we found no significant difference in the odds of entering graduate school, with one exception. After controlling for all other variables in the model, Black students were significantly more likely to have enrolled in a graduate program than other students. While the overall averages show Asian American students entering graduate school at the highest rates, similar to results for females discussed above, this advantage was accounted for by the other variables in the model. For Black students, however, their ethnoracial identity maintained its predictive significance even after accounting for the influence of a host of other variables.

Second, SES and precollege educational aspirations are key variables in models of status attainment (Ethington & Smart, 1986; Haller & Portes, 1973; Walpole, 2003) and appear to be the most deterministic influence of graduate enrollment among the background characteristics

we examined. Our general effects models, in the presence of all other variables we examined, showed that students from higher SES backgrounds were significantly more likely to have enrolled in graduate school. Similarly, the higher a student's education aspirations prior to college, the more likely she/he entered a graduate program within the first few years of completing college. However, these findings proved conditional on ethnoracial identities; our results suggest that the long-term influence of students' precollege SES operates only among White students. Among all other ethnoracial groups, SES failed to have a significant influence on graduate enrollment. Precollege educational aspirations, while still yielding a significant influence, followed the most consistent association with graduate enrollment among White students.

On the one hand, the pervasive influence of these early status measures (SES as a direct measure of status and educational aspirations as psychological measure of one's hope to achieve status via education) signals the challenges the higher education system faces in terms of reducing social inequality. On the other hand, the fact that students' ascribed SES did not ultimately determine the graduate propensities of non-White students may point to the merits of the higher education system to provide students with an avenue for social mobility in which academic achievement and experiences outweigh the influence of pre-college social status.

Our third key finding is that early and sustained academic achievement, as well as involvement during college, matter in terms of graduate enrollment. Accounting for students entering academic achievements (based on SAT composite or converted ACT scores), the results show positive associations between achieving higher college GPAs, being more involved (based on our scaled measure of students' reported college participation in internships, research projects, student abroad, and other "high impact" experiences), and having out-of-class contact

with faculty regarding academic issues. The results we uncovered for college GPAs mirrors the findings from past studies that have shown college grades to be a positive and strong determinant of graduate school enrollment (Bedard & Herman, 2008; Sibulkin & Butler, 2015). In addition, given the similarities between our measures of undergraduate involvement and notions of integration examined in past studies, our results complement those of Hathaway, et al. (2002) and others who have highlighted the positive influence of faculty-student interaction (Micari & Pazos, 2012; Hearn, 1987; Ethington & Smart, 1986; Umbach & Wawrzynski, 2005).

Interestingly, whereas the positive influence of college GPAs extended across nearly all ethnoracial groups, college involvement proved most advantageous for Black and multiracial students, and faculty academic contact for White students. Because these measures captured information on having participated in an activity and not on the quality of the experience, the results do not indicate that a given form of college involvement may influence graduate school outcomes positively for some but not all students. The results most likely reflect differences in students' propensities to seek certain activities. For example, White students may be more inclined to seek time outside of class to discuss academics with a faculty member. A key takeaway is the general positive influence of involvement during college on graduate school enrollment, and the importance of ensuring easy access to a host of undergraduate activities, along with encouraging all students to get involved beyond the classroom.

The fourth key finding pertains to students' undergraduate majors. We found relatively few significant effects of college major on subsequent graduate enrollment, with the exception of business (versus education) majors; business majors were significantly less likely to enter graduate school in the years immediately following college, possibly due to relatively higher opportunity costs for those with higher paying jobs. While no other differences were found

among the other undergraduate major categories, a handful of differences were uncovered across ethnoracial groups, consistently showing majoring in education as a distinctly positive determinant of graduate enrollment. Embedded within these findings is an interesting lack of differences in the influence of majoring in a STEM field (versus education) among females and well as males. In short, controlling for all other variables in the model, the influence of college major on a student's likelihood of enrolling in graduate school appears not to be conditional on sex. This finding provides a somewhat different perspective from disaggregated studies, which have shown that women are overrepresented in graduate biological science programs and underrepresented in disciplines like physics, astronomy, and economics (Perez-Felkner, Nix, & Thomas, 2017; Posselt, 2016; Sax, 2001).

The final finding points to the influence associated with attending different types of undergraduate institutions. Unlike students' choice of major, the kind of institution attended has an important and sizable, though possibly counterintuitive, influence on graduate education. Our results suggest that attending a for-profit (versus public) institution and attending a less selective institution significantly increases one's likelihood of enrolling in graduate school within the first few years of college graduation. Moreover, these findings appear conditional on sex and ethnoracial identity. The associations between institutional control, selectivity, and graduate enrollment were found among females but not males. Additionally, attending a for-profit college distinctly increases the odds of graduate enrollment among Hispanic students, while the effect of attending a less selective institution was apparent among Asian and White students.

It may be that an undergraduate education from a for-profit and/or less-selective institution serves to push some students into graduate school, possibly to strengthen labor market ties or to gain additional skills. This finding runs counter to past studies: Ethington and Smart

(1986), Mullen, et al. (2003), Zang (2005), Tinto (1980) and Eide, et al. (1998) have all shown the selectivity of one's undergraduate institution to be an important predictor of graduate school enrollment. We know of no previous study that has suggested graduate school motivations for students from different undergraduate institutions, making our explanation of these findings merely speculative. However, Carnevale (2016a, 2016b) has suggested that less selective, open-access colleges educate disproportionate shares of ethnoracial minorities, and that resource and graduation rate disparities between highly selective and less selective institutions is partly to blame for graduate education disparities. Because our sample comprised only of individuals who had completed a bachelor's degree, our findings may speak more to differences in labor market opportunities (that may drive students to seek a graduate degrees) than educational quality differences across undergraduate institutions.

Conclusion

Given the importance of education attainment in securing socioeconomic status, the importance of advanced degrees in maintaining a highly skilled labor force, and the relatively little previous research on the intersection of students' backgrounds and their pathways into graduate education, the study provides important new research to the extant literature. Future studies should continue to unpack differences across important social identity characteristics, as an intersectional approach provides the type of nuance that is necessary in developing more inclusive policies and practices that promote graduate enrollment. Future studies should also examine a fuller range of undergraduate curricular and co-curricular involvement, and more attention is needed in disaggregating undergraduate and graduate loan debt to gain a clear understanding of how undergraduate loan debt may impede or facilitate later educational decisions to attend graduate school. This study, along with those reviewed, provides an important

impetus for researchers to continue examining disparities in access throughout the educational pipeline in order to advance educational equity for all students.

References

- Adedokun, O. A., Bessenbacher, A. B., Parker, L. C., Kirkham, L. L., & Burgess, W. D. (2013). Research skills and STEM undergraduate research students' aspirations for research careers: Mediating effects of research self-efficacy. *Journal of Research in Science Teaching, 50*(8), 940-951.
- Alexander, K. L., Eckland, B. K. (1974). Sex differences in the educational attainment process. *American Sociological Review, 39*, 668–682.
- Allum, J., Okahana, H. (2015). *Graduate enrollment and degrees: 2004 to 2014*. Washington, DC: Council of Graduate Schools.
- Alon, S., Donahoe, D., & Tienda, M. (2001). The effects of early work experience on young women's labor force attachment. *Social Forces, 79*, 1005-1034.
- Arrendondo, M. (1995, November). *Faculty-student interaction: Uncovering the types of interactions that raise undergraduate degree aspirations*. Paper presented at the Association for the Study of Higher Education, Orlando, FL. (ERIC Document Reproduction Service No. ED 391423).
- Baum, S., & O'Malley, M. (2003). College on credit: How borrowers perceive their education debt. *Journal of student financial aid, 33*(3), 1.
- Becker, G. S. (1974). A Theory of Marriage. In T.W. Schultz (Ed.), *Economics of the Family*. Chicago, IL: University of Chicago Press.
- Becker, G. S. (1993). *Human capital: A theoretical and empirical analysis with special reference to education* (3rd Ed.). University of Chicago Press, Chicago.
- Bedard, K., & Herman, D. A. (2008). Who goes to graduate/professional school? The importance of economic fluctuations, undergraduate field, and ability. *Economics of Education Review, 27*(2), 197-210.
- Blau, P., & Duncan, O. D. (1967). *The American Occupational Structure*. New York, NY: John Wiley & Sons.
- Breneman, D. W. (1976). The Ph.D. production process. In: J. T. Fromkin, D. T. Jamison, R. Radner (Eds.), *Education as an industry* (pp. 1-52). Ballinger, Cambridge, MA.
- Carnevale, A. (2016a, December 7). White flight is creating a separate and unequal system of higher education. *Washington Post*. Retrieved from https://www.washingtonpost.com/news/grade-point/wp/2016/12/07/white-flight-is-creating-a-separate-and-unequal-system-of-higher-education/?utm_term=.598c698ffc2a.

- Carnevale, A. (2016b, December 8). American higher education is far more effective at helping white students achieve their potential than black and Latino students. [Weblog post]. Retrieved <https://www.linkedin.com/pulse/american-higher-education-far-more-effective-helping-white-carnevale>.
- Carnevale, A.P., Cheah, B., Strohl, J., 2012. Hard times: College majors, unemployment and earnings: Not all college degrees are created equal. Available online at: https://repository.library.georgetown.edu/bitstream/handle/10822/559308/Unemployment_Final.update1.pdf?sequence=1.
- Chang, M. J., Sharkness, J., Hurtado, S., & Newman, C. B. (2014). What matters in college for retaining aspiring scientists and engineers from underrepresented racial groups. *Journal of Research in Science Teaching*, 51(5), 555-580.
- Chung, Y. B., Loeb, J. W., & Gonzo, S. T. (1996). Factors predicting the educational and career aspirations of Black college freshmen. *Journal of Career Development*, 23(2), 127-135.
- Clogg, C. C., Petkova, E., & Haritou, A. (1995). Statistical methods for comparing regression coefficients between models. *American Journal of Sociology*, 100(5), 1261-1293.
- Davis, S. D., Amelink, C., Hirt, J. B., & Miyazaki, Y. (2012). Women's educational opportunities: Factors that influence their graduate school aspirations. *NASPA Journal about Women in Higher Education*, 5(2), 141-165.
- Eagan Jr., M. K., Hurtado, S., Chang, M. J., Garcia, G. A., Herrera, F. A., & Garibay, J. C. (2013). Making a difference in science education: the impact of undergraduate research programs. *American Educational Research Journal*, 50(4), 683-713.
- Eide, E., Brewer, D. J., & Ehrenberg, R. G. (1998). Does it pay to attend an elite private college? Evidence on the effects of undergraduate college quality on graduate school attendance. *Economics of Education Review* 17, 371-376.
- Ethington, C., and Smart, J. (1986). Persistence to graduate education. *Research in Higher Education*, 24, 287-303.
- Fox, M. F. (1992). Student debt and enrollment in graduate and professional school. *Applied Economics*, 24, 669-677.
- Goff, J., & Snowden, M. (2015). Emerging SEM organizations for graduate and international students. In B. Bontrager et al. (Eds.), *Handbook of strategic enrollment management* (pp. 508-520). San Francisco, CA: Jossey-Bass.
- Hathaway, R.S., Nagda, B.A., & Gregerman, S.R. (2002). The relationship of undergraduate research participation to graduate and professional education pursuit: An empirical study. *Journal of College Student Development*, 43, 614-631.
- Haller, A. O., & Portes, A. (1973). Status attainment processes. *Sociology of Education*, 51-91.

- Hearn, J. C. (1987). Impacts of undergraduate experiences on aspirations and plans for graduate and professional education. *Research in Higher Education* 27, 119-141.
- Heller, D. E., 2001. Debts and Decisions: Student Loans and Their Relationship to Graduate School and Career Choice. *Lumina Foundation for Education, New Agenda Series* 3.
- Horvat, E.M. (2001). Understanding equity and access in higher education: The potential contribution of Pierre Bourdieu. In J.C. Smart (ed.), *Higher Education: Handbook of Theory and Research* (Vol. 16, pp. 158–171). New York: Agathon Press.
- Hurtado, S., Cabrera, N. L., Lin, M. H., Arellano, L., & Espinosa, L. L. (2009). Diversifying science: Underrepresented student experiences in structured research programs. *Research in Higher Education*, 50(2), 189-214.
- Jencks, C., Crouse, J., & Mueser, P. (1983). The Wisconsin model of status attainment: A national replication with improved measures of ability and aspiration. *Sociology of Education*, 3-19.
- Kaltenbaugh, L. S., St John, E. P., & Starkey, J. B. (1999). What Difference Does Tuition Make? An Analysis of Ethnic Differences in Persistence. *Journal of Student Financial Aid*, 29(2), 21-31.
- Kena, G., Musu-Gillette, L., Robinson, J., Wang, X., Rathbun, A., Zhang, J., Wilkinson-Flicker, S., Barmer, A., and Dunlop Velez, E., (2015). *The Condition of Education 2015* (NCES 2015-144). U.S. Department of Education, National Center for Education Statistics, Washington. <http://nces.ed.gov/pubsearch>.
- Kerckhoff, A. C. (1976). The status attainment process: socialization or allocation? *Social Forces* 55, 368–381.
- Kincheloe, J. L., & McLaren, P. L. (1994). Rethinking critical theory and qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 138-157). Thousand Oaks, CA; Sage.
- Malcolm, L. E., & Dowd, A. C. (2012). The impact of undergraduate debt on the graduate school enrollment of STEM baccalaureates. *The Review of Higher Education*, 35(2), 265-305.
- Mayhew, M.J., Rockenbach, A.N., Bowman, N.A., Seifert, T.A., & Wolniak, G.C. (2016). *How college affects students: 21st century evidence that higher education works* (Vol. 3). Jossey-Bass, San Francisco.
- Micari, M., & Pazos, P. (2012). Connecting to the professor: Impact of the student–faculty relationship in a highly challenging course. *College Teaching*, 60(2), 41-47.
- Mullen, A. L., Goyette, K.A., & Soares, J.A. (2003). Who Goes to Graduate School? Social and Academic Correlates of Educational Continuation after College. *Sociology of Education*, 76, 143-169.

- National Assessment of Educational Progress (NAEP), 2012. Improving the Measurement of Socioeconomic Status for the National Assessment of Educational Progress: A theoretical foundation. National Center for Education Statistics, Washington.
https://nces.ed.gov/nationsreportcard/pdf/researchcenter/Socioeconomic_Factors.pdf.
- Okahana, H., Feaster, K., & Allum, J., 2016. Graduate enrollment and degrees: 2005 to 2015. Council of Graduate Schools, Washington.
- Pascarella, E. T., Terenzini, P. T., & Hibel, J. (1978). Student–faculty interactional settings and their relationship to predicted academic performance. *Journal of Higher Education*, 49, 450–463.
- Paulsen, M. B., & St John, E. P. (2002). Social class and college costs: Examining the financial nexus between college choice and persistence. *The Journal of Higher Education*, 73(2), 189-236.
- Perez-Felkner, L., Nix, S., & Thomas, K. (2017). Gendered pathways: How mathematics ability beliefs shape secondary and postsecondary course and degree field choices. *Frontiers in Psychology*, 8(386).
- Perna, L.W. (2004). Understanding the decision to enroll in graduate school: Sex and racial/ethnic group differences. *Journal of Higher Education* 75, 487-527.
- Posselt, J. R. (2016). *Inside graduate admissions: Merit, diversity, and faculty gatekeeping*. Harvard University Press.
- Posselt, J. R., & Grodsky, E. (2017). Graduate Education and Social Stratification. *Annual Review of Sociology*, 43, 353-378.
- Reynolds, J. R., & Burge, S. W. (2008). Educational expectations and the rise in women’s post-secondary attainments. *Social Science Research* 37, 485–499
- Sax, L. J. (2001). Undergraduate science majors: Gender differences in who goes to graduate school. *The Review of Higher Education*, 24(2), 153-172.
- Sewell, W. H., Haller, A. O., & Portes, A. (1969). The educational and early occupational attainment process. *American Sociological Review*, 34, 82–92.
- Sewell, W. H., & Hauser, R. M. (1980). The Wisconsin longitudinal study of social and psychological factors in aspirations and achievements. *Research in Sociology of Education and Socialization*, 1, 59–99.
- Sibulkin, A. E., & Butler, J. S. (2005). Differences in graduation rates between young black and white college students: Effect of entry into parenthood and historically black universities. *Research in Higher Education*, 46(3), 327-348.

- Solorzano, D. (1997). Images and words that wound: Critical race theory, racial stereotyping, and teacher education. *Teacher Education Quarterly*, 24, 5-19.
- St. John, E. P., Paulsen, M. B., & Carter, D. F. (2005). Diversity, college costs, and postsecondary opportunity: An examination of the financial nexus between college choice and persistence for African Americans and Whites. *The Journal of Higher Education*, 76(5), 545-569.
- Stage, F. K. (2007). Answering critical questions using quantitative data. *New Directions for Higher Education*, 133, 5-16.
- Stage, F. K., & Hossler, D. (1989). Differences in family influences on college attendance plans for male and female ninth graders. *Research in Higher Education*, 30, 301-315.
- Thomas, S., and Zhang, L. (2001). Post Baccalaureate Wage Growth within Four Years of Graduation: The Effects of College Major, Quality, and Performance. Paper presented at the 2002 Annual Meeting of Association for the Study of Higher Education, Richmond, VA.
- Tinto, V. (1975). Dropout from higher education: A theoretical synthesis of recent research. *Review of educational research*, 45(1), 89-125.
- Tinto, V. (1980). College Origins and Patterns of Status Attainment: Schooling Among Professional Andbusiness-Managerial Occupations. *Sociology of work and occupations*, 7(4), 457-486.
- Tinto, V. (1997). Classrooms as communities: Exploring the educational character of student persistence. *The Journal of higher education*, 68(6), 599-623.
- Umbach, P. D., & Wawrzynski, M. R. (2005). Faculty do matter: The role of college faculty in student learning and engagement. *Research in Higher Education* 46, 153-184.
- Walpole, M., (2003). Socioeconomic status and college: How SES affects college experiences and outcomes. *The Review of Higher Education* 27, 45-73.
- Weiler, W. C. (1991). The effect of undergraduate student loans on the decision to pursue post-baccalaureate study. *Educational Evaluation and Policy Analysis*, 13, 212-220.
- Weidman, J. C., Twale, D. J., & Stein, E. L. (2001). *Socialization of graduate and professional students in higher education: A perilous passage?* ASHE-ERIC Higher Education Reports 28, Issue 3. San Francisco: Jossey-Bass.
- Wells, R. S., Lynch, C. M., & Seifert, T. A. (2011). Methodological options and their implications: An example using secondary data to analyze Latino educational expectations. *Research in Higher Education*, 52, 693-716.

- Wendler, C., Bridgeman, B., Markle, R., Cline, F., Bell, N., McAllister, P., & Kent, J. (2012). *Pathways Through Graduate School and Into Careers*. Princeton, NJ: Educational Testing Service.
- Xu, Y.J. (2016). Aspirations and application for graduate education: Gender differences in low-participation STEM disciplines. *Research in Higher Education*. Online first, available at: <http://link.springer.com/article/10.1007%2Fs11162-016-9411-5>.
- Zhang, L. (2005). Advance to graduate education: The effect of college quality and undergraduate majors. *The Review of Higher Education*, 28(3), 313-338.

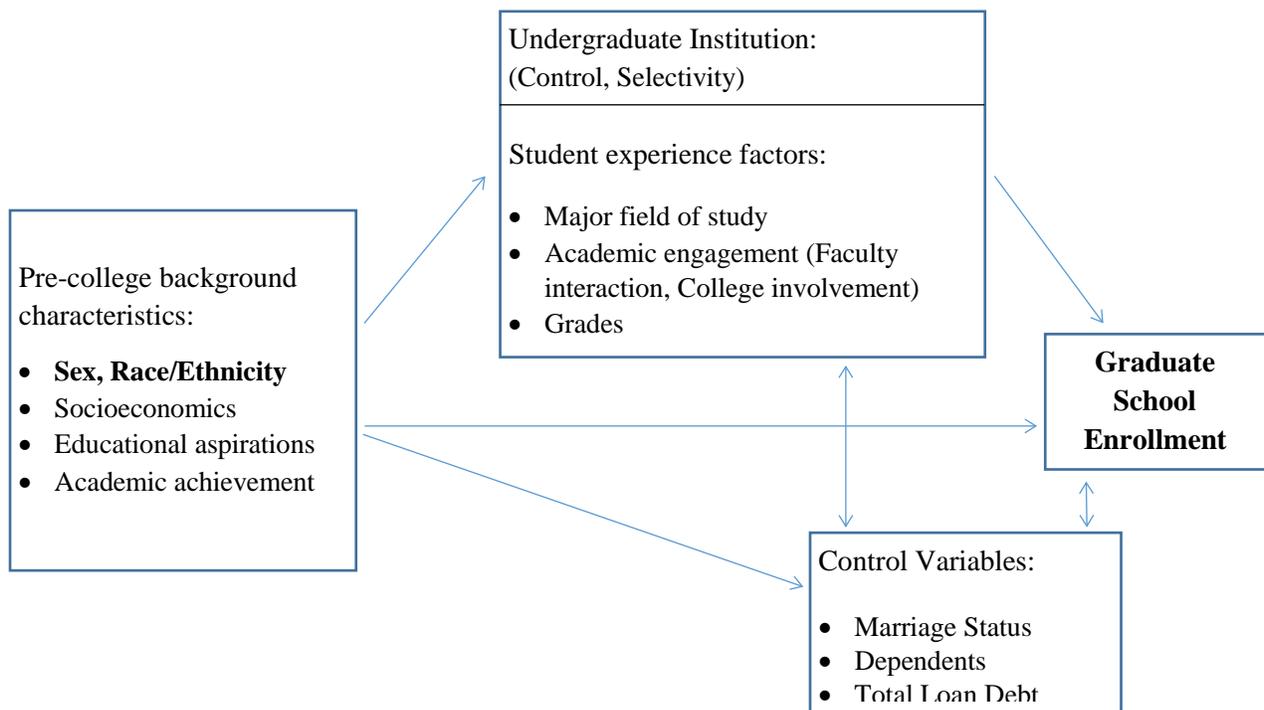


Figure 1. Conceptual framework: Evidence-based factors influencing graduate school enrollment

Table 1. Descriptive Statistics of Study Variables

	Min	Max	Mean	SE
Ascribed Characteristics				
Male	0	1	0.447	0.010
Female	0	1	0.553	0.010
Asian	0	1	0.064	0.005
Black	0	1	0.084	0.007
Hispanic	0	1	0.087	0.006
White	0	1	0.727	0.011
Multiracial / Other	0	1	0.038	0.004
SES	-2.12	1.87	0.385	0.018
Precollege Educational Aspirations and Academic Achievement				
Less than college	0	1	0.029	0.003
BA	0	1	0.375	0.009
MA	0	1	0.360	0.009
Doctorate	0	1	0.210	0.007
Undecided	0	1	0.027	0.003
SAT Composite	4.20	16.00	10.807	0.044
College Grades and Experiences				
GPA	2.00	4.00	3.224	0.009
College Involvement Index	0	5	1.705	0.022
Faculty Academic Contact	1	3	2.144	0.010
Major: STEM	0	1	0.173	0.007
Major: Social Science	0	1	0.234	0.008
Major: Education	0	1	0.061	0.004
Major: Business	0	1	0.185	0.007
Major: Arts & Humanities	0	1	0.116	0.006
Major: Health & Human Services	0	1	0.085	0.005
Major: Other	0	1	0.069	0.005
Major: Missing	0	1	0.077	0.005

Table 1. *Continued.*

College Type: Private	0	1	0.650	0.010
College Type: Public	0	1	0.301	0.010
College Type: For-profit	0	1	0.044	0.004
College Selectivity: Highly Selective	0	1	0.317	0.010
College Selectivity: Moderate	0	1	0.426	0.010
College Selectivity: Inclusive	0	1	0.106	0.006
College Selectivity: Other	0	1	0.151	0.006
Control Variables				
Married	0	1	0.272	0.009
Dependents	0	1	0.124	0.007
Student Debt: \$0	0	1	0.282	0.009
Student Debt: \$1-\$20,000	0	1	0.240	0.008
Student Debt: \$20,001-\$40,000	0	1	0.211	0.007
Student Debt: \$40,001-\$60,000	0	1	0.107	0.006
Student Debt: \$60,001-\$80,000	0	1	0.068	0.004
Student Debt: \$80,001 or greater	0	1	0.092	0.005
Unweighted $N = 4,820$				
Weighted $N = 1,065,030$				

SOURCE: ELS 2002 Restricted Dataset.

Table 2. Estimated General Effects Predicting Graduate Degree Enrollment

	<i>B</i>	<i>OR</i>	<i>SE</i>	
Ascribed Characteristics				
Female	0.141	1.151	0.094	
Asian	0.077	1.080	0.113	
Black	0.453	1.572	0.165	**
Hispanic	-0.026	0.975	0.157	
Multiracial / Other	0.076	1.079	0.237	
SES	0.202	1.223	0.071	**
Precollege Aspirations & Academics				
Undecided	-0.967	0.380	0.336	**
Less than college	-1.185	0.306	0.364	**
BA	-0.831	0.436	0.120	***
MA	-0.464	0.628	0.103	***
SAT Composite	0.093	1.097	0.035	**
College Grades & Involvement				
GPA	1.061	2.891	0.101	***
College Involvement Index	0.107	1.113	0.036	**
Faculty Academic Contact	0.134	1.144	0.068	*
Undergraduate Major				
STEM	0.192	1.211	0.197	
Social Science	0.048	1.049	0.203	
Business	-0.633	0.531	0.212	**
Arts & Humanities	-0.364	0.695	0.224	
Health & Human Services	-0.306	0.736	0.221	
Other	-0.183	0.833	0.243	
Undergraduate Institution				
Private	0.199	1.220	0.104	+
For-profit	0.558	1.748	0.262	*

Table 2. *Continued*

Selectivity, Moderate	0.354	1.425	0.119 **
Selectivity, Inclusive	0.413	1.511	0.165 *
Model Fit (<i>Nagelkerke-R</i> ²) = 0.278			
Unweighted <i>N</i> = 4,820			
Weighted <i>N</i> = 1,065,030			

SOURCE: ELS 2002 Restricted Dataset.

NOTES: “*OR*” represents estimated Odds Ratios (*Exp(B)*). Reference categories are Race/Ethnicity: White=0; Ed Aspirations: Doctoral Degree=0; Major: Education=0; College Selectivity: High=0. Additional variables for “Missing” major, “Other” selectivity and controls for marital status, number of dependents, and total accumulated loan debt were included in the model but not shown in the table. ⁺*p*<0.10; **p*<0.05; ***p*<0.01 ****p*<0.001.

Table 3. Estimated Effects Predicting Graduate Degree Enrollment by Ethnoracial Identity

		Asian		Black		Hispanic		White		Multiracial/ Other	
Ascribed Characteristics											
Female	<i>B</i> =	0.601	<i>*w,m</i>	0.249		0.494	<i>m</i>	0.092	<i>a</i>	-0.821	<i>a,h</i>
	<i>OR</i> =	1.823		1.283		1.639		1.096		0.440	
SES	<i>B</i> =	0.008		0.032		-0.016		0.251	**	-0.019	
	<i>OR</i> =	1.008		1.033		0.984		1.285		0.982	
Precollege Aspirations & Academics											
Undecided	<i>B</i> =	-0.292	<i>b,h</i>	-3.215	<i>*a,w</i>	-3.654	**a,w	-0.656	<i>b,h</i>	-1.719	
	<i>OR</i> =	0.747		0.040		0.026		0.519		0.179	
Less than college	<i>B</i> =	-1.176		-3.058	**h	0.070	<i>b,w</i>	-1.679	** h	-1.859	
	<i>OR</i> =	0.308		0.047		1.073		0.187		0.156	
BA	<i>B</i> =	-0.961	***	-1.309	**	-0.668		-0.905	***	-0.435	
	<i>OR</i> =	0.383		0.270		0.513		0.405		0.647	
MA	<i>B</i> =	-0.093		-0.689	*	-0.467		-0.544	***	-0.154	
	<i>OR</i> =	0.911		0.502		0.627		0.580		0.857	
SAT Composite	<i>B</i> =	0.246	**m	0.114		0.102		0.087	+	-0.176	<i>a</i>
	<i>OR</i> =	1.279		1.120		1.107		1.091		0.838	
College Grades & Involvement											
GPA	<i>B</i> =	1.475	***b,m	0.648	<i>* a</i>	1.194	**	1.086	***	0.295	<i>a</i>
	<i>OR</i> =	4.370		1.912		3.300		2.963		1.343	
College Involvement Index	<i>B</i> =	0.102	<i>b,m</i>	0.428	**a,w	0.140	<i>m</i>	0.070	<i>b,m</i>	0.697	**a,h,w
	<i>OR</i> =	1.107		1.534		1.151		1.072		2.008	
Faculty Academic Contact	<i>B</i> =	0.068		0.410	<i>m</i>	-0.220		0.203	**m	-0.691	<i>b,w</i>
	<i>OR</i> =	1.071		1.506		0.802		1.225		0.501	

Table 3. Continued

		Asian	Black	Hispanic	White	Multiracial/ Other	
Undergraduate Major							
STEM	<i>B</i> =	-0.371	-0.204	-0.056	0.097	2.164	
	<i>OR</i> =	0.690	0.815	0.945	1.102	8.703	
Social Science	<i>B</i> =	-1.412	+ <i>w,m</i> -0.098	-0.612	<i>m</i> 0.024	<i>a,m</i> 2.791	+ <i>a,h,w</i>
	<i>OR</i> =	0.244	0.906	0.542	1.025	16.289	
Business	<i>B</i> =	-1.894	* <i>m</i> -1.286	-1.477	+ -0.578	* 1.112	<i>a</i>
	<i>OR</i> =	0.150	0.276	0.228	0.561	3.042	
Arts & Humanities	<i>B</i> =	-1.689	* -0.603	-0.895	-0.292	0.020	
	<i>OR</i> =	0.185	0.547	0.408	0.747	1.020	
Health & Human Serv	<i>B</i> =	-2.132	* <i>m</i> -1.416	-1.616	+ <i>w,m</i> -0.077	<i>h</i> 1.162	<i>a,h</i>
	<i>OR</i> =	0.119	0.243	0.199	0.926	3.195	
Other	<i>B</i> =	0.365	0.049	-1.757	+ <i>m</i> -0.228	1.726	<i>h</i>
	<i>OR</i> =	1.441	1.050	0.173	0.796	5.616	
Undergraduate Institution							
Private	<i>B</i> =	0.488	* -0.748	* <i>w</i> 0.270	0.100	<i>b</i> 0.899	
	<i>OR</i> =	1.630	2.114	1.310	1.105	2.457	
For-profit	<i>B</i> =	0.707	0.755	1.527	* <i>w</i> 0.315	<i>h</i> 0.566	
	<i>OR</i> =	2.027	2.129	4.602	1.370	1.761	

Table 3. *Continued*

		Asian		Black		Hispanic		White		Multiracial/ Other	
Selectivity, Moderate	<i>B</i> =	0.423	^{<i>h,m</i>}	0.137		-0.853	^{<i>a,w</i>}	0.502	^{<i>*** h,m</i>}	-1.026	^{<i>a,w</i>}
	<i>OR</i> =	1.527		1.146		0.426		1.652		0.359	
Selectivity, Inclusive	<i>B</i> =	1.119	^{<i>** w</i>}	0.152		0.770		0.377	^{<i>a</i>}	-0.260	
	<i>OR</i> =	3.061		1.164		2.159		1.457		0.771	
Model Fit (<i>Nagelkerke-R</i> ²)		0.527		0.384		0.469		0.263		0.538	
Unweighted <i>N</i>		640		370		390		3,220		200	
Weighted <i>N</i>		68,264		89,610		92,730		774,270		40,150	

SOURCE: ELS 2002 Restricted Dataset.

NOTES: “*OR*” represents estimated Odds Ratios ($Exp(B)$). Reference categories are Race/Ethnicity: White=0; Ed Aspirations: Doctoral Degree=0; Major: Education=0; College Selectivity: High=0. Additional variables for “Missing” major, “Other” selectivity and controls for marital status, number of dependents, and total accumulated loan debt were included in the model but not shown in the table.

^{*+*} $p < 0.10$; ^{***} $p < 0.05$; ^{****} $p < 0.01$ ^{*****} $p < 0.001$.

^{*a*} Estimated effect is significantly ($p < 0.10$) different from Asian estimate.

^{*b*} Estimated effect is significantly ($p < 0.10$) different from Black estimate.

^{*h*} Estimated effect is significantly ($p < 0.10$) different from Hispanic estimate.

^{*m*} Estimated effect is significantly ($p < 0.10$) different from Multiracial/Other estimate.

^{*w*} Estimated effect is significantly ($p < 0.10$) different from White estimate.

Table 4. Estimated Effects Predicting Graduate Degree Enrollment by Sex

		Female	Male	
Ascribed Characteristics				
Asian	<i>B</i> =	0.201	-0.064	
	<i>OR</i> =	1.223	0.938	
Black	<i>B</i> =	0.436 +	0.443 +	
	<i>OR</i> =	1.546	1.558	
Hispanic	<i>B</i> =	0.009	-0.146	
	<i>OR</i> =	1.009	0.864	
Multiracial/Other	<i>B</i> =	-0.268	0.448	
	<i>OR</i> =	0.765	1.565	
SES	<i>B</i> =	0.211 *	0.179	
	<i>OR</i> =	1.235	1.196	
Precollege Aspirations & Academics				
Undecided	<i>B</i> =	-1.336 *	-0.531	
	<i>OR</i> =	0.263	0.588	
Less than college	<i>B</i> =	-1.818 ***	-0.682	
	<i>OR</i> =	0.162	0.506	
BA	<i>B</i> =	-0.806 ***	-0.800 ***	
	<i>OR</i> =	0.447	0.449	
MA	<i>B</i> =	-0.460 ***	-0.443 **	
	<i>OR</i> =	0.631	0.642	
SAT Composite	<i>B</i> =	0.081 +	0.123 *	
	<i>OR</i> =	1.085	1.131	
College Grades & Involvement				
GPA	<i>B</i> =	1.051 ***	1.073 ***	
	<i>OR</i> =	2.862	2.924	
College Involvement Index	<i>B</i> =	0.070	0.171 **	
	<i>OR</i> =	1.073	1.187	
Faculty Academic Contact	<i>B</i> =	0.066	0.251 *	
	<i>OR</i> =	1.068	1.285	
Undergraduate Major				
STEM	<i>B</i> =	0.436	0.164	
	<i>OR</i> =	1.547	1.179	

Table 4. *Continued*

		Female	Male
Social Science	<i>B</i> =	-0.020	0.229
	<i>OR</i> =	0.981	1.257
Business	<i>B</i> =	-1.011 ***	-0.228
	<i>OR</i> =	0.364	0.796
Arts & Humanities	<i>B</i> =	-0.490 +	-0.050
	<i>OR</i> =	0.613	0.951
Health & Human Services	<i>B</i> =	-0.361	-0.304
	<i>OR</i> =	0.697	0.738
Other	<i>B</i> =	-0.148	-0.185
	<i>OR</i> =	0.862	0.831
Undergraduate Institution			
Private	<i>B</i> =	0.212	0.168
	<i>OR</i> =	1.236	1.184
For-profit	<i>B</i> =	1.311 *** ^m	-0.517 ^f
	<i>OR</i> =	3.711	0.596
Selectivity, Moderate	<i>B</i> =	0.444 **	0.241
	<i>OR</i> =	1.560	1.272
Selectivity, Inclusive	<i>B</i> =	0.461 *	0.346
	<i>OR</i> =	1.586	1.413
Model Fit (<i>Nagelkerke-R</i> ²)		0.310	0.271
Unweighted <i>N</i>		2,710	2,110
Weighted <i>N</i>		589,090	475,940

SOURCE: ELS 2002 Restricted Dataset.

NOTES: “*OR*” represents estimated Odds Ratios ($Exp(B)$). Reference categories are Race/Ethnicity: White=0; Ed Aspirations: Doctoral Degree=0; Major: Education=0; College Selectivity: High=0. Additional variables for “Missing” major, “Other” selectivity and controls for marital status, number of dependents, and total accumulated loan debt were included in the model but not shown in the table.

⁺ $p < 0.10$; * $p < 0.05$; ** $p < 0.01$ *** $p < 0.001$.

^f Estimated effect is significantly ($p < 0.10$) different from Male estimate.

^m Estimated effect is significantly ($p < 0.10$) different from Female estimate.

Appendix

Table A-1. List of College Majors by Major Category

Arts & Humanities

- 9 Humanities
- 17 Architecture
- 20 Design and applied arts
- 23 Theology and religious vocations

Business

- 15 Business/management/marketing/related

Education

- 16 Education

Health & Human Services

- 14 Health care fields
- 19 Public administration and social services

Social Science

- 7 Social sciences
- 8 Psychology
- 10 History
- 18 Communications
- 21 Law and legal studies

STEM

- 1 Computer and information sciences
- 2 Engineering and engineering technology
- 3 Biological and physical science, science tech
- 4 Mathematics
- 5 Agriculture and natural resources

Other

- 6 General studies and other
 - 11 Personal and consumer services
 - 12 Manufacturing, construction, repair, and trans
 - 13 Military technology and protective services
-

SOURCE: ELS 2002 Restricted Dataset