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# International Graduate Students: How Do They Choose Academic Majors?

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International graduate students are a sizeable segment of the student body in the U.S. higher educational system, but remain an understudied population in the educational literature. As a result, this student population is not adequately understood by higher education administrators and faculty. The current study explored 16 factors associated with international graduate students' choice of academic majors for their American degrees and how factors affected this population's academic choice among four academic categories. Based on the findings, this study suggests recruitment and admission policies and support services and programs to attract and retain international graduate students, in order to understand and direct this population of students during their study in the United States, and to increase international graduate students' contributions in economy, innovation, and diversity.

## **Disciplines**

Higher Education | Higher Education Administration

## **Comments**

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# International Graduate Students: How Do They Choose Academic Majors?

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## ***Abstract***

*International graduate students are a sizeable segment of the student body in the U.S. higher educational system, but remain an understudied population in the educational literature. As a result, this student population is not adequately understood by higher education administrators and faculty. The current study explored 16 factors associated with international graduate students' choice of academic majors for their American degrees and how factors affected this population's academic choice among four academic categories. Based on the findings, this study suggests recruitment and admission policies and support services and programs to attract and retain international graduate students, in order to understand and direct this population of students during their study in the United States, and to increase international graduate students' contributions in economy, innovation, and diversity.*

Since the 1950s, the United States has been a major host country to international students from around the globe. According to an Open Doors report (2010), 293,885 international students enrolled in graduate programs (approximately 43% of the total international students) in the U.S in 2009–10. Moreover, international graduate students represented approximately 12% of graduate enrollment in American higher education institutions (Snyder, Dillow, & Hoffman, 2008). The total number of international graduate students in the 2009–10 academic year was 3.7% higher than the previous year. This represents a 23% growth from the previous decade (Open Doors, 2010). American higher education institutions have increasingly relied on international graduate students to enhance enrollment in doctoral programs in certain disciplines (Davis, 1999).

Enrollment of international students has enriched American higher education economically while adding a necessary dose of cultural diversity. In the current financial climate, higher education institutions face tight and declining budgets. Public institutions are facing a profound shift forcing them to depend more on tuition than on state appropriations (Desrochers, Lenihan, & Welman, 2010). In most cases, international students enrolled in public institutions pay a higher (non-state-subsidized) tuition rate and hence contribute significantly to institutional costs. The total economic contribution of international students in the United States was nearly \$20 billion in 2009–2010 (Open Doors, 2010). In addition, international graduate students often provide qualified research and teaching assistants (Davis, 1999). Researchers found that international graduate students are important contributors to U.S. innovation (Chellaraj, Maskus, & Mattoo, 2005).

Due to the specialized nature of graduate level study, along with the critical contributions made by international graduate students, they merit focused study apart from of their undergraduate counterparts (Poyrazli, Arbona, Nora, McPherson, & Pisecco, 2002). The extant research on international graduate students consists solely of studies about social and educational experiences (Perrucci & Hu, 1995; Trice, 2004), culture shock and adjustment strains (Chapdelaine & Alexitch, 2004; Poyrazli et al., 2002; Poyrazli & Kavanaugh, 2006), impact of language proficiency and communication needs (Kim, 2006; Xu, 1991), conflict with faculty supervisors (Adrian-Taylor, 2007), mental health needs and use of counseling services (Hyun, Quinn, Madon, & Lustig, 2007), career placement concerns and needs (Shen & Herr, 2004), and academic success factors (Nelson, Nelson, & Malone, 2004).

The extant research has not explored how international graduate students choose their academic majors for graduate study in the United States. The existing research on choice of major for American students has included academic preparation, gender role, academic climate, parental influences, and value systems for American undergraduate and graduate students (e.g., Malgwi, Howe, & Burnaby, 2005). Although international graduate students likely share some of the same reasons for choosing their majors with their American counterparts, international students also face a unique set of influencing factors. For example, international students must also consider their native culture and values, English language ability, affordability, and a foreign collegial atmosphere as well as

adjustment to new social environs. A better understanding of how international students choose their majors may enable universities to attract and retain more international graduate students, as well as to increase international graduate students' contributions in economy, innovation, and diversity.

### ***Factors Associated With Choice of Academic Majors***

Following an intensive review of the literature, no study specific to international graduate students' choice of academic majors could be identified. Without previous academic literature in which to situate this study, we were informed by the literature and research pertaining to choice of academic majors among international undergraduate students and American graduate students. We acknowledge the divides between the undergraduate and graduate experiences, yet we believe that the literature on how undergraduates choose their majors can be instructive. The lack of specific literature on how graduate students choose their majors speaks loudly for the need of the current inquiry.

Porter and Umbach (2006) found that studies on the choice of undergraduate academic majors have emphasized academic preparation, social and cultural influences, demographic attributes of students, academic climate, and value systems. There is a close tie between academic preparation, academic achievement, standardized test scores, and the selection of a major for both undergraduates and graduate students (Gamoran, 1987; Simpson, 2001).

Student selection of courses and majors is based on previous academic performance and expectancies (Lackland & De Lisi, 2001). Turner and Bowen (1999) reported that different academic preparation—especially precollege level mathematics performance—was a main factor influencing academic choices regardless of gender. They asserted that because men tended to take more advanced math courses in high school, they tended to exceed women in college math skills. Simpson (2001) also noted that the more math preparation a student received in high school, the more likely the student will choose a technical-related major. International graduate students' academic background may be highly related to their choice of study field.

Social support received from family also affects a student's academic choice and performance. Parental aspirations for children's education impact students' educational attitudes and college plans (Zea, Jarama, & Bianchi, 1995). Shih,

Pittinsky, and Ambady (1999) indicated that the influence of sociocultural stereotypes on individual performance was powerful. For example, it was found that Asian students were more likely to choose college majors in the sciences and technology (Tang, Fouad, & Smith, 1999). International graduate students' social support may affect their valuation of academic disciplines.

Gender role identification stereotypes have also been found to influence students' choice of college majors. Lackland and De Lisi (2001) found that English, education, and nursing majors were dominated by women likely because these majors reflect traditional female gender roles. Similarly, traditional male roles were found to promote men's choice of majors in fields such as mathematics, engineering, and natural sciences. Gender role socialization (e.g., nurturing and involvement with people) and family responsibility (e.g., pregnancies and child rearing) were cited as reasons for women's educational and career choices in the social sciences and humanities (Jacobs, 1995).

Researchers found that underrepresented groups felt uncomfortable and unsupported on campus. Women were more likely to study in fields enrolling a large number of females (Kanter, 1993). A "chilly climate" has been reported in natural sciences and engineering, typically blamed on an underrepresentation of women (Sandler & Hall, 1986). The small proportion of female students in these classes is believed to cause discomfort and feelings of lack of support. Minority groups may similarly feel a "chilly climate" on a campus dominated by White students. For example, Hispanic students were more successful at institutions with diverse population than those dominated by White students (Hagedorn, Chi, Cepeda, & McLain, 2007). When international students view themselves as the underrepresented group in the area of study, they may feel "chilly" and uncomfortable.

Lackland and De Lisi (2001) found that student's value systems were significant predictors of choice of courses and academic majors. The selection of a major in the "helping professions" was associated with a humanitarian concern, but the utility value was highly ranked among science majors, especially among male students. Eccles, Adler, and Meece (1984) explained that gender differences in academic choice and achievement arise from gender differences in the subjective values attached to various achievement activities.

Institutional factors and academic ability also play a role in the selection of academic majors (Lackland & De Lisi, 2001). College students' choice of majors was strongly influenced by interest in the subject, the availability of employment, and potential earnings (Kim, Markham, & Cangelosi, 2002; Malgwi et al., 2005). Malgwi and colleagues (2005) also indicated that women were strongly influenced by their beliefs, while men were more influenced by expectations.

Leppel, Williams, and Waldauer (2001) suggested that educational choices and career choices are essentially linked, and educational decisions represent a step toward career decisions. While some students plan to return to their home countries immediately after finishing study in the United States, others plan to live and work in the United States indefinitely (Shen & Herr, 2004). Hence, career plans upon graduation and employment opportunities in the home country and America affect international students' academic choice in American graduate study.

### **Purpose of the Study**

The current study appears to be unique in identifying how international graduate students choose academic majors in the United States. The problem this research will address is how to best recruit and retain international graduate students specifically in targeted majors. This is important because the increasing enrollment of international students may positively contribute to a university's budget as well as diversity. The findings may also assist higher education practitioners in developing effective recruitment strategies to attract more international students, to better understand and direct this population during their study in the United States, and to retain high quality international graduate students.

The research questions of this current study are:

- (1) What are the factors associated with the choice of academic majors among international graduate students?
- (2) How do the factors influence the choice of academic majors?

This study's conceptual framework is based on a modified version of the Expectancy-Value model of achievement motivation (Wigfield & Eccles, 2000) and the nature of international students. In the Expectancy-Value model, student's academic-related choices are influenced by subjective task values

and expectation of success. Wigfield and Eccles (2000) proposed three major components of subjective values: attainment value (importance of doing well on a given task), intrinsic value (enjoyment from performing the task), and utility value (usefulness for future plans). Expectation of success was defined as beliefs about how well one will perform on upcoming tasks, either in the immediate or long term future. Both values and expectations are directly influenced by goals and beliefs, which are influenced by two constructs—the individual's interpretations of experience, and an individual's perception of beliefs, expectations, and attitudes. The construct of interpretations of experience is influenced by perception, previous achievement-related experience, differential aptitudes, beliefs, and behaviors, and the cultural milieu.

The conceptual framework includes five constructs: demographics, academic-related inputs, personal perceptions, subjective values, and choice of academic majors. Based on the academic division at the research site and the distribution of international students in the fields of study (Open Door, 2010), academic majors are divided into four categories: business and management, engineering, natural and health sciences, and humanities and social sciences.

For the purposes of this study, the construct of demographics includes age, gender, native region, and graduate level. The construct of academic-related inputs consists of continuity of academic majors, relevance to academic background, and relevance to work experience. English language ability belief, expectation of success, family influence, and feeling welcome are included in the construct of personal perceptions. Subjective values comprise academic interest, prestige of the academic program, professor's prestige, employment opportunities, and financial assistance opportunities.

## **Methods**

This study used an original researcher-developed questionnaire based on the literature and findings of numerous previous studies. An expert panel—three professors and two doctoral candidates in the areas of educational research and higher education studies—reviewed and commented on the questionnaire construction, operationalization, wording format, and question flow to ensure that the content of this instrument sufficiently addressed international graduate students' choice of academic majors. Upon the approval of the Institutional Review Board at the research site, a pilot test of 20 questionnaires was conducted.

The questionnaire was conducted online at a large public research university located in the southeast U.S.. More than 50,000 students study at the institution which offers over 100 undergraduate majors and almost 200 graduate programs. After modifications were made to the questionnaire from findings during the pilot activities, an email invitation (containing the online questionnaire link) was sent to 2,112 international graduate students the entire international graduate student population at the research site. As a result of reminder email messages, 505 responses were received for a response rate of 33.5%.

### ***Participants***

Of the 505 participants responding to the online questionnaire, 136 (27%) were master's students and 369 (73%) were in doctoral programs. Three hundred and six (60%) participants were male. The age of the participants ranged from 21 to 46 years ( $M = 27.9$ ).

The participants reported 72 home countries/areas, which were subsequently divided into eight regions. Participants' academic majors, also self-reported, were subsequently divided into four categories. Table 1 provides the academic majors' distribution by participants' native regions. Similar to the makeup of international graduate student population on campus, most of the participants majored in the engineering discipline, and were from East and Southeast Asia.

**TABLE 1** | Participants' Academic Major Distribution by Native Region

Native region	Natural and health sciences	Engineering	Humanities and social sciences	Business and management
Africa	7	5	5	3
Central and South America	9	20	5	14
North America	0	3	3	0
Central and South Asia	31	95	5	7
East and Southeast Asia	54	102	24	33
Middle East	5	14	3	7
Europe	12	17	9	10
Oceania	2	1	0	0

*Note: Participants from North America were Canadian, and those from Oceania were Australian and New Zealanders.*

### ***Data Analysis***

To adjust for possible sampling bias, a weighting procedure based on the country of origin was applied to the sample. The weighted data represented the international graduate student population on campus. Since the number of participants from North America (Canada) and the Oceania (Australia and New Zealand) regions was far lower than those from other regions, data from these two regions were excluded. In addition, students from these two regions spoke English as their first language and hence may have had different experiences.

A nominal regression analysis was performed to investigate variables associated with international graduate students' choice of academic majors. The dependent variables were the academic fields of study—business and management, engineering, humanities and social sciences, and natural and health sciences; the independent variables were age, gender, native region, graduate level, continuity of academic major, relevance to academic background, relevance to work experience, English language ability belief, expectation of success, family influence, feeling welcome, academic interest, prestige of the academic program, professor's prestige, employment opportunities, and financial assistance opportunities.

The variables of age (younger [ $< 30$  years old] vs. older), gender (male vs. female), graduate level (master's vs. doctoral), and continuity of academic major (continuity vs. discontinuity) were dummy coded in SPSS.

The variables of relevance to academic background, relevance to work experience, English language ability belief, expectation of success, family influence, feeling welcome, academic interest, prestige of the academic program, professor's prestige, employment opportunities, and financial assistance opportunities were self-reported based on assessments of these variables' affects on students' academic choices. These assessments used Likert-type scales, with 1 representing "strongly agree" and 5 representing "strongly disagree."

Due to the nature of nominal regression and the need to predict four categories of academic majors—humanities and social sciences, engineering, natural and health sciences, and business and management—three models were created for the analysis. The three models related to the first three academic major categories, while the last category, business and management, was considered the baseline

group for comparison. Comparisons were made based on the log odds of being placed in one of the three other groups as opposed to business and management.

An inspection of significant parameters was conducted to determine the significant variables necessary for a viable model. While the three aforementioned models could be used to predict the odds of entering an academic major other than business and management, the use of all three simultaneously enabled the prediction of the specific academic major that would be chosen. For example, whichever of the three equations gave the highest odds determined inclusion in that particular program. On the other hand, if the three equations all implied low odds of being in a major other than business and management, then the assumption was made that the individual would study business and management.

In order to create more useful predictive equations, the log odds equations can be used to create four separate probability equations that predict the probability of being within a certain academic major. Let the vector of parameter estimates including the intercept be called  $B$ . Then let the vector of standard and dummy coded variables be called  $X$ . Thus, for the product  $BX$ , a standard regression equation can be made as in Formula 1 below.

$$BX = \beta_0 + \beta_1 X_1 + \dots + \beta_n X_n \quad \text{Formula 1}$$

Here,  $n$  is the total number of predictors, including all standard continuous variables and dummy coded variables. The equation in Formula 1 is equivalent to the log odds found in Formula 2. Formula 2 uses humanities and social sciences as an example, with the baseline being the business and management major.

$$\text{Log}_e \left( \frac{\pi_{\text{Humanities}}}{\pi_{\text{Business}}} \right) = BX \quad \text{Formula 2}$$

Similar formulas can be created using the engineering and natural and health sciences majors.

Let the parameter estimates for the humanities and social sciences be called  $B_h$ , the estimates for engineering be called  $B_e$ , and the estimates for natural and health sciences be called  $B_n$ . In order to calculate the direct probabilities for the academic majors, the equations must be manipulated in the following manner.

To find the probability of a student falling in the humanities and social sciences category, Formula 3 must be used.

$$\pi_{Humanities} = \frac{e^{\beta_h}}{1 + e^{\beta_h} + e^{\beta_c} + e^{\beta_n}} \quad \text{Formula 3}$$

In the above formula,  $\pi_{Humanities}$  is the probability of a student being in the academic major of humanities and social sciences. The probability equations for the remaining three categories can be found below.

$$\begin{aligned} \pi_{Engineering} &= \frac{e^{\beta_c}}{1 + e^{\beta_h} + e^{\beta_c} + e^{\beta_n}} \\ \pi_{Natural\ Sciences} &= \frac{e^{\beta_n}}{1 + e^{\beta_h} + e^{\beta_c} + e^{\beta_n}} \\ \pi_{Business} &= \frac{1}{1 + e^{\beta_h} + e^{\beta_c} + e^{\beta_n}} \end{aligned} \quad \text{Formula 4}$$

The equations used to find the probabilities can be solved directly by SAS JMP. The JMP program then uses these equations to determine the probability that a given individual will pursue one of the four academic major categories. The calculated probabilities for academic major membership can then be analyzed using ANOVA, followed by Tukey’s Honestly Significant Difference test to determine specific group differences.

## Results

Nominal regression analysis was used to answer the first research question: What are the factors associated with the choice of academic major among international graduate students? An overall inspection of the nominal regression model for the parameters indicated that all sixteen of the independent variables were significant, with all associated p-values less than 0.001. The model shows good fit in the form of minimal variability that cannot be explained by the model, as shown by the two Pseudo R-square values; namely, the Cox and Snell at 0.650 and Nagelkerke at 0.709. The overall correct classification rate was 72.5%. The correct classification rates were 69.4% for humanities and social sciences, 76.7% for engineering, 68.6% for natural and health sciences, and 78.9% for business and management. Thus, on the whole the model was adequate in its ability to determine which of the four academic major categories an international graduate student would enter based on the noted predictors, with a model significance of 0.00.

For inclusion in any of the academic majors apart from business and management, the odds were increased the most due to “relevance to academic background” and “feeling welcome.” Thus, the three equations weighed most heavily in terms of increased odds for categorical inclusion due to two variables. Of these two factors, relevance to academic background was the greatest contributor to an increase of the odds ratio. Specifically, the greater the relevance of a major to an individual’s academic background, the more likely that individual was to be in that major.

The parameter estimates for the nominal regression formulas can be found in Table 2. Note that these values were the parameter estimates for the log odds regression equation. As such they can be used to create the direct probability equations, as shown in the Analysis section. The direct resulting formulas are too complex to display here, but can clearly be used to create rather accurate probabilities to estimate academic major membership based on the independent variables.

**TABLE 2** | Parameter Estimates for Nominal Regression Equations

Parameters	Humanities and social sciences	Engineering	Natural and health sciences
Intercept	39.161	13.438	10.359
Younger age	2.643	4.319	3.723
Male	1.646	4.142	2.342
Master’s program	0.018	-5.500	-6.321
Continuity of academic major	2.940	4.639	3.786
Africa	0.007	-18.506	-4.029
Central and South America	0.001	-5.772	-5.246
Central and South Asia	1.028	2.524	1.782
East and Southeast Asia	8073.962	9.118	8.620
Middle East	91.192	5.055	4.078
Relevance to academic background = Strongly agree	15.663	36.432	12.149
Relevance to academic background = Agree	15.119	35.545	11.516
Relevance to academic background = Neutral	12.018	47.714	21.343
Relevance to academic background = Disagree	3.724	22.572	-0.809

**TABLE 2** | Parameter Estimates for Nominal Regression Equations

Parameters	Humanities and social sciences	Engineering	Natural and health sciences
Relevance to work experience = Strongly agree	-5.224	-4.231	-3.250
Relevance to work experience = Agree	-3.975	-4.706	-3.895
Relevance to work experience = Neutral	8.233	-6.830	21.343
Relevance to work experience = Disagree	-2.677	-1.315	-0.809
Academic interest = Strongly agree	-20.013	-32.027	-6.509
Academic interest = Agree	-25.813	-37.419	-3.895
Academic interest = Neutral	11.544	-20.910	-6.863
Academic interest = Disagree	-12.062	-24.288	-1.429
Prestige of academic program = Strongly agree	-1.896	-0.856	0.816
Prestige of academic program = Agree	0.355	1.116	2.669
Prestige of academic program = Neutral	-4.09	-0.743	0.735
Prestige of academic program = Disagree	4.683	3.247	5.818
Expectation of success = Strongly agree	-15.949	-5.809	-3.841
Expectation of success = Agree	-12.006	0.098	1.339
Expectation of success = Neutral	-20.074	-8.209	-6.831
Expectation of success = Disagree	-21.868	-10.264	-8.219
Prestige of professor = Strongly agree	-10.430	-10.547	-10.285
Prestige of professor = Agree	-0.566	-1.173	-0.652
Prestige of professor = Neutral	-3.615	-4.845	-4.514
Prestige of professor = Disagree	-5.179	-3.767	-2.497
Feeling welcome = Strongly agree	8.696	8.419	11.011
Feeling welcome = Agree	9.100	9.412	11.144
Feeling welcome = Neutral	13.575	14.258	15.957
Feeling welcome = Disagree	13.182	12.212	12.598

**TABLE 2** | Parameter Estimates for Nominal Regression Equations

Parameters	Humanities and social sciences	Engineering	Natural and health sciences
Family influence = Strongly agree	-4.439	-3.678	-5.328
Family influence = Agree	-2.643	-1.118	-1.627
Family influence = Neutral	3.757	4.731	4.411
Family influence = Disagree	-0.436	-0.645	-1.788
Financial assistance opportunity = Strongly agree	0.747	3.538	1.714
Financial assistance opportunity = Agree	0.528	3.331	1.995
Financial assistance opportunity = Neutral	3.617	6.767	5.334
Financial assistance opportunity = Disagree	4.650	7.541	5.524
English language ability belief = Strongly agree	-12.875	-13.517	-11.329
English language ability belief = Agree	-14.164	-15.633	-12.676
English language ability belief = Neutral	-17.956	-18.132	-15.261
English language ability belief = Disagree	-20.411	-22.609	-20.266
Employment opportunity = Strongly agree	2.034	2.482	-0.189
Employment opportunity = Agree	5.388	4.216	1.211
Employment opportunity = Neutral	8321.693	10.882	8.592
Employment opportunity = Disagree	0.057	-0.903	-3.019

The second research question—How do the factors influence the choice of academic majors?—was answered by the probabilities of variable level changes for academic major membership. The SAS JMP program computed probabilities for inclusion in any of the four academic major categories; these were then analyzed to investigate variable level changes for membership in the categories. Table 3 shows the averaged probabilities based on gender and the four academic majors. Female students were more likely to enter humanities and social sciences or natural and health sciences, while males were more likely to study engineering. These averages all had p-values less than 0.001. Business and management, however, was found to be equivalent based on gender.

**TABLE 3** | Average Estimated Probabilities for Academic Majors by Gender

	Humanities and social sciences	Engineering	Natural and health sciences	Business and management
Male	0.116182	0.506224	0.323650	0.053943
Female	0.335483	0.206451	0.399999	0.058067

The probability of academic major membership was analyzed using ANOVA. The averaged values are placed in Table 4. The older age group ( $\geq 30$  years old) was more likely to choose the humanities and social sciences, natural and health sciences, or business and management than their younger counterparts. Younger students, on the other hand, were more likely to be pursue the engineering major than older students with similar criteria.

**TABLE 4** | Average Estimated Probabilities for Academic Majors by Age

	Humanities and social sciences	Engineering	Natural and health sciences	Business and management
Younger age	0.122136	0.557252	0.290076	0.030536
Older age	0.244360	0.304511	0.383458	0.067671

The average probability for academic major membership can be found in Table 5. The outstanding attribute of this table was the fact that knowing the native region for a specific student allows a probability estimate to be assigned for possible academic major selection. Students from Africa, Central and South America, Central and South Asia, and Europe were most likely to enter the natural and health sciences. The category of humanities and social sciences appeared to take a cross sectional set of students from the six regions except for Central and South Asia. The makeup of the engineering category consists mainly of students hailing from Central and South Asia, East and Southeast Asia, and the Middle East. Overall, the students in this study were less likely to pursue majors in the business and management category.

**TABLE 5** | Average Estimated Probabilities for Academic Majors by Native Region

	Humanities and social sciences	Engineering	Natural and health sciences	Business and management
Africa	0.294111	0.058822	0.529406	0.117661
Central and South America	0.210526	0.210526	0.394737	0.184211
Central and South Asia	0.046296	0.555556	0.361110	0.037038
East and Southeast Asia	0.257310	0.385965	0.333333	0.023393
Middle East	0.320000	0.400000	0.240000	0.040000
Europe	0.289473	0.236841	0.368421	0.105265

Tables 6–12 denote the averages for academic major membership based on the self-reported importance of family influence, feeling welcome, relevant academic background, employment opportunity, financial assistance opportunity, academic interest, and prestige of academic program on the decision of the respondent. Generally, respondents did not agree that family influence, feeling welcome, relevant academic background, employment opportunity, academic interest, and financial assistance opportunity affected their choice of the humanities and social sciences.

**TABLE 6** | Average Estimated Probabilities for Academic Majors by Family Influence

	Humanities and social sciences	Engineering	Natural and health sciences	Business and management
Strongly agree	0.100000	0.500000	0.300000	0.100000
Agree	0.137255	0.411765	0.411765	0.039126
Neutral	0.119658	0.470086	0.384615	0.025641
Disagree	0.247999	0.40800	0.255999	0.088003
Strongly disagree	0.304877	0.256096	0.378049	0.060978

**TABLE 7** | Average Estimated Probabilities for Academic Majors by Feeling Welcome

	Humanities and social sciences	Engineering	Natural and health sciences	Business and management
Strongly agree	0.222221	0.206350	0.507934	0.063494
Agree	0.186335	0.434782	0.316770	0.062113
Neutral	0.157895	0.429824	0.385964	0.026317
Disagree	0.333332	0.361111	0.222221	0.083336
Strongly disagree	0.304348	0.434782	0.130435	0.120435

**TABLE 8** | Average Estimated Probabilities for Academic Majors by Relevance to Academic Background

	Humanities and social sciences	Engineering	Natural and health sciences	Business and management
Strongly agree	0.190265	0.376106	0.389380	0.044250
Agree	0.206666	0.406667	0.320000	0.066667
Neutral	0.000004	0.857135	0.142854	0.000006
Disagree	0.357141	0.285714	0.214284	0.142861
Strongly disagree	0.599989	0.00000864	0.111119	0.200005

**TABLE 9** | Average Estimated Probabilities for Academic Majors by Employment Opportunity

	Humanities and social sciences	Engineering	Natural and health sciences	Business and management
Strongly agree	0.208954	0.343283	0.343282	0.104482
Agree	0.151724	0.462069	0.337931	0.048277
Neutral	0.203389	0.372881	0.398304	0.025425
Disagree	0.285714	0.387755	0.244898	0.081634
Strongly disagree	0.333333	0.166666	0.388889	0.111111

**TABLE 10** | Average Estimated Probabilities for Academic Majors by Financial Assistance Opportunity

	Humanities and social sciences	Engineering	Natural and health sciences	Business and management
Strongly agree	0.222222	0.324787	0.393161	0.059831
Agree	0.161538	0.423077	0.361538	0.053846
Neutral	0.114284	0.457142	0.371427	0.057146
Disagree	0.228069	0.491228	0.245613	0.035090
Strongly disagree	0.499999	0.142855	0.250001	0.107145

**TABLE 11** | Average Estimated Probabilities for Academic Majors by Prestige of Academic Program

	Humanities and social sciences	Engineering	Natural and health sciences	Business and management
Strongly agree	0.218302	0.336166	0.355824	0.089709
Agree	0.165873	0.456750	0.324705	0.052672
Neutral	0.197459	0.390271	0.372148	0.040122
Disagree	0.222299	0.351920	0.354675	0.071106
Strongly disagree	0.327745	0.340405	0.278583	0.053267

**TABLE 12** | Average Estimated Probabilities for Academic Majors by Academic Interest

	Humanities and social sciences	Engineering	Natural and health sciences	Business and management
Strongly agree	0.215384	0.323076	0.405128	0.056412
Agree	0.210191	0.433121	0.292993	0.063695
Neutral	0.040000	0.559999	0.360000	0.040000
Disagree	0.249996	0.499998	0.299996	0.00000933
Strongly disagree	0.499991	0.499997	0.00000455	0.000006966

Engineering students agreed that family influence, relevant academic background, employment opportunity, and financial assistance opportunity were influential factors, while disagreeing that feeling welcome and academic interest had affects. Prestige of academic program had similar probabilities across the agreement scale.

International graduate students in natural and health sciences reported that they agreed the factors of feeling welcome, relevant academic background, financial assistance opportunity, and academic interest influenced their choice of study field. But the probabilities were similar across the agreement scale regarding family influence, prestige of academic program, and employment opportunity.

International students in business and management had factors of family influence, employment opportunity, and prestige of academic program that were rather similar across the agreement scale probability-wise. Students in this academic major disagreed that the factors of feeling welcome, relevant academic background, and financial assistance opportunity affected their decision to choose the business and management major. However, respondents agreed that academic interest was an influential factor for their choice.

## **Discussion**

All 16 factors were significantly associated with international graduate students' choice of academic major—age, gender, graduate level, native region, continuity of academic majors, relevance to academic background, relevance to work experience, academic interest, English language ability belief, expectation of success, family influence, feeling welcome, prestige of academic program, professor's prestige, financial assistance opportunity, and employment opportunity. These factors influenced international graduate students' selection of four academic fields: humanities and social sciences, engineering, natural and health sciences, and business and management.

The results show that younger male Asian students were more likely to choose the engineering major. Receiving family support, having a relevant academic background, getting financial aid, and having better employment opportunities contributed to international graduate students' decision to choose the engineering major. This finding reflects the norm that engineering is viewed as male's field

(Lackland & De Lisi, 2001). Moreover, Asian culture and sociocultural norms (Tang, Fouad, & Smith, 1999) contributed to the differences among native regions as well as the importance of family support of major selection. Engineering programs expect incoming graduate students to be academically well-prepared; hence, most respondents agreed that relevant academic background was one of the reasons they selected this major. In addition, these students valued not only financial aid opportunities while in the program, but also job opportunities upon graduation. This finding was in agreement with Kim, Markham, and Cangelosi (2002). Receiving financial assistance not only benefited international students' financial situation, but also enriched their academic experience if the funding source was from research grants or assistantships. Considering employment opportunities during the academic decision process reflected the fact that educational choices and career choice are linked (Leppel, Williams, & Waldauer, 2001). Engineering students also disagreed that feeling welcome affected their choice. They may have been aware of the large number of international graduate students enrolled in engineering programs at the research site as well in the United States (Open Door, 2010). Due to a combination of other influential factors, academic interest did not play an important role for international graduate students who pursued in engineering majors.

Older female international students from outside of Central and South Asia tended to choose the humanities and social sciences. This finding concurs with Jacobs's research (1995) in highlighting a decision trend that reflects traditional female roles. In contrast with engineering majors, international students in humanities and social sciences did not agree that family support, relevant academic background, financial assistance opportunity, or employment opportunities affected their choice of academic major. The expectations of the humanities and social sciences are different than those in engineering. This academic category does not rely so much on knowledge from prior academic experience. In addition, older students are less influenced by their family members in selection of academic fields than younger students. International students who selected the humanities and social sciences did not value financial assistance or employment opportunities, unlike their counterparts in engineering. These older students probably had better financial situations than younger students; hence, financial assistance opportunity did not affect their choice of studying in the humanities and social sciences.

Older female international students from Africa, Central and South America, Central and South Asia, and Europe were more likely to choose the natural and health sciences. Although the finding of gender difference conflicts with Lackland and De Lisi's study (2001), the conflict may be caused by the academic differences at the graduate level, while Lackland and De Lisi's study was targeted toward undergraduate students. Similar to engineering students, relevant academic background and financial assistance opportunity influenced students' decision to choose this academic major category. Moreover, according to the responses of natural and health sciences students, academic interest and feeling welcome were influential factors as well. Hence, these students cared about the departmental climate and personal interests.

The average probabilities of gender and native region for students studying in the category of business and management were almost equivalent on the agreement scale. The students in this academic field at the graduate level are expected to have more work experience, especially in the master's of business administration program; therefore we found that older students tended to select this academic category. In addition, similar to students who selected the humanities and social sciences, relevant academic background and financial assistance opportunities had a low influence on students' academic decisions. It is possible that students enrolled in the master's of business administration program have various academic backgrounds. Those students may not need financial supports, as they probably have a better financial status due to their multiple years of work experience. This study also found that international students' selection of business and management majors was based on their academic interest.

Clearly, international graduate students' academic decisions were influenced by a combination of several factors. Therefore, higher education administrators need to understand all influential factors and apply them to international graduate student recruitment and retention strategies.

## **Implications**

International graduate students are a unique and increasing student population at American higher education institutions. Administrators and faculty members at these institutions typically expect this population to assimilate and emulate American students. However, this group brings unique backgrounds and

reasons for choosing their major disciplines. Based on the results of this study, universities may consider developing the following services, programs, and policies in order to attract and admit future international students, assist international graduate students' success, keep a diverse student population on campus, and maintain economical contributions from this student population.

### ***Recruitment and Admission Policies***

The results of this study indicated that demographic factors influenced international graduate students' choice of majors. Engineering discipline recruiters may find more interest in the younger international student population, while other discipline recruiters may find older students more willing to apply. Female students may be more likely to apply for programs in the humanities and social sciences and natural and health sciences disciplines, while the engineering discipline may receive more applications from male students.

Recruiters may consider the native culture and values that students bring with them. Engineering recruiters might consider intense recruitment in Asia because people in this region are more likely to pursue engineering majors. Natural and health sciences recruiters might target Africa, Central and South America, Central and South Asia, and Europe. Humanities and social sciences recruiters might consider decreasing their recruitment efforts in Central and South Asia. In addition, financial opportunities, prestige of academic program, employment opportunities, and a diverse and hospitable campus should be highlighted on international recruiting advertisements, as these factors also influence international graduate students' decisions about academic majors.

This study suggests that recruitment policies could be developed to recruit international students in underrepresented disciplines. This study found that the majority of international graduate students were in engineering programs, while the number of international graduate students in humanities and social science programs was significantly lower. The unbalanced student population does not contribute to diversity at American universities. Although we acknowledge that international students may feel a chilly climate when the department is dominated by Americans, the other side of this issue is that American students benefit from working in a diverse setting with international students.

The recruiting officers may develop policies to attract international students to underrepresented disciplines. These policies should take into account the following recommendations: offering financial aid opportunities to international students who apply to underrepresented disciplines, providing research and work opportunities with a diverse student population in underrepresented departments, hiring international students from underrepresented regions as recruiting assistants in their home countries, and replacing selected admissions criteria with international students' relevant work experiences and educational backgrounds.

Graduate school applications usually request applicants' demographic and academic-related information. However, this study found that personal perceptions and their subjective values also influence the academic choices of international graduate students. The researchers recommend that preadmission interviews, conducted online or over the telephone, be included in the admission process. Understanding why students are interested in a major may help institutions to provide better guidance.

### ***Support Services and Programs***

Retention is as important as recruitment. Support services and programs are crucial to assist international students' academic success at American universities. This study found that the factor of feeling welcome influenced international graduate students' choice of natural and health sciences. Hence, natural and health sciences graduate programs are encouraged to work with the university's international student center to organize events and clubs for students from the same region and invite them to participate in regular activities, such as African Nights or the Middle Eastern Club. These activities would assist students from certain regions to support each other academically and socially. Interaction activities between international and domestic students as well as between international students and faculty/staff originally from other countries may also be organized, so that international students feel welcome and recognized on campus.

*Support services and programs are crucial to assist international students' academic success at American universities.*

Financial assistance opportunity was an influential factor among international graduate students who chose engineering and natural sciences and health majors. For this reason, unsupported or partially supported currently enrolled

international students and new applicants in these academic fields should be equally considered for financial assistance opportunities. Financial concerns may distract students' focus on academic study or cause discontinuity of study. Full financial assistance not only contributes to students' academic success, but also increases their contribution in teaching and/or research if the funding is through teaching and/or research assistantships. Additionally, international students in these academic areas are more likely to remain in their selected major.

This study found that 16 factors are associated with the choice of academic majors among international graduate students. Moreover, a combination of several factors affected students' academic decisions. The university may consider providing workshops for international graduate students to better understand or appreciate the wide array of choices of majors in U.S. universities. They may not understand that they can modify their earlier choice. The workshops would allow international graduate students to explore different ideas and options. The international student academic advisors could provide appropriate advisement based on the students' demographic attributes, academic-related inputs, personal perceptions, and subjective values. International graduate students' academic advisors should help them select the academic program that fits their needs, as well as direct them during their study in the selected academic area.

A supportive academic environment may result in successful learning experiences and may attract more international graduate students in the future. International students bring welcome revenue to the institution and are future international alumni. They build a global network for the institution and the institution's international reputation in their home countries.

### **Limitations**

One of the limitations of this study was the relatively low response rate of the online survey. This study's response rate was 33.5%, which is higher than the expectation of an email survey response rate of 25%–30% (Kirtleson, 1997), because "the response rates for email surveys appear to be somewhat lower than those of traditional mail surveys" (Sheehan & McMillan, 1999, p. 48). Confidentiality and Internet security were concerns for many participants. Some respondents were hesitant to reply to a request for participation over the Internet (Sills & Song, 2002).

The results of the study may not be generalizable to other institutions. The study was conducted in a Southeastern public university with an enrollment of approximately 50,000 students. Since the participants were from one institution, the study results may be applicable only to public universities with a large number of international graduate students who are demographically alike.

## **Conclusion**

An increasing number of international graduate students decide to pursue their graduate studies in the United State every year, coming with various purposes and motivations. International graduate students not only assist in teaching and research and enrich campus diversity, but also contribute economically to American universities' tight and declining budgets as well. The current study contributed to the very limited literature on this population and their motivations for academic decisions. Sixteen factors were found related to international graduate students' academic choices. Although some of these factors are shared with their domestic counterparts, many were unique to international graduate students. This study discussed how factors affected international students' choices among four academic major categories. Based on the findings, recruitment and admission policies as well as support services and programs targeted toward international graduate students were suggested, in order to effectively attract and retain more high quality international graduate students. We also suggested that international graduate students be acknowledged and respected at higher education institutions and that further studies on this population be considered.

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