Race, Gender, and the Job Search Process among STEM Graduates

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Abstract:
Despite training large numbers of STEM workers, policymakers debate whether the United States produces a sufficiently large STEM labor force. This paper investigates the internship experiences and job search strategies of two graduating cohorts of chemistry and chemical engineering majors from 2015 and 2016 at two universities in the United States. Analyses show few gender differences in job search behaviors but stronger race/ethnic differentials. Asian-American students invest the most in job search strategies, whereas African-American and Hispanic students engage in the fewest job search strategies (especially those that involve using social capital to improve their job prospects). This pattern is most pronounced for African-American and Hispanic men. Disparities in job search strategies and internship experiences may be responsible for inequalities in initial job placement. The quality of first job matches could help explain attrition by gender and race during the early careers of STEM workers.

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Despite the investment of considerable money to increase women and minorities' representation in science and engineering education, underrepresentation in the science workplace remains. Women are now more likely than men to obtain a college degree, and by 2010 they received 50.3% of all bachelor's degrees in science, math, and engineering (STEM)-related fields of study (National Science Foundation, 2013, Table 3). Yet women's representation in the STEM workforce lags behind their educational gains (Xie and Shauman, 2003). As of 2011, women were only 26% of the STEM workforce (Landivar, 2013). Racial disparities in STEM employment are also stark; Hispanic and African-American workers comprised only 13% of the STEM labor force despite representing 26% of the overall U.S. labor force (Landivar, 2013).

We know from prior work that these figures represent not just failures to invest in STEM education and training on the part of underrepresented groups, but also failures to successfully transition from school to work and remain in the STEM labor force over time (Glass, Sassler, Levitte, and Michelmore, 2013). Some fields, such as engineering, computer science and physical sciences have been particularly slow to change (National Science Board, 2008).

In this paper, we examine the factors associated with job search processes among recent STEM graduates in two related fields, chemistry and chemical engineering, where enrollment figures for women and minorities in higher education have shown substantial improvement. Focusing on gender and race, we assess whether differences in search processes or internship experiences may play a role in this continuing disparity by looking at the activities of graduating seniors at two universities [a private Ivy League university and a prominent state flagship university]. If search processes and internship experiences differ systematically by gender or race, these differences could create more first job mismatches between graduates and employers among underrepresented groups and contribute to the disproportionate decline in STEM employment among underrepresented groups as cohorts age.

Understanding Under-Representation: Educational and Career Pathways

A common analogy likens women's pathway into science careers, to water flowing through a channel, the "pipeline" model, and argues that at each education and professional level (from high school to college to graduate school to early career) the "flow" of women is weaker (Levin and Stephan, 2005). In this model, the focus is on crucial pipeline barriers (Bystydzienski and Bird, 2006) such as negative educational experiences, discouragement in pursuing science careers, or structural discrimination.

But what happens when underrepresented groups study science-related occupations? Among those committed enough to major in a particular area of interest, what possible factors deter or encourage them to continue employment in that field? In this paper we focus on two primary factors affecting underrepresentation in scientific and engineering occupations after the requisite period of education and training: (1) internship experiences that link students to potential employers; and (2) job search strategies and the effective use of social capital.

Internship experiences are common in engineering curriculum, less so in chemistry and physics. Summer internships, in particular, often link students to potential employers who use these internships to find suitable entry-level employees for their firms without extensive search processes. Yet recent work shows that women and minorities often report less desirable experiences in their internships (Seron, Silbey, Cech, and Rubineau, 2016), potentially closing off a major pathway towards employment in field following graduation. Job search strategies are also of substantial importance, since referrals from advisors, family members and acquaintances are common avenues leading to employment in field. The ability to use social networks to find employment may be one way in which women and ethnic minorities lag in their attempts to find suitable matches with employers post-graduation.

Data and Measures

Data were collected across two graduating cohorts (2015 and 2016) in chemistry and chemical engineering at two universities in the United States during the spring semester of their final year in school. For each year, researchers obtained lists of the population of graduating students from the Chemistry and the Chemical Engineering departments at one large, private Northeastern university (47% of respondents) and one large, public Southern university (53% of respondents). Links to the survey were emailed to all students, and students were encouraged to participate via announcements in popular courses and emails from department administrators. All participants were compensated with Amazon gift cards (or their cash equivalent) upon completion of the survey. At Northeastern University, the response rate was 59%, while at Southern university the response rate was 70.9%.

The final sample included 575 respondents, 304 from the Southern university and 271from the Northeastern University. The respondents were 73% Bachelor's degree recipients, 2% Master's recipients, and the rest Doctoral degrees. Forty-three percent of respondents were in Chemistry and the remainder in Chemical Engineering. Respondents ranged in age from 16-35, with an average age of 24. The final sample was 51% White, 34.2% Asian, and 15% Black or Hispanic. Forty-three percent of the sample is female, 56% is male, and two respondents identified themselves as "other". The sample was broadly representative of the broader fields of chemistry and chemical engineering. Our sample somewhat oversampled White and Asian respondents and international students for both men and women relative to recent NSF data on graduates in the sciences.

For our analytic sample in this paper, we excluded those Bachelor's degree respondents who expected to continue into graduate school rather than search for a job following graduation, leaving us with 427 respondents. Table 1 displays the sample characteristics of both the total sample and our smaller analytic sample entering the labor market.

Our focus in this paper is on two sets of outcome variables – internship experiences and job search strategies. We asked students about the total number of internships they held during college related to their major, and then several items gauging their overall impression of their most recent internship. From these we created the Internship Experience scale, which contains 7 items (alpha=.95) that measure respondents' experiences with their peers, supervisor, job responsibilities, and opportunities for skill development while at their latest internship. Response

Table 1: Sample Description

	Full Sample		Planning to Work	
	N	%	N	%
School				
Southern Public	304	52.9%	235	55.0%
Northeastern Private	271	47.1%	192	45.0%
Gender				
Female	249	43.4%	185	43.3%
Male	325	56.6%	242	56.7%
Field				
Chemistry	249	43.3%	172	40.3%
Chemical Engineering	326	56.7%	255	59.7%
Race Ethnicity				
Asian	197	34.3%	139	32.6%
Black or Hispanic	86	15.0%	57	13.3%
White	292	50.8%	231	54.1%
Degree Level				
Bachelor	420	73.0%	288	67.5%
Master	14	2.4%	11	2.6%
Doctorate	141	24.5%	128	30.0%
Nativity				
Born in the US or to Citizen Parents	435	77.8%	336	78.7%
Born Abroad to Non-Citizen Parents	124	22.2%	91	21.3%

options ranged from "Very Satisfied" to "Very Dissatisfied" on a 7-point scale. We measured job search strategies by asking students to report how often they engaged in ten strategies to find jobs. These ten items were measured on a Likert scale of (1) = "never" through (7) = "a great deal." These ten items asked how often students used the internet, went to career orientation programs, used campus placement offices, talked to people experienced in their career area, developed their resume, prepared for interviews, submitted their resume to places they wanted to work for, talked to their classmates, talked to their mentors or advisors, or used referrals from their friends or family members to search for jobs.

Our primary independent variables include two ascribed statuses: (1) Gender – a dichotomous variable indicating whether the gender identity of a respondent was female or male; and (2) Race or Ethnicity – measured as three broad categories including White or European origin, Asian origin, and African-American or Hispanic origin. Other control variables included in our multivariate analyses include self-reported GPA, field of study (chemistry vs. chemical engineering, degree level (BS, MS, Ph.D.), institution (public vs. private), nativity (foreign versus U.S. born) and sexual orientation (exclusively heterosexual vs. other). We also control for internship experiences using the scale developed above, since those with positive internship experiences may be more likely to get directly hired into entry-level positions. If a job has already been promised to an intern upon graduation, this would limit any further job search behavior.

Analytic Approach. We utilize OLS regression to estimate the effects of the independent variables on the dependent outcomes (job search strategies and internship experiences). For ease of interpretation, we present coefficients for our main analytic variables only in the tables, although control variables are present in the equation and listed in table footnotes.

Results

Table 2 presents the results of two-way ANOVA's based on gender and race for all outcome variables. The first two rows reveal no significant gender or race differences in the number of internships or the overall rating of the last internship experience, thought there was a slight tendency for African-American and Hispanic students to rate their internships less favorably. Turning to the job search strategies themselves, there is little evidence that women are using fewer job search strategies. The significant gender differences found generally show women making greater attempts to use certain search strategies relative to men [talking with individuals in field, practicing interview questions, submitting resumes]. There is, however, substantial evidence of race differences in search strategies that could disadvantage African-American and Hispanic students; as well as race by gender interactions indicating a particular surfeit of search strategies among minority men. Asian students, by contrast, show higher levels of search engagement on virtually every measure than even majority white students. Turning to the type of strategies used by students, we see that 3 of the four social capital strategies reveal race differences in engagement that disadvantage African-American and Hispanic students – talking with individuals in field, talking with peers, and talking with mentors or advisors. Only family and friend referrals show no overall race differences. Moving to self-marketing behaviors, African-American and Hispanic students were less likely to use on-campus resources and submit resumes to employers.

Because race differences may be confounded with other background characteristics, we ran initial multivariate analyses and report the results in Table 3. In a multivariate context, none of the previous gender differences in search strategies were significant. Nor were any of the contrasts between search behaviors of Asian origin and white students. However, many of the contrasts between students of color and white students remained statistically significant. In particular, two of the four social capital strategies showed lower utilization among African-American and Hispanic students – talking with peers and getting referrals from family and friends. With respect to self-marketing strategies, African-American and Hispanic students were less likely to search the internet or submit resumes for jobs, attend career programs, or practice interview questions. We also controlled for the impact of internship experiences among those who had them. Negative internship evaluations were strongly related to increases in other search behaviors, while positive internship evaluations decreased other search behaviors, presumably because these more often led directly to entry-level jobs.

Table 2: ANOVAs for Job Search Strategies with Gender, Race, and Gender* Race

	Gender		Asian			Black/Hispanic			White			
	Women	Men	All	Women	Men	All	Women	Men	All	Women	Men	Significance
Internship Experience	4.26	4.01	4.10	4.24	4.01	3.68	4.06	3.50	4.23	4.30	4.17	
Number of Internships	2.74	2.72	2.83	2.93	2.77	2.39	2.44	2.36	2.74	2.69	2.80	#G
Talked with Peers	4.66	4.20	4.83	4.75	4.88	3.93	4.11	3.85	4.71	4.71	4.72	#R
Talked with Mentor/Adviser	3.12	2.83	3.50	3.31	3.63	2.91	2.67	3.03	3.07	3.10	3.04	#R
Used Friend/Family Referrals	3.38	3.05	3.55	3.40	3.64	2.93	2.89	2.95	3.48	3.46	3.50	
Talked with Individuals in Field	4.54	4.10	4.71	4.71	4.71	4.32	5.17	3.92	4.46	4.35	4.58	#G #R*G
Searched for Jobs on the Internet	4.64	4.21	4.78	4.67	4.85	4.12	4.11	4.13	4.69	4.71	4.66	
Practiced Interview Questions	4.55	3.98	4.87	4.93	4.83	4.11	4.94	3.72	4.31	4.30	4.32	#G #R*G
Developed Resume	5.17	4.34	5.27	5.24	5.29	5.02	5.94	4.59	5.18	5.02	5.33	#G #R*G
Submitted Resume	4.91	4.31	5.27	5.31	5.24	4.35	5.28	3.92	4.64	4.65	4.64	#G #R
Attended Career Orientation Programs	4.05	3.50	4.42	4.38	4.45	3.35	4.00	3.05	3.86	3.89	3.82	#R
Used Campus Placement Office	4.24	3.19	4.78	4.91	4.70	3.67	4.33	3.36	3.84	3.89	3.78	#R
N	185	242	139	55	84	57	18	39	231	112	119	

#G = significant differences in means by gender

#R = significant differences in means by race

#R*G = significant interaction effect between race and gender

Table 3: Search Strategies Regressed on Gender, Race, and Internship Experience (N=427)

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	Talked with Peers		Talked with Mentor/ Adviser		Friend/ Family Referrals		Talked with Individuals in Field		Searched Internet		Practiced Interview Questions		Developed Resume		Submitted Resume		Career Programs		Used Campus Career Office	
Female	-0.12		-0.19		-0.22		-0.08		-0.22		0.03		0.33		0.09		-0.34		0.52	
Asian	0.05		0.30		-0.26		0.09		-0.06		0.36		0.32		0.21		0.31		1.03	
Black or Hispanic	-0.99	**	-0.18		-1.02	**	-0.37		-1.01	**	-0.57	+	0.25		-0.84	*	-0.80	*	-0.13	
Intern Experience	7.13	***	7.10	***	6.99	***	7.12	***	7.07	***	7.09	***	7.24	***	7.11	***	7.05	***	6.89	***
R-squared	0.85		0.84		0.81		0.85		0.82		0.83		0.47		0.83		0.83		0.44	

***=.000; **=.01; *=.05; +=.1

Conclusions and Future Work

These results show surprisingly few gender differences in the intensity of job search behaviors among recent STEM graduates in chemistry and chemical engineering, but marked limitations in the job search strategies of students of color (not including Asian origin). The pattern of results consistently showed Asian origin students engaging in the most intense and diverse search behaviors prior to graduation and African-American and Hispanic students engaging in the fewest, with white students in-between these two groups. Further exploration shows that this disadvantage is most pronounced among minority men, while African-American and Hispanic women engage in search strategies at levels similar to their white peers. Future models of job search strategies will (a) incorporate controls for parents' occupation, class background, student debt, and participation in clubs and organizations within their major (b) further explore interactions between gender and race, especially the diverging strategies of women and men of color in these STEM majors, and (c) add interactions between race and major, and race and degree level where sample sizes permit, to ascertain what might underlie the less intensive search strategies used by minority men in particular. We also intend to expand our outcomes and directly model internship participation and the internship experience scale to see how these precursors to good jobs might operate differently for women or students of color. These will enable us to better assess where interventions in the search process might be most effective for men and women in disadvantaged minority groups.

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