

Post-Baccalaureate Interventions

Interventions targeted at graduate students, postdoctoral fellows, and young faculty members can be even more influential in broadening participation than undergraduate interventions. Post-baccalaureate students have demonstrated that they can succeed in science. If they had the necessary support, such students would be more likely to make decisions that would increase the numbers in research careers. Presenters at the conference described a number of programs that can provide such support, from post-baccalaureate research programs that can prepare students for graduate school to summer programs for new faculty.

POST-BACCALAUREATE RESEARCH PROGRAMS FOR ASPIRING PHD STUDENTS: WHO CHOOSES THEM AND WHY?

Aspiring PhD students have multiple reasons for enrolling in a post-baccalaureate research program before beginning graduate school. Some want to try research to see if they like it; others are changing career trajectories. Some want to get into the best graduate programs, while others are seeking to reconcile their self-image or strong cultural ties with the culture of biomedical research. Robin Remich of Northwestern University explored these reasons using multiple social science theories in presenting the initial findings of a study of such students who had enrolled in NIH-funded Post-Baccalaureate Research and Education Programs (PREPs) around the country.

The study sample consisted of 53 participants from seven PREP programs. Forty-two percent were Latino, 47 percent African American, 4 percent American Indian/Alaska Native, 4 percent more than one race, and 2 percent each Asian/Asian American and white. Neither parent had a bachelor's degree for 47 percent of participants, while 17 percent had at least one parent

with a bachelor's degree as the highest degree, and 36 percent had at least one parent with a master's degree or above. Seventeen percent had no previous research in a biomedical field, 17 percent had one experience, and 66 percent had two or more experiences. With regard to graduate school preparation, 42 percent took the GRE before starting PREP, 25 percent had applied to graduate school, and 4 percent were already accepted to graduate school.

Building Skills

Remich identified a number of skills that students acquire on an idealized trajectory toward the PhD. As beginning researchers, they learn lab techniques and observe others. As they start to become independent, they design experiments, analyze data, present results, and follow protocols. When making connections, new researchers contribute in the lab, raise questions, look for literature, and write proposals. As they develop an identity as scientists, they complete independent projects, produce papers or theses, and network beyond the lab. The nature and quality of these experiences can be influenced by a large number of factors, including mentoring, personal support, messages about gender and race, and exposure to other researchers.

When students do not feel that they are ready to begin a PhD program, they may seek a program like PREP. The program consists of one to two years of mentored research on an independent research project. Additional activities include application guidance, GRE preparation, graduate classes, journal clubs, attendance at conferences, interview practice, and writing support. The idea is to prepare students to succeed in graduate school.

Remich looked at several different kinds of students for whom PREP is valuable and explained their differences using social cognitive career theory, identity development, and cultural capital as analytical frameworks. *Interest testers* want to try research. As one such student said, "I wanted to pursue an MD, but I never knew what research was all about. . . . I really didn't pursue it much, until my senior year. I started working in the lab, and that really sparked my interest. Some of the teachers held PhDs, and they told me about real research, not just you and a rat and a crazy dark room. So I just decided to try out the PREP program." From a cultural capital perspective, such students need experiences to build knowledge of practices, norms, and expectations of real research. They want to test a new interest and then decide if and how research will become part of their long-term career goals.

Career changers want experience for a new career intention. According to one such student, who was formerly interested in medical school, "I knew I wanted to get my PhD . . . So I knew I needed research . . . hence, the PREP program, which is a one-year post-bac research experience that prepares you for grad schools. It fit 100 percent. I needed that to get to grad school. I needed the research to say I did it, I can survive, this is what I want to do." Such students may have experience with research in another field and know that they want to get a science PhD. Their goal is to prepare for a new field while gaining awareness of options and steps toward biological science ca-

reers. They can be confident because of mastery gained in another field but also know that they have deficits in science research that they need to remedy.

Confidence builders want to be sure before they make a commitment to a PhD. As one said, "even though chemistry was my major, I was on the biochemistry track. . . . I knew I liked biology. So I was, like, 'Well, I don't want chemistry for graduate school, but I'm not sure exactly what area I want. . . . Maybe I should consider a program like [PREP]. I'll get to see research pretty much every day for a more extended period of time than the summer programs, to see if this is really what's right for me.'" These students are not ready to commit based on inconsistent experiences. PREP allows them to clarify future goals and feel more secure about their identity as a researcher.

High shooters want to get into the best programs and hit the ground running to excel. One student said, "in my final year of undergraduate studies I wanted to really invest all of my time and effort into keeping my GPA up," and PREP gave the student a chance to excel in research as well. Minorities in this situation may feel pressure during senior year to complete work at a high level and "work twice as hard because racism still exists." In this case, enrolling in PREP is a strategic decision to help them achieve their high goals.

Big thinkers need to reconcile their self-image as scientists with the culture of biomedical science. One said, "I couldn't talk the talk and walk the walk . . . in front of those professors. I got really nervous. . . . So that's one of the things that I'm looking forward to through PREP, is to be able to explain things more clearly." Such students can be vulnerable because of inflated confidence in their ideas, especially when they are challenged to focus and explain their ideas. PREP allows them to build credentials for graduate school, integrate into a lab community, and practice talking about their science.

Finally, *cultural straddlers* need to reconcile strong cultural ties with the culture of biomedical science. They may be attracted to research if it is related to their own culture and have difficulty envisioning a future if research conflicts with cultural expectations. As one such student said, a home culture "is something that you grow up with . . . for your whole life, and then you kind of get removed from it. It's kind of hard to function, I guess. I need to go every now and then just to hear the music and meet some people."

Multiple Needs

PREP can meet multiple needs, Remich observed. It offers a breadth of experiences to move toward the PhD. Knowledge of why different students seek PREP can help programs consciously design services or select only students they are prepared to assist.

PREP also helps students come to terms with their own needs. They can get credentials, GRE preparation, graduate courses, and experience with research.

In the future, said Remich, the program plans to use exit interviews to study the impact of PREP on scholars and their decisions. It also will use the data from PREP scholars to analyze their longer-term outcomes toward PhDs and careers.

THE FISK-VANDERBILT MASTERS-TO-PHD BRIDGE PROGRAM

Fisk, a highly regarded historically black university, and Vanderbilt, a research-focused institution that also has a strong academic reputation, began building the Fisk-Vanderbilt Masters-to-PhD Bridge program seven years ago with the idea of developing a model for such partnerships. The program links the universities, helping students transition from one to the other and combining resources to enhance their experience at both schools. "We wanted to do this in a way that honors and respects and capitalizes upon the rich cultural complementary aspects of the two institutions," said Keivan Stassun, a professor of physics and astronomy at Vanderbilt and co-director of the program.

Since 2004, the program has enlisted 50 students. Of those, 44 came from underrepresented minority backgrounds, and 33 have completed their master's and begun a PhD. Like PREP, the program identifies students who are completing or have recently completed undergraduate degrees in science and engineering fields and who aspire to a PhD but for a variety of reasons are not ready to jump into a PhD program. Stassun explained that recruiting is a large part of the program. "We work very hard in this program to identify students with promise and potential," he said, comparing the task to that of an athletic scout. Program administrators solicit applications, searching for students with raw talent who they think will thrive under the Bridge curriculum. The retention rate is 94 percent.

The Master's as Preparation for the PhD

The Bridge program uses the master's degree as a stepping stone to the PhD. Students are initially admitted to a two-year program at Fisk, and then to the PhD program at Vanderbilt. The program provides full funding for the master's degree, and hands-on research training. Some GRE preparation is included, but administrators strive to help students develop a rich portfolio, with qualifications that diminish the importance of the GRE as a metric. Once students complete the Bridge program, they have fast track admission to a PhD with full support.

Stassun emphasized the importance of master's degrees in preparation for a doctorate. Between 1987 and 2006, the number of minority-serving institutions with a terminal master's degree in physics, computer science, and engineering increased by nearly 80 percent, and the number of underrepresented minorities earning those degrees went up 533 percent.¹ Research at the University of Washington that sampled over 80,000 students found that underrepresented minorities were much more likely to move from a baccalaureate degree to a master's before getting their PhD and were likely to

¹Stassun, K. G., S. Sturm, K. Holley-Bockelmann, A. Burger, D. Ernst, and D. Webb. (2011). The Fisk-Vanderbilt Master's-to-PhD Bridge Program: Recognizing, enlisting, and cultivating unrealized or unrecognized potential in underrepresented minority students. *American Journal of Physics* 79:374.

complete all three degrees at different institutions². The students have been making this path for themselves, Stassun said. The Bridge program is there to give it support.

Stassun called the master's degree a "safe rehearsal space" for students. "It's important that the students have an opportunity and a space to build up to that quality of performance, where they feel safe to make mistakes, where they feel safe to look dumb, where they can learn from their peers. And then they make their debut before their eventual evaluators, looking like they're really on the ball."

However, the program does not encourage minorities to go the master's route rather than directly to the PhD. "What we did not want to do," Stassun said, "was to build a program where we said, you're not ready for our PhD program, so go earn a master's degree and call us in two years. This is intended to be a path to the PhD from day one."

Students begin the program with a joint advising committee consisting of one faculty mentor at Fisk and one at Vanderbilt. Ideally the faculty are collaborating in research to some degree, which makes the transition even smoother. Courses required for the master's also fulfill some of the PhD requirements, so students can enter with advanced standing. Thesis research for the degree must be conducted in either a Vanderbilt lab or a Fisk lab that collaborates with a Vanderbilt lab, so that students get to know the faculty and become recognized. Also, students are required to take at least one PhD level course at Vanderbilt while completing their master's. The students in the program have built a strong community, although the early years without a critical mass of students were challenging, Stassun said.

Faculty also meet with the students to discuss hidden aspects of graduate school culture that may not be otherwise apparent. They are explicit about expectations and what is required to do well and impress advisors and mentors.

The program has been very experience based, Stassun said. "With our social science colleagues, we're beginning to name the core precepts of the program, in terms of theoretical mechanisms, so that other people can try to understand what really is important about what we're doing and why."

Careful attention to the students is critical, Stassun said. Because the program strives to consider qualifications beyond grades and other paper metrics, faculty have had to name the attributes and characteristics they are looking for: passion, persistence, an entrepreneurial spirit, creativity, commitment. "It has been profoundly impactful for us to write this down and say the words and breathe on them and give them significance, because it forces us to stay focused on these qualities," Stassun said.

With this in mind, recruiters have developed a protocol for what they ask in interviews. "We know that the students who go through our program are about to undertake what is probably the most challenging and rigorous academic experience of their lives." Interviewers look for people with mental

²Lange, S. E. (2006). *The Masters Degree: A Critical Transition in STEM Doctoral Education*. PhD Dissertation, University of Washington.

toughness and “a certain level of grit” who have demonstrated that they have the inner strength and external resources to survive.

Measures of Success

Vanderbilt has seen an increase in underrepresented students applying for a PhD, due to an interest in the program and the realization that people at the school are committed to students’ success. Money is another measurement of the program’s success. “We all know graduate education is a very expensive proposition,” Stassun said. Funding comes overwhelmingly from research grants, not training grants. This speaks to the quality of the junior faculty at both universities, Stassun pointed out, many of whom received large NSF CAREER awards over the course of their involvement in the Bridge program.

The Bridge program draws primarily from minority-serving institutions but also has proven attractive to students at top undergraduate colleges. Not all students choose to complete their PhDs at Vanderbilt. One graduate is on track to become the first African American woman to earn a physics PhD from Yale. The partnership also has generated institutional benefits for both universities. Since 2006, Fisk has been the top producer of African American master’s degrees in physics, and one of the top ten producers of those degrees for all U.S. citizens. “This is not just a feeder program,” Stassun emphasized. “There are real, substantial, lasting capacity-building benefits for the HBCU partner in this case—and tremendous bragging rights.”

A challenge in sustaining the program has been sustaining the individuals who are working to keep it going. “This is exhausting work and it is incredibly rewarding, as you all know,” Stassun commented. But he also cited Charles De Gaulle’s dictum that graveyards are full of indispensable men. Programs need to be sustainable beyond the efforts of the heroes who created them.

The Bridge program does more than enhance the overall quality of the practitioners in science and engineering research, Stassun concluded. “It makes the face of science appear more like the face of America. We meaningfully touch lives that extend into deep and long histories. It is a profound thing to remember and to realize.”

GRADUATE AND NEW FACULTY INTERVENTIONS AT UMBC

A successful intervention for the University of Maryland, Baltimore County (UMBC) has been the use of a dissertation coach, said Renetta Tull, assistant dean for graduate student development at UMBC and Director of PROMISE: the National Science Foundation’s Alliance for Graduate Education and the Professoriate (AGEP) for the state of Maryland. In 2005 UMBC’s then-Associate Dean of the Graduate School (and current Dean and Vice Provost for Graduate Education) Janet Rutledge learned about Wendy Carter-Veale, owner of “TADA: Thesis and Dissertation Accomplished,” a small higher education company that specialized in helping students complete

degrees through workshops and distribution of course materials on the topic. With funding from NSF through PROMISE, Maryland's AGEP, and the Council of Graduate School's PhD Completion Project, UMBC hired Carter-Veale on a part-time basis to bring her expertise in-house. In 2005, Rutledge, Tull, and Carter-Veale learned about Sonja K. Foss' Scholar's Retreat at the University of Colorado-Denver, where graduate students paid to attend a two-week writing camp designed to help them complete their dissertations. The idea of combining UMBC's new in-house dissertation coach as a prominent feature of the annual PROMISE team-building retreats, which began in 2004, grew from that example.

The first PROMISE retreats, with graduate students from UMBC, the University of Maryland College Park, and the University of Maryland Baltimore (UMB, the founding campus that houses the medical school) took students to West Virginia for three days. Other weekends have taken place in various parts of Maryland, but most of the sessions for the Dissertation House are now on UMBC's campus, running in four-day blocks from 9 to 5 each day. Students sign up for one-on-one coaching sessions and spend the rest of their time listening to mini-lectures, participating in interactive exercises, and writing. The dissertation coach provides encouragement, guidance, and direction, giving talks on professional development, time management, goal setting, stress management, and overcoming writer's block. All students are required to set measurable goals for their time at the dissertation house. Since the dissertation coach has a faculty background, Tull said, she can help students understand the faculty perspective, acting as a liaison between students and advisors. Between 15 and 18 students participate in each session, and the campus holds two to four sessions per year. The coach also provides a 1.5-hour workshop on thesis and dissertation completion for UMBC's graduate school community each semester and holds office hours either in-person or through video chats. Students receive invitations to participate in the Dissertation House via a university listserv and campus intranet. Students also receive invitations through their subscriptions to the website and blog for the Dissertation House and through the social media presence that PROMISE maintains on Facebook, Twitter, and LinkedIn.

Role of the Dissertation Coach

"The dissertation coach is a cheerleader for the student, an advocate for the student, a leader, a teacher, a colleague, an administrator, and a mentor," said Tull. The coach serves as each student's "counselor and confidante." The dissertation coach may give a student advice on navigating the job market, public speaking, and preparing for a thesis defense. An online community is also part of the program so that students without physical access to the retreat can participate. Students blog throughout the year using the website for the Dissertation House to continue to share daily goals with each other and to have a regular, virtual connection to the coach.

Tull emphasized that the dissertation coach is not a replacement for the advisor, but a supplementary mentor for the students and someone who can

work alongside the advisor to make sure students have all the resources they need to complete their program. “Unfortunately, not every advisor is a great mentor,” Tull pointed out. “Sometimes they think that the students are just going to get it, or that they will learn from the others in their lab or the others in their group. But it doesn’t always work by osmosis, and some students need someone else to be alongside them to help.”

Each department has different format and presentation requirements for a dissertation, but some errors are common across disciplines, Tull said, and can be targeted without worrying about specifics. The dissertation coach also does a session for students early on in their graduate seminars, to help them prepare for the coming years. Students can participate in the dissertation house as early as their first year, although the program gives priority to any student graduating with a PhD in the next six months and those recommended by faculty members.

Tull referred to “raw drafting” as a useful exercise for students to keep them from getting stuck in the writing process. Based on a writing process that Ben Dean of MentorCoach, LLC, introduced to graduate students at College Park, students in the Dissertation House are guided through the process to write for a specified period of time without stopping, regardless of what their results look like. “You write without stopping to correct your spelling, without stopping to correct your grammar,” said Tull. “Even if you draw a blank and you can’t think about what the next thought should be.” Although the task is intimidating the first time, she reported that many students became very efficient at producing work under those conditions. The program also holds public speaking workshops, allowing students to practice presenting to an audience. “This gives them an opportunity and a safe environment with people who are going to be supportive to talk about their research,” Tull said.

“PhD completion is a process, and it doesn’t always have structure,” Tull said. “Students don’t really see the end of the road, so they’re not able to understand it.” The dissertation coach helps students develop a schedule and move from one step to the next, and follows up with those who drop off the radar. “We want to make sure that if they’re demotivated, they’re not just in a depressive mode, sitting and not doing anything,” Tull said. In the years since the program began, the dissertation coach has also served as a counselor, helping students with personal issues they may not have shared with their advisor.

At UMBC the dissertation coach splits her time between coaching and program evaluation, and funding comes from grants and some institutional resources. Currently, the budget does not allow for a full-time position, so the coach works 60 percent at the university and fills the rest of her time consulting for other schools.

The Summer Success Institute

Tull also spoke later in the conference about the PROMISE Summer Success Institute, which is an intervention to ease academic transitions for STEM graduate students, postdoctoral fellows, and faculty of color. The Summer

Success Institute is a conference held every August. When it began in 2003, it was focused on graduate students, but it has expanded to postdoctoral fellows and young faculty because the alumni of the program were interested in continuing to participate.

Through plenary presentations and breakout sessions, the institute is designed to help participants move to the next level. "Originally we wanted to make sure that our graduate students were going to be prepared particularly for their proposals and for their dissertation defenses, because we noticed that a lot of our students had a lot of knowledge and a lot of intellect, but they weren't always able to communicate it effectively," said Tull. The institute also provided students with strategies such as sitting in the front of the classroom, going to office hours, and communicating with faculty.

Given the success of the original institutes, the program was expanded to other groups. It now has talks on such subjects as faculty interviews, understanding tenure and promotion, and the use of social media. A recent speaker was Dr. Randall Pinkett. "He was the winner of *The Apprentice* in the early years," said Tull. "He also has a PhD in STEM fields, so he is an engineer. But he came to talk to us about taking the road and what do you do when no one has gone before you: You keep on walking and you just keep on moving forward, even when no one has traveled the road before you."

The institute was originally held on college campuses and two weeks long, but that did not work well. Now it is held at a central hotel and has two days of programming, and that model is working well, according to Tull.

The institute has a family environment for faculty or graduate students with children. Evaluations have been overwhelmingly positive. In recent years, the institute has expanded to the social sciences. "That was one of the best things we ever did," said Tull. However, a major and continuing challenge has been covering the expense of the event, which has ranged between \$7,000 and \$15,000.

MENTORING, NETWORKS, AND INTERVENTIONS FOR PREDOCTORAL MINORITY SCHOLARS

There have been few systematic examinations of the effect of the social capital of graduate advisors on the post-PhD career trajectories of minority scholars. Social capital encompasses social networks and connections in gaining access to knowledge, institutional resources, and other support, and graduate school and early-career mentoring is a key process by which exposure to these social networks takes place. In more measurable terms, mentoring can create conditions for success in graduate school and beyond by increasing scholarly productivity, grant funding, service to the discipline, and progress toward tenure and promotion.

Jean H. Shin, Director of the ASA Minority Affairs Program, presented the results of a NSF-funded study by Roberta Spalter-Roth, Olga Mayorova, and Shin. This study examined whether mentoring by white male advisors (the dominant group in academic disciplines) has a significant effect on the career trajectories of participants in the American Sociological Association's (ASA) Minority Fellowship Program (MFP) when compared with two other

groups—awardees of the NSF Dissertation Improvement Grants in sociology, and a control group of PhD graduates in sociology, when other factors are held constant. The study population included PhD cohorts from 1997 through 2009.

A study database was created including information on demographic, institutional, and employment characteristics, professional association activities, publications, grants, and tenure status. This information came from ASA and NSF records, on-line curriculum vitae, and Google searches. Names of dissertation advisors and dissertation topics were found in the ProQuest theses and dissertation database.

Specifically, the study examined graduate mentors' roles in significantly increasing the likelihood of pursuing an "ideal" career compared to an "alternative" career. This "ideal" career path starts at a research I graduate program, leads to employment in a tenure-track position and tenure at a research I institution, and involves scholarly productivity in the form of peer-reviewed journal articles and books as well as scholarly presentations and external grants, all leading to increasing prestige in the discipline. The "ideal" career path is assumed to be the model for graduate training. "Alternative" careers include employment in applied non-academic positions, employment at minority-serving institutions, or employment at teaching-oriented or non-research extensive institutions. An "alternative" career can be a matter of choice or a matter of failure to successfully pursue an "ideal" career.

Findings

According to Shin and his colleagues, the three groups are not precisely comparable. Members of the NSF awardee group are most likely to have attained their PhDs at a research I institution (97.7 percent did), are almost entirely white, and are more likely to have graduated more recently than the other two groups. Therefore, this group would be expected to do better than the MFP or control groups. Members of the control group are also more likely to be white, while the MFP group includes only non-white racial and ethnic minorities. The MFP group, however, is more likely to attend graduate school at research I institutions than the control group (81.5 percent compared to 69.6 percent).

The descriptive findings from the study suggest that participation in MFP by itself does not "level the playing field." MFP scholars, in general, do less well than the NSF awardee group and about the same as the control group in terms of attaining successful "ideal careers." They are less likely to obtain post-PhD appointments at research I schools than either the NSF group or the control group (11.1 percent compared to 15.2 percent and 36.8 percent, respectively). They are less likely to have tenure-track positions than the NSF awardee group but equally likely to have this status compared to the control group (60.2 percent, compared to 71.8 percent and 61.4 percent, respectively), and they are more likely to be employed in "alternative" career positions, especially at minority-serving institutions, compared to the NSF awardee group and the control group (18.5 percent compared to 5.6 percent, and 10.1

percent, respectively). In terms of scholarly productivity, they publish fewer peer-reviewed journal articles than the NSF group, but the same number as the control group (with a median of five articles compared to three articles). They are less likely to receive at least one major NSF research grant than the NSF awardee group, but are more likely to do so than the control group (9.2 percent compared to 16.8 percent and 9.2 percent, respectively).

Regression Results

Shin reported that the success of the MFP group improves significantly when they have access to the social capital of white male mentors. According to the results of logistic regression analysis, having such a mentor has a direct effect on attaining a position at a research I university for MFP PhDs. Holding other variables at their means, MFP Fellows with white male advisors are about three times as likely to obtain this type of position as MFP Fellows without white male advisors. Having a white male advisor does not have a significant effect for the NSF awardee group or the control group. This may be because the NSF awardee group is already on the track to have an "ideal" career and members of the control group are less likely to be at graduate programs that have white male mentors with the most social capital. This finding suggests that MFP Fellows require the social capital that white male mentors can provide in order to obtain "ideal career" positions at research I institutions.

Once positioned through white male advisors at a research I institution, the career paths of former MFP Fellows continue to follow an "ideal" career trajectory, although having a white male mentor is no longer a direct effect. Employment at a research I university is positively and significantly related to publication rates, regardless of the comparison group, with former MFP Fellows less likely to publish in the three top journals in sociology. This failure to publish in the top three journals may be because former MFP Fellows are less likely to submit to these general sociological journals, perhaps because they regard them as less likely to publish on topics that MFP Fellows consider important to broadening the discipline such as race and ethnicity, gender, and minority health disparities. Both former NSF awardees and former MFP Fellows are more likely to participate in disciplinary leadership activities than the control group, seemingly as a result of their status at research I schools. White male mentors once again have a direct effect for obtaining tenure on time. Having a white male mentor in graduate school has a direct positive effect on receiving tenure within seven years after graduating while holding other variables constant. There is no statistically significant difference in the likelihood that NSF awardees and MFP Fellows will receive tenure within this standard time frame compared to the control group. Given that white male mentors do not appear to have significant influence on the number of publications, NSF grants, or section leadership, additional research will be necessary to understand their continued importance for the earning of tenure.

Shin further noted that more former MFP Fellows than former NSF awardees or members of the control group work at HBCUs and other

minority-serving institutions, and MFP Fellows and control group members are somewhat more likely to be employed in non-academic positions than former NSF awardees. Graduate training at research-intensive or doctoral universities and having minority male and female advisors are positively related to pursuing an "alternative" career trajectory. Other factors such as writing a dissertation on race or ethnicity issues do not have a significant effect on career attainment.

Conclusions

Shin drew several conclusions from this report. Early-career minority PhDs in the scholarly pipeline may not have similar resources, professional opportunities, supportive environments (especially if they are the only minority faculty member in a department), and protection from perceived negative behaviors as their white peers, especially those who have been awarded NSF Dissertation Improvement Grants. Participation in MFP gives minority doctoral students a leg up compared to minority students who are not part of the program. But MFP, by itself, does not appear to be sufficient for pursuing "ideal" careers. High-status white male mentors are instrumental to MFP Fellows in securing academic positions at high-status research I universities. This is partly because there are proportionally fewer minority faculty members in high-status positions with the social capital to move their students into "ideal careers."

Shin went on to note that former MFP Fellows are more likely to pursue "alternative" career paths. These career paths may be choices for those who do not wish to pursue careers in the academy that emphasize extensive academic publication and grant-based research as criteria for advancement, but may wish instead to pursue careers with stronger connections to teaching, applied research, public policy, sociological practice, or service to minority-serving institutions. In fact, minority graduate mentors may encourage such careers for MFP Fellows who are likely to have backgrounds that include research or employment in areas including health care services, health disparities, drug abuse, domestic violence, and HIV/AIDS prevention. These Fellows may wish to continue to serve predominantly minority communities with the added expertise of their doctoral-level sociological training. Shin noted that the study authors are not fully confident that these "alternative" careers are clear choices or the result of the lack of social capital that leads to "ideal" careers.

The researchers plan to enlarge the study sample by adding three more cohorts so that the intersectional analysis between fellows and mentors becomes more valid. They also plan to add data on publications and the grant status of mentors to further understand the effects of the mentoring relationships. And they will examine co-authorship patterns to see if NSF awardees and MFP Fellows are more likely to be part of professional networks than the control group.

MODELING WOMEN'S CAREER CHOICES IN CHEMISTRY

Although money and resources have been devoted to improving the recruitment and retention of women at research-intensive universities, women remain underrepresented in these institutions. What is attracting women chemists to some careers—teaching and industry, in particular—over careers in academia? That question was addressed by Megan Grunert of Iowa State University, who with George Bodner of Purdue University has been examining the career decision-making process for graduate women in chemistry.

From 1999 to 2003, 32 percent of chemistry doctoral graduates were women. But over this same period, only 18 percent of applicants for tenure-track academic research positions in chemistry were women. In 2009, women held just 17 percent of the faculty positions at the top 50 funded chemistry departments. Women tend to be at smaller schools with less emphasis on research, in non-tenure track positions, or serving as instructors or lab coordinators.

Questions that Drive Motivation

Grunert described a study of six research faculty at three institutions, four teaching faculty at three institutions, and ten graduate students at two institutions. The institutions encompassed low, medium, and high percentages of women faculty.

With the graduate students, narrative analysis allowed individual voices and experiences to be heard, while cross-case analysis allowed for comparison across narratives. With the faculty, a constant comparative method allowed for data from each interview to be compared, while thematic analysis identified commonalities across interviews.

Women in chemistry ask themselves many questions as they consider career options. Among the questions listed by Grunert were:

- What career options are available?
- What do women I see in different careers tell me about what that career is like?
- How well does a career fit with what is important to me?
- Do I have what it takes to be successful?
- Does this work yield results that are meaningful for me?
- What stressors are involved in success in this career?
- Do I have to worry about a partner, children, elderly parents, etc., when making this decision?
- How congruent is my ideal self with my possible self in different careers?
- What career choice is most congruent with my ideal self and best fits my needs?

Grunert especially emphasized the four areas of expectation of success, personal values, career outcomes, and the cost or stress to self. These factors are weighed against each other when making a decision, she said.

Qualitative Results

Grunert cited representative statements from graduate students and faculty members in each of these four areas. In the area of expectation of success, respondents said:

I don't think I could do it. . . . I could do the teaching. [But] come up with the . . . new idea, that next big thing that really has the flavor of originality? While I might be able to get there eventually, I don't think I would get there soon enough to establish a program before tenure.

I'm not really very creative. I don't have the big research ideas, and I don't think I could survive in that environment, to have those big ideas and push them and do the grants and that kind of thing.

In the area of personal values, typical statements included the following:

I think being able to touch people is something that research, I mean, you can touch people with research, but being able to have that one-on-one contact . . . being able to see people respond . . . helping them understand a concept for example, that's a reward that I see a lot that I don't necessarily get from research.

Research really for me is constant problem-solving . . . that's a great challenge. You never get bored; there are always new questions . . . the challenge to my brain, every day's different, new problems all the time.

Regarding academic research career outcomes, students and faculty said:

I think everybody kind of comes into the science field thinking they're going to discover the one thing that's going to change the world and then you realize that's just not going to happen. That you're not part of the small fraction of people that's going to do that, and I'm now okay with that and I've learned to kind of think of other things that I want to do and where I feel more comfortable with my skills.

One of the problems I've had with even majoring in science and chemistry is that I couldn't see the relevance of it, you know, why is this important, why are we doing this, how does this relate to everyday life?

Finally, with regard to the stress or cost to self, typical statements were:

It takes so much time out of your life to do that kind of research, that if you start talking about, you know, having kids or having a family, juggling that on top of trying to get tenure and, you know, trying to do really good science . . . just seems impossible . . . you see your boss and you're just like, 'that's not the life I want.' I'm not that great scientist, and I don't want to pretend that I am and I don't want to put in 20 hours a day or 18 hours a day, you know, I don't want to think about science all the time.

I like the fact that it's not really a nine-to-five job. So I can set my own hours, and in fact, generally I work more than a nine-to-five job. . . . I like the idea of having like a little bit more freedom.

Conclusions

Both graduate students and faculty members recognize the challenges inherent in academic faculty life and success in a chemistry department, including time commitments, pressures to publish and obtain funding, and challenges balancing family and personal life. However, graduate students often fail to identify the primary rewards and career choice motivators reported by research university faculty, and they tend to overlook the positive outcomes from academic chemical research. Graduate students may lack confidence in their ability to be a successful academic researcher, and they may perceive that academic research is incompatible with their family and personal goals.

Grunert suggested giving graduate students more information through candid conversations between women faculty and graduate students and mentoring relationships between women in the department outside of the advisor–advisee dynamic. She also suggested making explicit the relevance and impact of chemistry research and providing professional development opportunities for graduate students.

In addition, chemistry departments need family-friendly policies that are supported and accepted, such as tenure clock stoppage and maternity/paternity leave. Dual-career couples receive such supports as job placement and recognition that both members of a couple are working. Departments also need to provide support for a balanced life and lower expectations regarding the amount of time spent in a lab.

The take-home message, said Grunert, is that career decision making for women in chemistry is complex and multifaceted. Women are making active choices, not “leaking from the pipeline.” There is a lack of visibility regarding the lifestyle of women in academic research, and the resistance to academic research careers among women reproduces the culture of academic research departments. Critical points in the decision-making process need to be targeted for interventions if more women are to be attracted to academic research careers.