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Article

What Do I Want to Be with My PhD? The Roles of Personal Values and Structural Dynamics in Shaping the Career Interests of Recent Biomedical Science PhD Graduates

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Interest in faculty careers decreases as graduate training progresses; however, the process underlying career-interest formation remains poorly defined. To better understand this process and whether/how it differs across social identity (i.e., race/ethnicity, gender), we conducted focus groups with 38 biomedical scientists who received PhDs between 2006 and 2011, including 23 women and 18 individuals from underrepresented minority (URM) backgrounds. Objective performance and quality of advisor relationships were not significantly different between scientists with high versus low interest in faculty careers. Career interests were fluid and formed in environments that generally lacked structured career development. Vicarious learning shaped similar outcome expectations about academic careers for all scientists; however, women and URMs recounted additional, distinct experiences and expectations. Scientists pursuing faculty careers described personal values, which differed by social identity, as their primary driver. For scientists with low interest in faculty careers, a combination of values, shared across social identity, and structural dynamics of the biomedical workforce (e.g., job market, grant funding, postdoc pay, etc.) played determinative roles. These findings illuminate the complexity of career choice and suggest attracting the best, most diverse academic workforce requires institutional leaders and policy makers go beyond developing individual skill, attending to individuals' values and promoting institutional and systemic reforms.

INTRODUCTION

The biomedical sciences (BMS) career landscape has transformed in the past half century. Forty years ago, the majority of PhD scientists progressed from graduate school to a faculty position, whereas today, only 14% of life sciences PhDs hold tenure/tenure-track faculty positions 5–6 yr after graduation (Stephan, 2012). Further, those pursuing an academic career face a significantly elongated path to independence—the average age at which new PhD investigators receive their first National Institutes of Health (NIH) RO1 grant is 42—and an academic job market in which the number of available tenure-track positions has not kept pace with the significant increases in the supply of newly minted PhDs (National Research Council [NRC], 2005b; McCook, 2011; Stephan, 2012). In line with these systemic changes, recent reports indicate many graduate students' interests in research careers decreases as their training progresses (Fuhrmann *et al.*, 2011; Sauermann and Roach, 2012), with many newly trained PhD scientists pursuing careers in policy, communication, law, and other nonacademic fields (Austin and Alberts, 2012).

Notwithstanding these changes, faculty members continue to play vital and unique roles in the scientific enterprise, shaping the national research agenda and training the next generation of scientists (Leggon, 2010). As such, funding agencies have invested significant resources in efforts to diversify the professoriate and research workforce (Handelsman *et al.*, 2005; NRC, 2005a) with the view that improving diversity is fundamental to advancing the BMS (Tabak and Collins, 2011).

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Diversity in many respects (including but not limited to, or exclusive of, personal demographic characteristics, such as race/ethnicity and gender) can improve research outcomes—broadening the scope of inquiry and increasing creativity in problem solving (Hong and Page, 2004; Schiebinger, 2008; NIH, 2012b). Further, faculty diversity has been shown to improve learning outcomes for all students, with a particularly positive influence on the retention and persistence of students from underrepresented backgrounds (Hernandez, 2000; Maton *et al*., 2000; Jackson *et al*., 2003; Carrell *et al*., 2009).

Despite these efforts, diversifying the professoriate remains "perhaps the least successful of the diversity initiatives" (National Academy of Sciences [NAS], 2011, p. 47), and the representation of women and minorities significantly lags in comparison with their share of PhDs awarded. African Americans, Latinos, Native American/Alaska Natives, and Native Hawaiian/Pacific Islanders (collectively underrepresented minorities, or URMs) receive nearly 13% of BMS PhDs awarded to U.S. citizens, but receive fewer than 5% of all NIH RO1 grants and are <2% of the basic science tenured/tenure-track (TTT) faculty at U.S. medical schools (Nelson and Brammer, 2010; NRC, 2011; NIH, 2012b). Similarly, women receive more than 50% of life sciences PhDs, but their representation on basic science TTT faculty at the most research-intensive institutions remains around 33% (Jolliff *et al.*, 2012). Thus, the diversity in the BMS PhD recipient pool is not reflected at the faculty level.

Strengthening the research enterprise and professoriate by ensuring the best researchers from all backgrounds participate requires a better understanding of the career decision-making process of recent PhDs, and how it might differ for scientists from underrepresented groups. Institutional hiring practices and climates have been cited as barriers to diversifying the faculty (NAS, 2011), and very recent evidence suggests that evaluation biases based on race/ethnicity and gender still exist, even when controlling for training and prior productivity (Ginther *et al.*, 2011; Moss-Racusin *et al.*, 2012). However, individual choice may also contribute to some of the underrepresentation seen at the faculty level. That is, highly skilled biomedical scientists from all backgrounds, including those underrepresented in faculty positions, may be choosing other career pathways because academic careers may be viewed as less attractive, welcoming, or satisfying than other professional options (NIH, 2012a).

This study begins to address the complex issue of career choice by examining the process and factors influencing the career decision making of 38 diverse recent BMS PhD graduates, focusing specifically on their interest in becoming faculty. This study addresses two research questions:

1. What is the process of career-interest formation toward or away from faculty careers?
2. To what extent does this process differ based on social identity, specifically, race/ethnicity and gender?

THEORETICAL FRAMEWORK

Vocational psychology has developed and empirically validated theoretical frameworks to understand, estimate, and explain differences in career choice (Fouad, 2007), and these can be useful in understanding career decision making in BMS. The social cognitive career theory (SCCT), and the social influence model frame this study. SCCT has been used to explain significant amounts of variance in the career choices of undergraduates from majority and URM backgrounds in science and engineering education (Lent *et al*., 2005, 2008, 2011; Byars-Winston *et al*., 2010) and is the basis of current interventions designed to broaden participation in the professoriate (Byars-Winston *et al*., 2011).

SCCT frames career attainment as a developmental process in which individuals make a series of personal decisions shaped by social and institutional context (Lent *et al*., 1994). SCCT posits that interests (i.e., "Do I want to do this?") lead individuals to pursue a particular training path (choice goals) and then to undertake the courses of action necessary to attain that goal (choice actions). Durable career interests are thought to result from positive self-efficacy beliefs and outcome expectations. Self-efficacy describes an individual's belief in his or her capacity to successfully execute the courses of action needed achieve a goal ("Can I do this?"), while outcome expectations frame an individual's anticipated outcomes for pursuing certain courses of actions ("What will happen if I do this?"). SCCT also recognizes the roles that personal characteristics (e.g., gender, race/ethnicity, disability status), learning experiences (e.g., access to role models, faculty or peer discouragement), and contextual supports and barriers can play in the process of career choice and development. This study examines whether and how recent PhD graduates describe the roles of self-efficacy, outcome expectations, and learning experiences in shaping goals and courses of action toward or away from pursuing faculty careers, as well as whether and how these vary based on social identity.

Recent work has also used a social influence model to frame the career intentions of undergraduate and graduate science students from URM backgrounds (Estrada *et al*., 2011). Estrada and colleagues showed that self-efficacy became a poor predictor of intentions to pursue a scientific career when "identification as a scientist" and "internalization of [scientific] values" were also considered. In this context, *values* refer to what matters and is important to the decision maker, and *identity* refers to the extent to which the decision maker has adopted the roles of and feels connected to a profession. In the face of challenges and barriers, it is important to consider the extent to which scientists from all backgrounds, including those underrepresented in the professoriate, make decisions about their interest in research and academia based on their values and the extent to which their values align with the values of academic culture. Thus, this study also considers whether and how individual values and the perceived values of the academy may play a role in the articulation of career goals, choice actions, and career decision making.

METHODS

Data Collection and Procedures

The purpose of this study was to examine how scientists who completed BMS PhDs between 2006 and 2011 made decisions about their career paths and to explore the extent to which decision making varied by social identity group. Therefore, a purposeful sampling strategy (Merriam, 1998) was developed to recruit a diverse set of participants with respect to

both social identity (i.e., race and gender) and career interest (i.e., faculty and nonacademic). Participants were recruited through listservs of PhD-level, science-policy professionals and academic and government postdocs; via direct contact at national scientific conferences; and with the help of graduate student and postdoctoral administrators at three research universities. Participants were also asked to recruit other eligible peers (i.e., snowball sampling; Bogdan and Biklen, 2007).

Potential participants completed a brief, online questionnaire, reporting demographic and academic information. Participants were also asked to indicate their interest in each of the following career tracks on a 5-point Likert scale: academic (research intensive), academic (teaching intensive), research career (nonacademic), or nonresearch career (e.g., consulting, policy, science writing, etc.). On the scale, 1 was equivalent to low interest, 3 represented moderate interest, and 5 indicated high interest. Thus, participants who answered 4 or 5 on either academic option (research or teaching intensive) were classified as having "high" interest in faculty careers, while those who answered 1–3 for both types of academic positions were classified as having "low" interest.

Eleven focus groups were conducted. Focus groups are ideal for promoting deeper understanding of how people think and feel about issues, experiences, and ideas (Kruger and Casey, 2000). Efforts were made to match individuals with similar levels of interest in faculty careers and, when possible, based on membership in a URM group. Groups ranged from two to six participants and met for 60–90 min. Participants were engaged around a series of questions exploring the development of their interest in science, changes in their career aspirations, graduate school and postdoctoral training experiences, and current professional goals. The protocol was semistructured, fostering consistency across focus groups but also allowing researchers to explore unique emerging phenomena. With participants' permission, all focus-group interviews were audio-recorded and transcribed. All participants were assigned and are referred to by pseudonyms. All work was done in compliance with the Pennsylvania State University (PSU) Office of Research Protections IRB #38896 (K.A.G. was affiliated at PSU during the period in which this research was conducted).

Data Analysis

Demographic, academic, and career-interest data were used to develop a profile of each participant and were analyzed by comparing the level of interest in academia based on objective performance measures, such as time to degree, number of publications, and training institution. Statistical analyses (*t* tests) were performed in SPSS (www.ibm.com/software/analytics/spss/).

The analytical design was informed by the team-based strategy used by researchers at the Centers for Disease Control (MacQueen *et al.*, 1998), with the goal of generating themes, trends, and understandings of common experiences across participants in the study (Bogdan and Biklen, 2007). Qualitative data were organized through a systematic, multistage process, consistent with the constant comparative method (Glaser and Strauss, 1967). Preliminary memos were written after each focus group to highlight first impressions of emerging themes. After interviews were transcribed, the transcripts and preliminary memos were read closely, and another set of analytical memos was written based on each focus group. Then comprehensive memos were drafted, identifying themes across all of the focus groups. Comprehensive memos were compared and discussed, and were then combined into an initial list of phenomena emerging from the data, capturing the ways in which PhD scientists described their career decision making. An initial list of inductive codes was developed based on these themes. The initial list of codes was supplemented through a deductive process, wherein codes capturing interview questions, propositions of SCCT, and the literatures on the development of faculty aspirations and academic socialization were added. This assisted in the process of identifying disconfirming evidence (inconsistent with emerging themes and overarching trends in the data), capturing the full range of participants' responses to questions.

Transcripts were then reread and coded. Code reports were generated, allowing the researchers to examine data assigned the same code and compare quotations with early perceptions of qualitative themes emerging from the data. To ensure trustworthiness of findings, the researchers were mindful of recognizing discrepant or disconfirming evidence, or examples not consistent with presented explanations and interpretations (Maxwell, 2005). Thus, in addition to presenting evidence supporting a theme, the researchers sought data inconsistent with the themes when establishing the salience and consistency the findings. Qualitative themes with similar underlying principles were clustered together, reflecting the ways in which various factors and experiences shape scientists' interest in pursuing careers as faculty. Larger narratives were then developed about the nature of participants' experiences during each training period and at each decision point, using data to support assertions.

RESULTS

Study Participants

Demographic and training information about study participants is found in Table 1 (full information on participants is found in Supplemental Table S1). The cohort included 38 scientists who received their PhDs at 28 different institutions between 2006 and 2011: 36 in the basic BMS, one in behavioral sciences, and one in other life sciences (NIH, 2012a). Eighteen participants (47%) belonged to URM groups (14 African American/black, 4 Hispanic/Latino), while 20 belonged to groups well represented in the BMS (17 white,

Table 1. Characteristics of study participants[a]

Interest in faculty position	High ($n = 19$)	Low ($n = 18$)
Female	14	9
Male	5	9
URM	7	10
Received PhD from top-50 funded institution	12[b]	15
Completed postdoctoral training	16	11
Currently a postdoctoral trainee	13	6

[a]One participant did not complete the demographic questionnaire but self-identified to the investigators as belonging to a URM group.
[b]One participant completed the PhD at an overseas institution.

Table 2. Objective performance measures for study participants

Interest in faculty position	High ($n = 19$)	Low ($n = 18$)
Median first author publications (range)	2 (0–12)	2.5 (0–7)
Median total publications (range)	7 (2–26)	6 (1–19)
Mean impact factor, journal publications (range)	5.8 (0.76–36.28)	6.1 (0.73–32.4)
Mean h-index (range)	5 (1–11)	4.7 (1–10)
Median years to PhD completion (range)	6 (4–8)	5.25 (4–7)

3 Asian). Twenty-three were women (11 from URM backgrounds and 12 from white/Asian backgrounds), and 15 were men (7 from URM backgrounds and 8 white). Twenty-eight completed postdoctoral training, including 20 who were postdocs at the time of the study. All participants were U.S. citizens/permanent residents, and all except one (Judy) completed graduate training in the United States. Of those completing PhD training in the United States, the majority (73%) received PhDs from one of the top-50 funded research universities.[1]

Quantitative Analysis

Objective Performance Measures Did Not Explain Differences in Interest in Faculty Careers. In this sample, the research productivity of the scientists with "high" versus "low" interest in faculty careers was comparable (Table 2). Scientists with high interest in faculty careers had a median of two first-author and seven total peer-reviewed publications (indexed in Scopus[2]); the journals in which they published had an average impact factor of 5.8; and these scientists had a mean h-index of 5 (Hirsch, 2005). Scientists in this sample with low interest in faculty careers had a median of 2.5 first-author and six total publications; the journals they published in had an average impact factor of 6.1; and these scientists had a mean h-index of 4.7. None of these differences were statistically significant ($p > 0.05$, two-tailed t test). Neither were differences in median time to degree significantly different between those with high versus low interest in faculty careers (6 vs. 5.25 yr, respectively). Therefore, for this sample of scientists, traditional objective performance measures did not account for reported differences in interest in faculty careers.

Relationship with Research Advisors Did Not Explain Differences in Interest in Faculty Careers. The nature of these scientists' relationships with graduate advisors also did not directly relate to their interest in faculty careers. The percentage of participants using positive language to describe their advisor relationships (i.e., terms such as "amazing," "very supportive," "great") versus those using mixed or negative language to describe their relationships (e.g., terms such as "rocky," "friction," "difficult") was not significantly different for those with high versus low interest in faculty careers (Table 3). Of the participants with a high interest in faculty careers, 42% described their relationships with their advisors positively, 47% described them negatively, and 11% did not describe the nature of their relationships with their advisors in great depth. In comparison, 56% of those with low interest in faculty careers described their relationships with faculty advisors positively, while 28% described their relationships negatively, and 16% did not describe the nature of their relationships with their advisors in great depth. Differences between two groups were not statistically significant ($p > 0.05$, two-tailed t-test). Thus, differences in the nature of their relationship with their PhD advisors also did not explain differences in interest in pursuing academic careers.

Table 3. Participants' descriptions of nature of relationship with PhD advisor

Interest in faculty position	High ($n = 19$)	Low ($n = 18$)
Positive	42%	56%
Mixed/negative	47%	28%
Not described	11%	16%

Narrative Analysis

Narratives from the 38 participants were examined to understand the process of career-interest formation. A thematic analysis, capturing trends across participants in the study, is presented below, describing: 1) choice actions with respect to training decisions; 2) training environments; 3) learning experiences; and 4) career choice goals, especially the decisions these scientists made toward or away from faculty careers. Unless otherwise noted, the themes described below were consistent across scientists from all racial/ethnic and gender backgrounds.

Choice Actions with Respect to Training Decisions Are Often Not Linked to Clear Career Goals

Pursuit of a PhD Is Often Motivated by a Love of Science and Career Potential, Not a Specific Career Goal. For most participants in this sample, the decision to pursue a PhD was not linked to a specific, well-defined career goal (Figure 1A): 55.2% described entering their PhD training with undefined (i.e., not clearly defined) career goals, while 26.3% stated they entered with intentions to pursue a faculty career (although half of this group said their interest in a faculty career was primarily shaped by a lack of knowledge of the other career options for PhD scientists). Remaining participants indicated they planned to pursue careers in academia or industry (10.5%), or a research career outside academia (i.e., industry or government; 5.3%). One scientist did not describe her career interests at entry.

Two core reasons were consistently articulated for the decision to pursue a PhD: 1) a love of science, typically fostered by undergraduate research; and 2) the recognition that a PhD was required for career mobility. Darren, a postdoctoral scientist, noted both of these reasons in his decision to pursue a PhD:

[1]With respect to expenditures for science and engineering research and development, see National Science Foundation (NSF) Science and Engineering Indicators (2012), Appendix Table 5-10: "Top 100 Academic Institutions in S&E R&D Expenditures, by Source of Funds: 2009" (www.nsf.gov/statistics/seind12/appendix.htm).

[2]For more information on the Scopus search engine, see: www.info.sciverse.com/scopus.

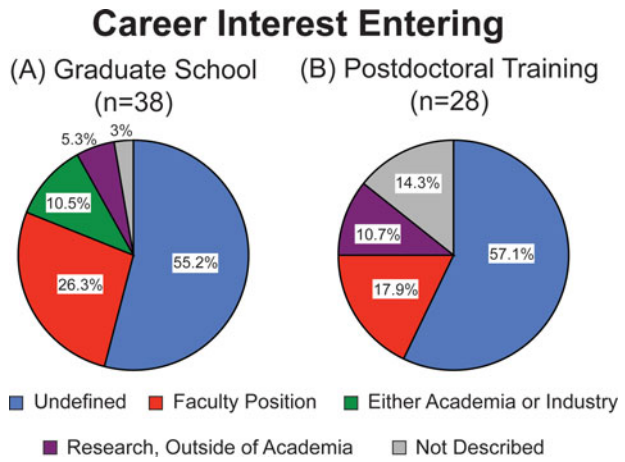

Figure 1. Training decisions often not linked to clearly defined career goals. Pie chart showing the top codes emerging from analysis of participants' narratives with respect to their career goals at entry into (A) PhD training or (B) postdoctoral training. Scientists who indicated that they did not have a clearly defined career goal are labeled as "undefined" and shown in blue; those who indicated interest in faculty careers are shown in red; those who indicated interest in either an academic or industry career are shown in green; and those who indicated they had an interest in a research career outside of academia (e.g., industry, government, etc.) are shown in purple. Participants who did not clearly describe their career interests are shown in gray. Ten scientists in the sample did not complete postdoctoral training and are not included in (B).

> I did undergraduate research my entire four years [and] never really wavered on going to do a PhD. Part of it was, I saw that the people who moved up in science . . . whether they were in academia or private industry, all had a PhD at the higher levels. So instinctively, I felt that if I wanted to be at one of the higher levels, then at some point I would need to get a PhD. But also, I just really loved working at the lab bench, the discoveries . . . I just really enjoyed working at the lab bench.

Leticia similarly pursued a PhD, because she "fell in love with research as an undergraduate." Meanwhile Matt's undergraduate research experiences showed him "that if you wanted to do anything in science, you really needed to get your PhD—to have credibility and to do your own research." Collectively, the narratives showed the main drivers of PhD attainment were the affinity toward research and the outcome expectation that a PhD was required for professional mobility and independence.

Participants differentiated between their love of research and intending to pursue a particular career path—faculty or otherwise. Meredith describes her mind-set at the beginning of her graduate studies this way:

> I did not have an end goal in mind . . . I don't think I ruled out being an academic research professor. But it wasn't the only reason I was going . . . I really enjoyed biology, I enjoyed asking questions, I enjoyed the experimentation process . . . but I didn't really have an idea of what I wanted to do in the end.

Similarly, Jordan began his PhD without "a clear end point" with respect to his career goals, but perceived the PhD "would be a springboard to new career possibilities," while Robin said, "I never thought about what I would do with a PhD . . . until right near the end [of graduate school]." This lack of career certainty was also true for the two men in the sample who had sought and recently accepted faculty positions at the time of the focus group. Mark said he "didn't really have any [career] goals" going into graduate school, while Thomas thought he would "get a PhD and then find a job" in industry, noting specifically that he "wasn't thinking of an academic professorship at that time that I entered the PhD program." Thus, participants chose to attend graduate school based on a love of science and an interest in scientific career mobility rather than a commitment to a specific career, faculty or otherwise. Moreover, very few participants articulated a strong, early commitment to pursuing faculty careers.

Pursuit of Postdoctoral Training Is Often Independent of a Clear Career Goal. As was the case with earning a PhD, participants distinguished between pursuing postdoctoral training and intending to pursue a faculty career. Again, the majority of focus-group participants (57.1%) described entering postdoctoral training without a clearly defined career goal (Figure 1B). For some, postdoctoral training provided an opportunity to clarify career plans. Nancy was unsure of her career goals after graduate school and saw postdoctoral training "was a great way to keep all of my options open." Meanwhile, Melanie chose to postdoc, because "I didn't know what I was going to do when I left grad school. I just knew I didn't want to stay in academia." While she still enjoyed bench science, the postdoc allowed her time to "figure out exactly what I'm going to do."

For many of the scientists who began postdoctoral training without a clearly defined career goal, the postdoc represented a default pathway rather than an intentional choice, made without strong consideration of other options. For example, Eric said he "didn't really consider anything other than a postdoc, but then maybe naively so," and Claudia seemed to default into postdoctoral training, asking rhetorically, "What was I gonna do when I finished my PhD other than do a postdoc?" Still others chose to pursue academic postdocs because of their belief that any other career step would foreclose future opportunities in academia. While Ann was unsure at the end of graduate studies that she wanted to be a faculty member, she chose to do a postdoc because of her perception that "if you branch out into industry or writing or science policy, you can't go backward into academia." Robert shared similar thoughts, noting that, while other career options were of interest to him, "I started having second thoughts about how reputable a postdoc in industry would be later if I chose to go back into academia."

While 17.9% pursued postdocs because of their goal of obtaining a faculty position, 10.7% used the postdoc as a way to become more competitive for research careers outside academia, that is, in industry or government (Figure 1B). Rodney decided in graduate school not to pursue a faculty career and chose to do a postdoc "to finish some of the papers" and get a letter of recommendation, so he could "then go do something else." Meanwhile, Natalie found that most of the government research positions she wanted required 3–5 yr of research experience beyond the PhD, so she decided to "do a couple postdocs" to "beef up" her skill sets for the research careers outside academia that she desired. Collectively, the narratives indicate that postdoctoral training opportunities were most often seen as a way to keep one's career options

open, rather than necessarily indicative of a particular career choice, or a declaration of one's intent to pursue an academic position.

Training Environments Generally Lacked Structured Career Development. While many participants entered their PhD and postdoctoral training with malleable career interests, only 16% of focus-group participants described having departmentally or institutionally sponsored, structured career development activities throughout their training—either toward or away from academic positions. Alicia, a postdoc with high interest in a faculty career, noted she did not learn "about what's being called 'alternative career options'" until reaching her postdoctoral institution. Similarly, Jack, a research scientist in a federal laboratory, noted that in graduate school "there weren't a lot of resources around to learn about what [career] possibilities were out there."

Poorly structured career development was especially pronounced for the academic postdocs in the sample. The NIH and NSF define postdoctoral positions as "temporary and defined periods of mentored advanced training to enhance the professional skills and research independence" for doctoral degree holders "to pursue [their] chosen career path" (Bravo and Olsen, 2007). Most postdocs in this sample, particularly those in the academic arena, described their experiences as lacking structured professional development. As Erin, a current postdoc, said,

> I am in a training position, and told that I am a "trainee," that's on my title. I can't think of a training moment that I have been a part of, where I was being trained.

Similarly, as Judy reflected on her postdoctoral experience, she rhetorically asked,

> If we are trainees, shouldn't there be some sort of structure for us to help guide us or teach us what it is that we're meant to be learning as trainees? It really baffled me. We get nothing.

Daniel added that, from his point of view, "being in the lab alone doesn't train us to be good scientists. We need other training beside technical work to become good scientists." All three of these postdocs were interested in pursuing faculty careers but felt they needed to develop additional skills such as grant writing, teaching experience, budget management, and personnel management before transitioning to a faculty position. Independent of their career interests, the academic postdocs in this sample described a lack of structured opportunities to develop these skills as part of their training, consistent with previous reports critiquing the lack of structured training postdocs receive (NAS, 2000; Davis, 2005). The notable exception was Thomas, a postdoctoral scientist at the NIH, who pointed out the presence of "an entire office . . . devoted to helping people make career decisions" at the NIH, but observed that, in his experience, this support "certainly is lacking at other institutes."

Learning Experiences Shape Outcome Expectations, and Differ by Social Identity

Vicarious Learning Shapes Outcome Expectations about Academic Hiring. In a context in which there was little structured career development, vicarious learning experiences (i.e., learning by observation) played a strong role in shaping outcome expectations about the process of obtaining a faculty position. Scientists in this sample—independent of career interest—articulated a nearly uniform outcome expectation that obtaining a faculty position was extremely difficult and often not predicated principally on research productivity. Thomas described obtaining his faculty position after 6 yr of postdoctoral training as the result of luck and chance rather than the realization of hard work:

> I just kept at it hoping that something would eventually come my way. I didn't delude myself at the beginning of this . . . the odds are greatly stacked against me. . . . I am just going to keep playing the lottery and maybe it will come my way. And one eventually did.

Similarly, Eric, a first year postdoc, aspired to a faculty career, despite perceiving it to be an increasingly unlikely proposition:

> The longer I have been in this, the more I realize that not everyone that's good and works hard is able to make that transition from postdoc to faculty. I guess that naively, I assumed if you worked hard and did good work, you would make it. Naively, I guess I still believe that, because I have to, but it's becoming increasingly clear that's not true for everybody.

Audrey, who also had a high interest in a faculty position, echoed the sentiments that she perceived obtaining a faculty job as not being predicated principally on research accomplishments. Having been a member of faculty search committees throughout her training, she remarked that, based on her observations, "it just seemed like at the end of the day" getting a faculty job "is not really necessarily based on merits, but who you know and how well you can network and play with the system."

Those with low interest in faculty careers echoed similar sentiments, noting observations of the extreme difficulty in obtaining faculty positions in the current landscape. Will described the employment prospects of a postdoc from his PhD thesis lab who he perceived as highly talented:

> I had a postdoc in my lab who had three *Nature* publications. Three! It took him two-and-a-half years to find a job. He is a very smart person, very good with mentoring . . . But I am like, if that type of person, [who] did this well cannot find a position . . . He ended up going to [an institution] and it is obvious that he didn't want to live there, but he had been a post doc for six years. He just had to move on. He had no control whatsoever in that.

Others with low interest in faculty careers pointed to the low supply of faculty jobs relative to the number of trained scientists as a source of difficulty in obtaining faculty positions. Melanie said, "There's obviously not enough academic jobs for all these grad students [and] all these postdocs that are coming through." These sentiments were echoed by Matt, who said, "There are not enough faculty jobs for people who want to stay in academia." Thus, the scientists in this sample—across career interests and social identity—described an outcome expectation that obtaining an academic position in the current job market is extremely difficult and often not predicated principally on performance, with very talented scientists having extreme difficulty obtaining faculty positions.

Vicarious Learning about the Nature of Faculty Lifestyles Shapes Expectations about Professional Outcomes. Independent of their level of interest in a faculty career, most participants described how their observations of professors at major research institutions created an outcome expectation that faculty lifestyles at major research universities were extremely demanding. Judy, who has a high interest in a faculty position, described her postdoc advisor's life as one in which he is "traveling around the world, not seeing his family, [and] sending out emails at three or four in the morning." Alicia, who also has high interest in a faculty career, noted the demanding workload of faculty, saying, "It's very intimidating to think about the amount of time that I will have to spend to make sure my lab stays up and running, and that I don't have grad students or postdocs who are . . . worried about not having the funding to do the work and to live, to eat."

Those with low interest in faculty careers also shared these sentiments. Aaron described the schedules and lifestyles of faculty at his institution with whom he rotated. One was "HHMI funded and pumping out *Cell* [and] *Nature* papers," but the demands on his time meant "he was never around," while the other was a "young tenure-track professor" with "really sexy projects," but his faculty obligations meant he had no "outside life." Similarly, Mandy, who has a low interest in a faculty career, noted that in observing the lifestyles of her principal investigator (PI) and other faculty in her graduate institution, "They are guiding other researchers, writing grants, and going home very late at night, every night. So it was like, 'if that's what I want to do, these are the people who I will turn out like. These are the lifestyles that I'll have to follow if I want to stay in research.'" Thus, across career interests and social identity, and consistent with previous work (Mason *et al.*, 2009; Fuhrmann *et al.*, 2011), participants noted that, based on their vicarious learning experiences, faculty life was demanding and required extensive commitments in terms of time and energy. Notably, only two participants (5% of the total sample) described faculty role models at major research universities who lived balanced lifestyles.

Unique Learning Experiences for Women and Scientists from URM Backgrounds. In addition to these shared learning experiences and outcome expectations, scientists from groups underrepresented in the professoriate (women and URM) described unique learning experiences and outcome expectations shaped by their race and gender. Three-quarters of the female scientists spoke about gender directly shaping either their training experiences or outcome expectations about faculty life, including all of the women with a high interest in faculty careers. Nancy recounted her experience at conferences in her male-dominated subdiscipline, where she, as one of the few women present, would receive "invitations back to faculty members' hotel rooms" after the networking activities. This in turn began to impact her self-efficacy, as she wondered, "Was this faculty member talking to me all evening because he's interested in my science or because I'm the only woman in the room and he wanted to go to bed with somebody?" Similarly, Erin described experiencing "major sexual harassment" from her PI as a graduate student, which included the PI adding a male author on her paper, because, in his words, he could not "listen to what a female was saying and believe it." Moreover, Alicia, a postdoc and mother who trained in an engineering-related subdiscipline, described the strong "pressure against having children" she had experienced throughout her training, and an instance in which she had to confront a colleague who wanted to hire a male undergraduate student instead of an equally qualified female student, because, in his view, "women can't do math and they're not really competent in mathematics." These and other women described learning experiences directly shaped by gender in a manner that the men in the sample did not describe.

In addition to these direct experiences, vicarious learning experiences of female professors also shaped the outcome expectation that pursuing a faculty career as a woman presented additional challenges. Christina noted that it seemed that "in order to be taken seriously you have to either overly assert yourself, or suppress your femininity." However, Nancy had a different perspective and felt there was a "double standard" when women assert themselves as compared with men, a view that was shaped by her observation of two "aggressive young faculty"—one male and one female. Although, she said, both "tended to make their students cry," the female professor was characterized in the department as a "raving [expletive]," while the behavior of the male professor was excused. Claudia noted how the contributions of women were generally minimized when compared with their male colleagues. Male invited seminar speakers were called "experts" by department faculty, while the female speakers were called "bright," a term she felt was more appropriate for a "high school student" than for well-funded and well-published faculty members. Thus, women in the sample—including all of the women with high interest in faculty careers (such as the five above)—described gender-specific training experiences or outcome expectations resulting from direct or vicarious learning, leading to expectations of encountering gender-related barriers that male colleagues would not if they pursued faculty careers.

There were also racial differences in training experiences, with the influence of race/ethnicity described in more personal and profound ways for women of color. For men of color, race was acknowledged as a reality, but they did not describe it as demonstrably impacting their training experiences. For example, Steve described his PhD cohort as a "a rainbow coalition" and said he had "no race issues," while Tim said that, with the exception of being mistaken for other minority scientists at conferences, race was not a major factor in his training and he was treated like "a regular grad student."

In contrast, women of color more often described race as having a direct impact on the quality of their training experiences. Robin said plainly, "Race is definitely an issue" in her graduate training. On returning from a departmental meeting, her PI once said to her, "It is really important to the department for you to get out. [The department] really wants minorities to get out [i.e., graduate] because of numbers." Although she noted that he was simply relaying facts and was not speaking in a "derogatory" manner, it began to impact her self-efficacy. As she explained, "[it] definitely makes you second-guess [yourself] . . . it affects how you perceive how good you are, when someone tells you those sorts of things." Race also shaped Natalie's training; she noted that, as the "only person of color" in her postdoctoral department, she consciously went out of her way, possibly sometimes to her "detriment," to ensure she was not portraying any

"stereotypes." She wanted to be sure that her colleagues would see her "as a scientist first" and did not stick her "in a box being the only person of color." Thus, women of color described the impact of race as shaping their experiences in a different manner than men.

Career Choice Goals Influenced by Personal Values and Structural Dynamics

Interest in Pursuing Faculty Careers Is Driven by Personal Values That Vary Based on Social Identity. Scientists in this study had similar objective levels of performance, perceptions and outcome expectations about faculty careers, and limited exposure to structured career development. These factors did not appear to explain development of interest in faculty careers. Notably, the primary driver for pursuing a faculty career, across racial, ethnic, and gender backgrounds, was personal values. That is, if what a scientist felt was important to him or her personally and professionally could be best achieved in an academic setting, he or she pursued a faculty career. These scientists described pursuing a faculty career despite their recognition of the structural dynamics of the current biomedical workforce (e.g., a difficult academic job market, low grant-funding rates, long training periods, and extremely high faculty workload) or the challenges faced specifically for scientists from groups underrepresented in the professoriate (e.g., training experiences and outcome expectations adversely impacted by social identity).

The values motivating pursuit of a faculty position were multifaceted and varied largely, but not exclusively, by social identity. Some scientists, particularly those from racial/ethnic majority backgrounds, articulated their choice goals based on the perception that academic environments allowed the greatest freedom to pursue research topics of interest. For example, Thomas began his PhD with the choice goal of obtaining a position in industry, but was inspired to pursue a faculty career when he attended scientific conferences in graduate school and began to understand "what academic research and teaching really meant." He had thought of professors as functioning in a manner similar to high school teachers, but was drawn to the professoriate when he saw that faculty members were doing "really mind blowing science" and by the "degree of freedom that came with academic research." Similarly, Mark was drawn to the professoriate because of "the freedom of academic research . . . just getting to do whatever you want, and have people pay you . . . That is awesome!"

Other postdocs from majority racial/ethnic backgrounds also articulated research freedom as the reason they continued to pursue academic careers. Eric said he continued to be drawn to a faculty position because of "the science, the questions, [and] the flexibility" he perceives the career path offers. Similarly, Ann continued to pursue an academic career because of the freedom to pursue her own research ideas, saying, "If I could have my own lab with a small group of people and pursue the research that I think is interesting . . . that would be fabulous." An industry career was not an appealing choice goal for her because of her perception that "they can take your projects away from you at any time." Thus, for many scientists from racial/ethnic majority backgrounds, including all the men and one woman who had attained or were pursuing faculty careers, research freedom was articulated as the main motivator for choosing to pursue an academic career.

In contrast, nearly all other women and postdocs from URM backgrounds who had high interest in faculty positions were motivated by the ability of faculty to engage in externally focused values they deemed important. This went beyond an interest in basic science or the freedom of academic research described by their peers from well-represented racial/ethnic or gender backgrounds. For example, some were motivated by the value they placed on the application of research to health problems facing their communities. Christina worked in a research field whose findings directly impact clinical practice in women's health, one in which, in her words, poorly designed studies can have "detrimental" consequences for patients and "failure actually means changing someone's life." While she described her field as "fascinating," she was persisting on the academic track and maintaining her faculty choice goal because "I'm really interested in where we are [and] getting to the finish line. That's why I come into work every day." She noted that "the work is so much bigger than any of the individuals" she works with, which kept her from letting the "negative experiences" she has had with advisors and colleagues deter her from continuing in the field. Similarly, Daniel felt that "an academic setting" would offer him a better environment in which to explore the research questions he felt were necessary to address a health challenge that is particular to his ethnic community. Therefore, for some scientists from URM backgrounds, the perception that academia presented them with the most favorable environment to conduct research applicable to pertinent health problems in communities they wanted to serve drove them to continue pursuing a faculty position.

Others placed a high value on impacting students, and the roles faculty members play as mentors motivated their career choice goals. Robert said he sees "few people of color in academia" and felt pursuing a faculty job was "a responsibility . . . I can do this so I should." Alicia had an academic career as her goal, because "It's rewarding to think about being able to mentor students. That's really what I'm passionate about." Nancy, who had accepted a position at a liberal arts college, said she was "very motivated to make sure that undergrads have that exposure to real research," noting "the biggest difference you can make" in someone's life is to "go be a good mentor." Similarly, Erin, a second-year postdoc who planned to pursue a faculty position at a research-intensive university was motivated by the fact that "research institutions need people that care about the way [training] is done . . . that is what keeps me going." Claudia was continuing on the path to a faculty career despite a "very rocky" graduate school experience, because she "knew that if I stuck this out that I could create opportunities" for others in science. Thus, many of the scientists in this sample from groups underrepresented in the professoriate (women and URM) placed importance on the externally focused values of serving as role models and facilitating the success of students; the ability of faculty to play these roles strongly motivated their pursuit of faculty careers.

Nonacademic Career Choice Goals Are Driven by Values and Structural Dynamics. Scientists pursuing careers outside academia also cited personal values, as well as the structural dynamics faced by PhDs seeking faculty positions, as the

drivers of their career decision making. Scientists who felt that the nature of faculty work would not allow sufficient engagement with values they felt were important chose nonacademic career paths. The principal value articulated—across social identity—was the need for their work to have a higher level of applicability than they felt would be attainable in a university. Mandy, a woman from a majority racial/ethnic background, exemplified the sentiments of many of those moving away from academia, saying,

> I wanted to make a difference in the world with my career, and I didn't see the molecules that I was studying actually changing anyone's life.

Similarly, Trent, a male from a majority racial/ethnic background, said that he began his PhD training "completely excited" about basic research but grew frustrated at the length of time needed to translate "basic research to any practical end result." His choice goal was to have a career in science policy, because, in his view, "it's an expression of science that engages directly into the public realm." Jack, also a male from a majority racial/ethnic background who worked as a scientist in a federal research lab, said that, while in his view basic research is "great," if his work did not lead to a "tangible advance, a product or a medicine or something like that," then he did not see "the point." He noted that in his current research position outside of academia, he had been able to pursue his goals of applying research to tangible outcomes "quite well," noting that at the end of his projects "we actually have . . . something you could touch."

Several women of color also cited the need for their work to have more directly applicable outcomes as the reason for their diminished interest in faculty careers. Lara moved into policy after postdoctoral training, because of "a misalignment in terms of my goals, the goals of the field and the goals of my department." While some saw academia as a means to help their communities in a direct way, she noted that "the reward structure of academia" would not allow her work to impact her own community in the way she felt was important. For others, working in academia limited their ability to translate research findings into practical application, making it less appealing. Robin, also a woman of color, "bowed out" of pursuing a faculty position because she felt academic work "was so incrementally small compared with the big picture in terms of where I thought I wanted to make a change." In sum, many of the scientists who moved away from academic career paths and developed other choice goals—independent of social identity—cited that their decision was based on their belief that the nature of faculty work would not allow them to make the types of contributions they deemed important.

In addition to personal values, the structural dynamics faced by scientists seeking academic employment also influenced choice goals, in some cases discouraging interest in faculty careers. For two-thirds of all men pursuing nonacademic careers, including 100% of the men from URM backgrounds, a variety of outcome expectations about the structural dynamics in the biomedical workforce—including the academic job market, availability of grant funding, and postdoc pay—diminished their interest in the professoriate. Will, a male from a URM background, said that "the seeming lack of control you have over your career" in academia "in terms of, whether not you get grants, or whether or not you publish, especially in this climate where the science funding has stalled or gone down in most cases over the last ten years," led him to pursue a nonacademic career. The funding climate was also a barrier for Aaron, another male from a URM background. He said that he has moved away from a faculty career path because "I want to do something that inspires me" but perceives "with the current funding situation . . . what I would be as an academic is not what would inspire me." For Steve, a male from a URM background, financial considerations played a strong role in career decisions—particularly forgoing postdoctoral training. While Steve knew that science was not the most "lucrative" field, he noted he "would have thought twice or even three times about leaving academia had the prospect for [postdoc salary] been something like $50,000–55,000." Thus, many of the men in the sample pursuing nonacademic careers, including all of the men from URM backgrounds, cited structural dynamics in the workforce as important reasons driving their career decisions.

The structural dynamics motivating some women to choose nonacademic careers were distinctive from those described by men. Career–life balance issues loomed large, and for some were determinative in their decision to pursue nonacademic careers, consistent with previous reports (Mason *et al.*, 2009; Fuhrmann *et al.*, 2011). Melanie said, "I saw the amount of stress and amount of total devotion to your lab and your research and writing grants . . . the amount precedence that [a faculty career] took over every other aspect of your life" and decided she "couldn't stay in academia." Similarly, Mandy, in addition to the limited impact she felt she would have as a faculty member, perceived an academic lifestyle as incompatible with other priorities, such as having a family. She noted, "I want to have a family and to be able to see my children grow up, not just get home when they are in bed" but felt that would not be possible as a professor, solidifying her pursuit of a nonacademic career. For Deborah, a woman of color, the climate she faced during her training prompted her move away from the professoriate. She said her interactions with colleagues were "the thing that deterred me from seeking a career in an academic environment," noting "there's no reason for me to work really hard to have these people be my peers." Thus, in addition to values, a number of structural dynamics in the research workforce and university environments prompted many scientists to pursue nonacademic careers.

DISCUSSION

While large numbers of scientists continue to pursue academic careers, the academy will continue to face significant challenges moving forward—especially in ensuring that the next generation of faculty includes talented scientists from a wide range of backgrounds. This study presents analysis of data documenting the process of career-interest formation and the factors influencing this process, collected from focus groups conducted with a diverse group of productive American PhD biomedical scientists. The data from this exploratory study are presented in an effort to better understand the process of career-interest formation and how this process differs by social identity, providing an emerging framework that can be tested in future work and against which others' experiences can be examined and compared. This work is the first stage of a larger project, which will examine whether

findings presented in this article are consistent across a larger sample and explore emergent themes with more depth. Subsequent research integrates quantitative data collected from almost 1900 participants and interviews with a subset of a diverse sample of 125 PhD biomedical scientists, documenting their training experiences and career development processes.

Participants in this study described career-interest formation as a dynamic process. Previous research and efforts to broaden participation in the nation's academic workforce have highlighted the importance of faculty relationships and mentorship, self-efficacy, and research training experiences (Lindley, 2006; Burke, 2007; Kaiser, 2012a; Wadman, 2012). However, neither these constructs, nor objective performance measures traditionally associated with scholarly productivity (e.g., publication record, time to degree), emerged as related to interest in faculty careers for the participants in this study. This is not to say that these factors and learning experiences are unimportant or inconsequential. There is considerable evidence that these variables are important for undergraduate students considering research careers (McGee and Keller, 2007; Balster *et al.*, 2010; Junge *et al.*, 2010) and for doctoral degree success and completion (Tenenbaum *et al.*, 2001; Anthony and Taylor, 2004; Johnson *et al.*, 2007). However, they were not salient in shaping the career aspirations of the PhD scientists in this study. Instead, alignment of personal values with career opportunities and the structural dynamics of the biomedical academic workforce (i.e., high number of PhDs relative to available academic jobs, pay, availability of grant funding, extremely high workload of faculty) played the most central roles in shaping their career interests.

SCCT provided a helpful lens for understanding much of the way in which this process functions for PhD graduates. For the scientists in this sample, choice actions with respect to training decisions were often not tightly coupled to specific careers or professions. In other words, decisions to pursue a PhD or postdoctoral training were generally not conflated with clear, well-informed career intentions or indicative of the desire to pursue a faculty career. Because these scientists began their PhD training with malleable career interests, their training environments played a strong role in shaping their professional aspirations. However, participants described their graduate and postdoctoral training environments as largely lacking structured career development. Although a number of institutions have in recent years expanded the career development activities offered to trainees, for the vast majority of scientists in this sample, there were neither opportunities to learn about the career options for PhD scientists, nor intentional opportunities to develop relevant competencies beyond their technical skills. Incorporating structured career development activities as a formal part of the graduate curriculum and postdoctoral training would enhance the career outcomes of all scientists—whether or not they pursue academic careers. The lack of structured career development meant that vicarious learning—that is, learning by observation—played a strong role in shaping their outcome expectations and perceptions of faculty positions. These vicarious learning experiences guided outcome expectations about the process of becoming a faculty member and the nature of faculty life.

Importantly, outcome expectations were consistent across social identity and level of interest in faculty careers. Most participants noted that obtaining a faculty position was extremely difficult due to, among other factors, the large supply of PhDs relative to the number of available positions, and that faculty at research institutions face extremely demanding workloads due to, among other factors, decreasing grant success rates (Kaiser, 2012b, 2013). Furthermore, these outcome expectations were not always directly linked to choice goals; those who had high and low interest in faculty careers had similar views of the process of becoming a faculty member and of faculty life. Thus, it seems that outcome expectations, in and of themselves, did not deter or encourage participants to pursue academic careers.

Rather, personal values were the primary lens through which these scientists engaged their outcome expectations as they related to pursuing faculty careers. Previous work has identified barriers, such as research skill and efficacy, inadequate mentoring, and hostile training environments, as having negative implications for career development, particularly for scientists who are women and/or from URM backgrounds (Adams, 1992; Meyers and Turner, 2000; Anthony and Taylor, 2004). Having completed their PhDs, participants in this study had by definition successfully navigated any such barriers. In forming interest in faculty careers, these scientists assessed whether the outcomes they expected in a faculty position were congruent with what matters to them, and the alignment of personal values with opportunities available as a faculty member played a strong role in promoting interest in faculty careers. However, values were not universal; they varied largely by social identity. Thus, our findings suggest personal values are an important additional factor that must be considered in models of career development.

Importantly, beyond personal values, the structural dynamics of the biomedical workforce—long training periods, low postdoctoral pay, tight grant funding, and a tight job market due to a large supply of PhD scientists without a comparable number of opportunities for independent research careers (Stephan, 2012)—were also cited as shifting some scientists' interest away from faculty careers. The potential implications of structural imbalances in the biomedical workforce have been discussed for at least the past two decades (NRC, 1994, 1998; Teitelbaum, 2008), with concerns that the landscape could cause young scientists to leave research careers because of a lack of attractiveness. Indeed, the scientists in this sample with low interest in academic careers illustrate that this concern may have been well founded, and the phenomenon of talented scientists moving away from biomedical research careers due to systemic issues may already be manifesting itself. The role of structural elements in driving career interests away from faculty careers suggests that the dynamics at universities and in the broader biomedical workforce may themselves be exerting a selective pressure on career choice. These scientists' narratives suggest that, in the current landscape, developing and maintaining interest in a faculty career for a scientist from any background would require, at a minimum, a willingness to accept a significant decoupling of effort and performance from obtaining the goal due to a supersaturated labor market. Further it would require being an individual who does not foresee the demands of an academic career as an impediment to family/household concerns, who does not see many years of postdoctoral salary as a burden to continued participation, and whose personal values align significantly with the traditional academic reward structure. Additionally,

Figure 2. Typical career pathway for early-career PhD biomedical scientists. The career pathway for a typical biomedical scientist consists of a number of decision points and training pathways. 1) Trainees enter PhD training and then 2) complete graduate training. After completing a PhD, 3) trainees decide whether or not to pursue postdoctoral training. 4) After completing postdoctoral training, scientists decide 5) whether to pursue faculty careers at research institutions, faculty careers at teaching institutions, research careers outside of academia, or nonresearch careers. Scientists forgoing postdoctoral training typically pursue nonresearch careers.

for many scientists from groups underrepresented in the professoriate, pursuing an academic career requires an ability to experience and persevere through negative experiences or expectations perceived to result from one's social identity.

Thus, strengthening the professoriate through diversity requires going beyond the focus traditionally placed on increasing skills, numbers of degrees granted, and mentoring opportunities for scientists from underrepresented groups. Individual-based interventions may be necessary, but these data strongly suggest they will in themselves be insufficient. These efforts, along with efforts to improve the training of all early-career scientists, should incorporate a career-pathways perspective, recognizing all five important milestones on the path to independence for a PhD biomedical scientist: 1) the decision to pursue a PhD, 2) graduate training experiences, 3) the decision to pursue postdoctoral training, 4) postdoctoral training experiences, and 5) the career decision after completing postdoctoral training (Figure 2). In particular, transitions into and through postdoctoral training are of importance, as this is a nearly uniform requisite for a faculty position and, at this training step, the participation of women and scientists from URM backgrounds drops significantly from levels seen at the PhD milestone (Martinez *et al*., 2007; NRC, 2011; National Science Board, 2012).

Moreover, efforts to diversify the nation's faculties must also be coupled with structural reforms at institutions and throughout the biomedical workforce, addressing the contexts in which scientists operate. A number of reports have presented strategies to increase participation of women in the professoriate, and funding agencies and institutions should use their resources to catalyze the cultural and structural changes at universities that will promote the full participation of female scientists (NAS, 2007; Goulden *et al.*, 2009). The men from URM backgrounds in this study raise the possibility that improved postdoctoral salary and rates of grant funding for biomedical researchers from all backgrounds would go a long way to making faculty careers more attractive to them. Strategies to increase URM representation in the professoriate must consider that women receive the majority of BMS PhDs awarded to scientists from URM backgrounds; therefore, increasing representation of minority faculty must take into account how the intersections of race and gender impact career attainment (Malcom and Malcom, 2011; Ong *et al.*, 2011).

While there are many valuable careers in which PhD scientists can use their skills, improving faculty diversity remains an imperative. If universities and funding agencies want diversity with respect to the scholars filling their faculty ranks, then there must be clear pathways to employment, equitable and inclusive hiring practices, and faculty positions and work environments that are attractive to a more diverse set of scientists. Generating a love of research or confidence in one's ability to do the work is not enough. Rather, increasing interest in the professoriate among a more diverse range of scholars appears to be a matter of ensuring the professoriate allows greater opportunities to align one's values with one's academic work, and structural changes that allow early-career scientists to support their families financially and emotionally on the elongated pathway to independence. Rethinking graduate education, postdoctoral training, and the nature of faculty positions in these ways may reshape career development, yield a more diverse faculty in years to come, and ultimately increase innovation and the capability for discovery.

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