

MARCH 2014

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The United States is at a critical juncture in its ability to remain internationally competitive in science, technology, engineering, and mathematics (STEM). At present, too few people from diverse populations, including women, participate in the STEM academic and workforce communities. This series of issue briefs is produced by American Institutes for Research (AIR) to promote research, policy, and practice related to broadening the participation of traditionally underrepresented groups in STEM doctoral education and the workforce.

AIR supports the national effort to prepare more students for educational and career success in STEM by improving teaching and providing all students with 21st century skills needed to thrive in the global economy; meeting the diverse needs of all students—especially those from underrepresented groups; and using technology, evidence, and innovative practice to support continuous improvement and accountability.

This material is based upon work supported by the National Science Foundation under research grant HRD-1029477. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Early Academic Career Pathways in STEM: Do Gender and Family Status Matter?

The gender inequities in the science, technology, engineering, and mathematics (STEM) academic workforce are well documented and remain of concern, especially given the urgent calls to increase and broaden participation in STEM. Women of all races and ethnicities continue to compose a small number of science and engineering faculty at U.S. research universities and often do not receive the same level of recognition, career affirmation, and resources as their male colleagues (National Research Council, 2007).

Data show that women of all races and ethnicities, despite having the necessary qualifications, are more likely than men to be in lower academic ranks and work at less prestigious institutions (Currie, Harris, & Thiele, 2000; Frome, Alfeld, Eccles, & Barber, 2006; Kurtz-Costes, Helmke, & Ulku-Steiner, 2006; National Research Council, 2007; Trower & Chait, 2002; Ulku-Steiner, Kurtz-Costes, & Kinlaw, 2000). For example, women make up about 36 percent of STEM PhD recipients (National Research Council, 2010) but only about 18 percent of full professors in science and engineering (Redden, 2007). Even in the biological/biomedical sciences where women have reached and even exceeded parity with men with respect to enrollment and degree production, they do not move into senior academic positions at the same rate as men (National Research Council, 2006).

One explanation for the gender inequities in STEM academic positions is the implicit and explicit biases against women who have or desire families and the challenges related to work-life balance that women may experience more acutely than their male colleagues (Drago et al., 2006; Mason, Wolfinger, & Goulden, 2013; Wolf-Wendel & Ward, 2006). An academic career in the scientific disciplines demands a continuous progression from undergraduate education to graduate education to postdoctoral position to academic position (Mason et al., 2013; Mavriplis et al., 2010). This lock-step model of advancement conflicts with the biological clocks of women who are beginning their careers at a point in their lives when they are most likely to be starting a family or considering doing so (Mason et al., 2013; Mavriplis et al., 2010). In addition, scholarship suggests that these biases, if not explicitly, may implicitly result in barriers or constrained choices for women that move them away from preferring or pursuing jobs that are male dominated or that they perceive as incompatible with their work/life commitments and desires for balancing work with family (Ceci, Williams, & Barnett, 2009, p. 218; Akerlof & Kranton, 2000). Data show that women of all races and ethnicities who earn STEM PhDs are also up to twice as likely as their male counterparts to leave STEM jobs, citing reasons that include a desire for more work-life balance and a perception that STEM work environments are unfriendly toward women (Jesse, 2006).

DEFINITIONS OF TERMS

Type of Position

Secured position: A signed contract or definite commitment is in place for a postdoctoral position, faculty position, or other work (includes returning to, or continuing in, a predoctoral employment position).

Academic position: A faculty, postdoc (postdoc fellowship or postdoc research associateship) or other position at a U.S. four-year college or university (including medical schools, university-affiliated hospitals, or medical centers), university-affiliated research institute, or U.S. community or two-year college.

Nonacademic position: A position not in, or affiliated with, a higher education institution, to include: U.S. preschools, elementary, middle, or secondary schools or school systems; the U.S. federal government; U.S. state government or local government; a nonprofit or not-for-profit organization; a for-profit industry; self-employment; or another type of nonacademic employment setting.

Type of Institution

Research institution: A doctoral/research university with extensive research activity, or a doctoral/research university with intensive research activity, as defined by the 2000 Carnegie Classifications.

Nonresearch institution: A nondoctoral/research university or a university without an extensive or intensive level of research activity, as defined by the 2000 Carnegie Classifications.

Within this context, this brief examines the extent to which factors related to work-life balance may be pushing or pulling women of all races and ethnicities out of academic careers early in the academic career pathway. Although research citing statistical data on the underrepresentation of women of all races and ethnicities in STEM and in STEM faculty positions is prolific, there is little research examining the extent to which inequities may exist at the start of STEM degree recipients' academic careers, and for graduates who are beginning their careers with family responsibilities. This brief examines the extent to which gender differences exist in the types of positions new STEM PhD recipients secure upon earning their degrees. Specifically, we examine whether recipients secured an academic (postdoc¹ or faculty²) or nonacademic position and, among those with academic positions, whether the position is at a research or nonresearch institution. This brief also examines these gender differences by marital and parental status.

Key findings include the following:

- *Men were more likely than women to secure a position upon earning their STEM PhDs, but among those with secured positions, women were more likely than men to begin their careers in academe.*
- *At the same time, males were significantly more likely than females to secure the more prestigious or difficult-to-obtain academic position: faculty at a research university.*
- *Being married and having children suggests a disadvantage in securing a position at a research institution—for both men and women.*

Methodology

Our analyses were conducted using 2009 and 2010 data from the National Science Foundation's Survey of Earned Doctorates (SED). These two years of data were selected to maximize sample size and to take advantage of the most recent years of data available at the time the analyses were conducted. The sample was limited to U.S. citizens and U.S. legal permanent residents who earned their degrees in STEM fields,³ and who indicated that they had secured a

¹ A "postdoc," as defined by the National Science Foundation's Survey of Earned Doctorates, is a temporary position primarily for gaining additional education and training in research. Typically, a postdoc is awarded in academe, industry, government, or a nonprofit organization.

² Faculty positions include nonpostdoc appointments at academic institutions such as full-time or tenure-track professoriate positions at universities, or internships or clinical residencies at university-affiliated medical centers.

³ For the purposes of this brief, STEM degree recipients were categorized into six major STEM subfields: (a) agricultural sciences, (b) biological/biomedical sciences, (c) computer and information sciences, (d) engineering, (e) mathematics and statistics, and (f) physical sciences. These subfields are based on the STEM classifications used in the 2010 SED survey, the most recent year of SED data available at the time these analyses were conducted.

position at the time of graduation. STEM PhD recipients who reported that they had not secured a position⁴ at the time of graduation were removed from the analysis. The total sample size included 27,724 respondents.⁵

Descriptive statistics and chi-square tests of independence were used to investigate differences in the first positions of STEM PhD recipients by gender, marital status, and parental status. All statistically significant differences are reported using an alpha level of .05.

Type of First Position of STEM PhD Recipients

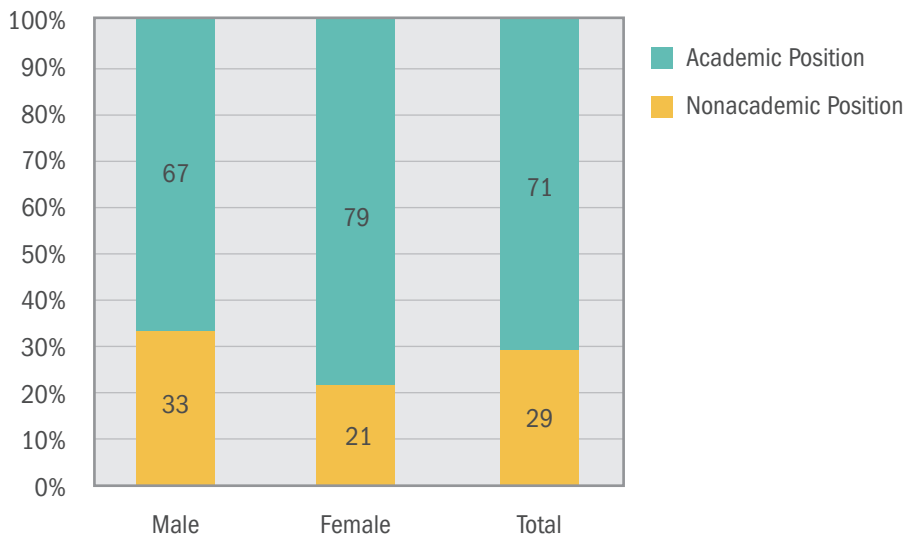
TYPE OF POSITION BY GENDER

Although the majority of both male and female STEM PhD recipients had secured first postdoctoral positions of any type (academic or nonacademic) at the time of earning their degrees, males were more likely than their female peers to have a signed contract or definite commitment. Among those with secured positions, however, women were more likely than men to begin their careers with a postdoc or faculty position versus a nonacademic position.

Men were more likely than women to secure a position upon earning their STEM PhDs, but among those with secured positions, women were more likely than men to begin their careers in academe.

About two-thirds (68 percent) of all STEM PhD recipients who earned their degrees in 2009 and 2010 had secured a position at the time of graduation. The percentage of men who had secured a position was higher than the percentage of women (70 percent compared with nearly 65 percent). The focus of this brief is on those PhD recipients with secured positions. Among recipients with secured positions, about 71 percent reported having an academic position, defined in this brief as a postdoctoral fellowship or associateship, or a faculty position within a postsecondary or affiliated institution. The remaining 29 percent reported securing a position within the nonacademic labor market, such as industry, business, government, or the nonprofit sector. A higher percentage of women than men secured an academic first position: almost 79 percent of women compared with about 67 percent of men (see Figure 1).

Figure 1. Academic/Nonacademic Distribution of STEM PhD Recipients Who Had Secured a Position, by Gender: 2009–2010



⁴ Respondents were defined as having no secured position if they reported that they were negotiating with one or more specific organizations, were seeking a position but had no specific prospects, were enrolling in another full-time degree program (e.g., MD, DDS, JD, MBA, etc.), did not plan to work or study (e.g., due to family commitments), or had otherwise not secured a position.

⁵ Approximately 68 percent of all STEM PhD recipients included in the 2009–2010 SED had secured employment at the time of earning their degrees. Specifically, 18,248 respondents reported that they secured a position, 8,605 reported having no secured position, and 871 participants were nonresponsive or had missing data regarding their postgraduate position.

TYPE OF POSITION BY GENDER AND FAMILY STATUS

Not only overall, but regardless of marital and parental status, significantly higher proportions of women than men had secured academic versus nonacademic positions upon earning their STEM PhDs. Marital status and parental status also appear to have little impact on whether women secure academic jobs, although the reverse is the case for men.

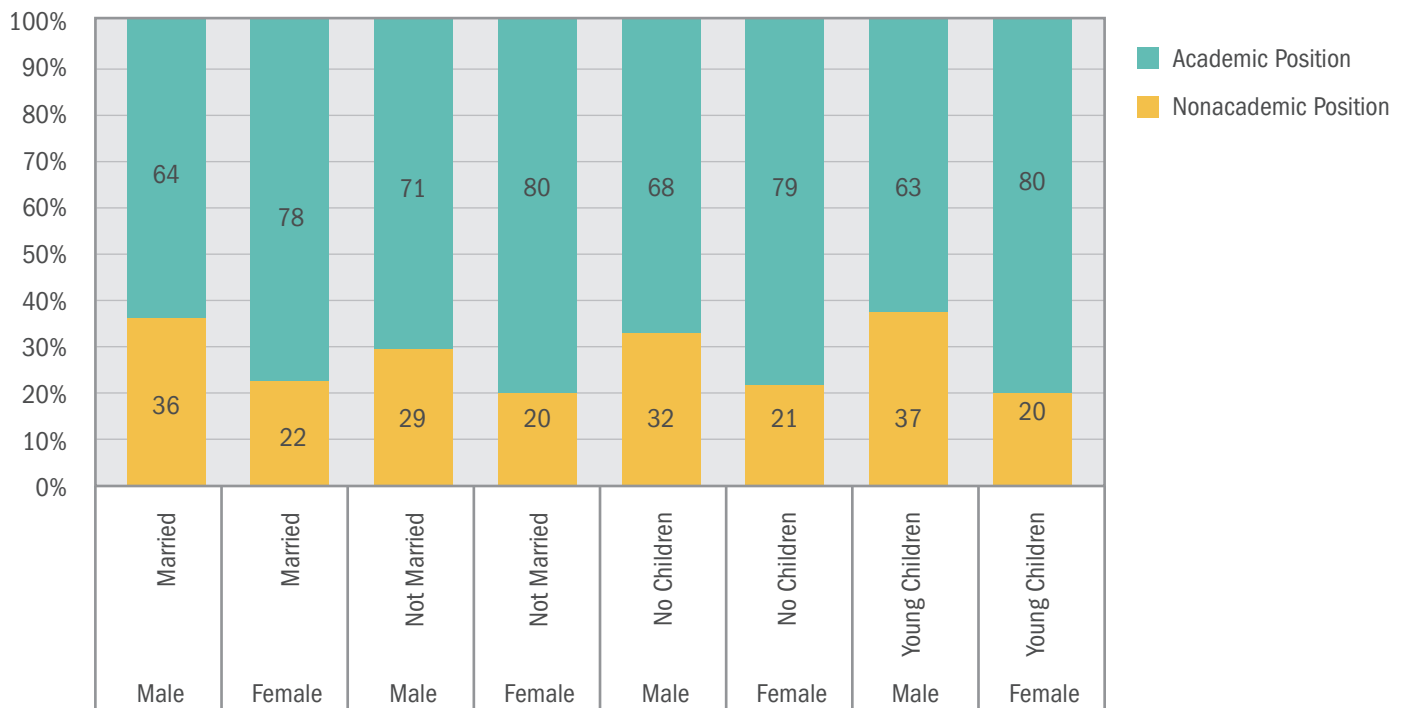
Women who had young children were equally as likely to secure academic positions as women who did not have young children, and married women (78 percent of married women) were only somewhat less likely to secure academic positions compared with unmarried women (80 percent of unmarried women). Married women were significantly more likely than married men, however, to secure academic positions, and mothers of young children also were significantly more likely than fathers of young children to secure academic positions. Notably, married men and men with young children were the least likely of all the groups examined to begin their careers in academe.

Marriage and children did not hold female STEM PhDs back from entering academic career pathways. Women with young children were equally as likely to secure academic positions as women who were not mothers of young children, and married women were only somewhat less likely to secure academic positions compared with unmarried women. In addition, higher proportions of new female PhDs with families than new male PhDs with families had secured academic positions upon earning their degrees.

Specifically, nearly 78 percent of married women compared with about 64 percent of married men secured an academic position (see Figure 2). Among doctoral recipients who were not married, the results are similar, with approximately 80 percent of unmarried women and nearly 71 percent of unmarried men reporting they had secured an academic position.

Significant gender differences were observed when parental status is considered. Eighty percent of women with young children compared with 63 percent of men with young children had secured an academic versus a nonacademic position. Likewise, among doctoral recipients with no young children, approximately 79 percent of women compared with about 68 percent of men secured an academic position (see Figure 2).

Figure 2. STEM PhD Recipients Who Had Secured Employment, by Gender and Family Status: 2009–2010

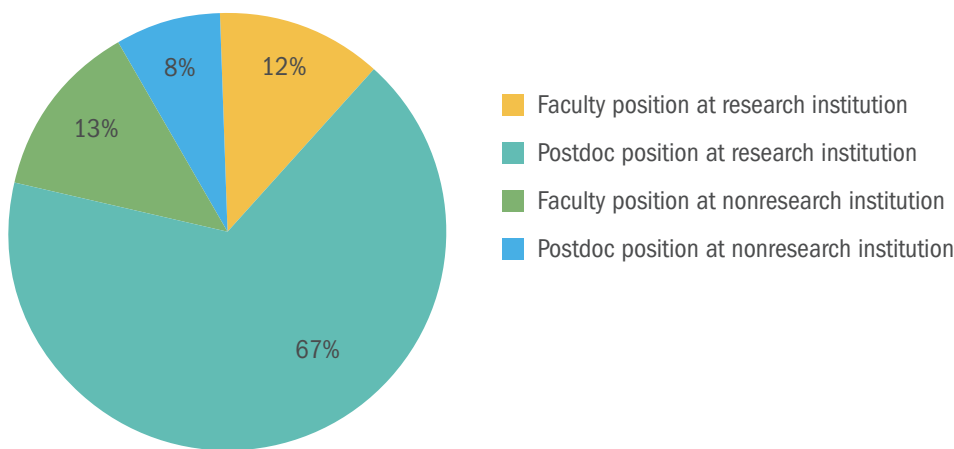


TYPE OF ACADEMIC POSITION BY INSTITUTIONAL TYPE

New female doctoral recipients with families may secure academic positions at higher rates than their peers. However, research indicates that over the long term women who are married or have children may face more challenges in securing and advancing through tenure or tenure-track positions at research institutions than their male colleagues and unmarried female colleagues without young children (Mason et al., 2013). Given this prior research, we examined the extent to which gender differences existed among STEM doctoral recipients who had secured academic positions at research universities *at the onset of their careers*, by type of academic position (faculty and postdoc), and by gender and family status.

Nearly 70 percent of all STEM doctoral recipients with secured academic positions started their careers with a postdoc position at a research institution. Few recipients with academic positions started their careers as faculty: 13 percent secured faculty positions at nonresearch institutions and 12 percent at research institutions (see Figure 3).

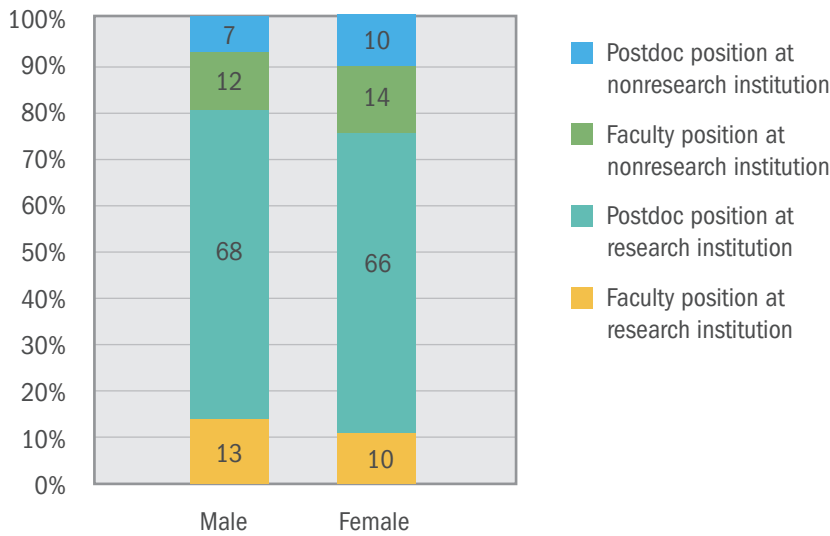
Figure 3. Type of Academic Position and Institutional Type of STEM PhD Recipients: 2009–2010



Males were significantly more likely than females to secure the more prestigious or difficult-to-obtain academic position: faculty at a research university.

The data on types of academic positions by institutional type for STEM doctoral recipients overall mask potentially important gender differences. Although the majority of both men and women with academic positions reported securing postdoc appointments at research institutions (68 percent and 66 percent, respectively), males were significantly more likely than females to secure the more prestigious or difficult-to-obtain academic position—faculty at a research university. Thirteen percent of males with secured academic positions began their postdoctoral careers in a faculty position at a research institution compared with just 10 percent of women (see Figure 4).

Figure 4. Type of Academic Position and Institutional Type of STEM PhD Recipients, by Gender: 2009–2010

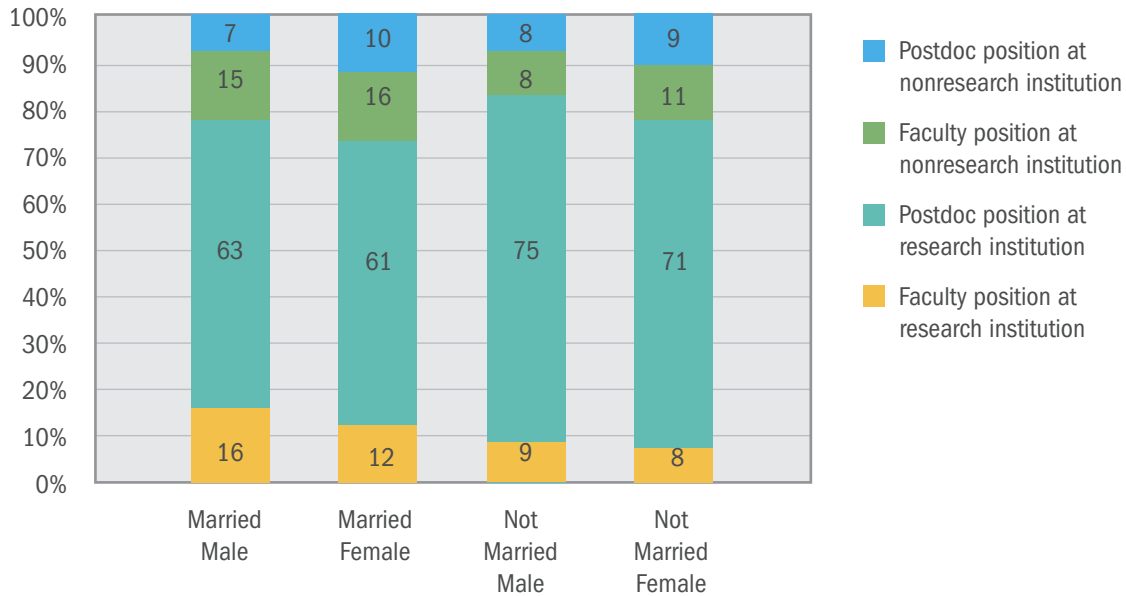


Marriage appears to have a negative impact on securing a first position at a research institution, for both men and women. However, among men and women with secured positions at research institutions, those who were married were more likely than their unmarried peers to begin their academic careers in a faculty position versus a postdoc position.

Among STEM PhD recipients with academic positions, marital status makes a difference (for both men and women) in the type of institution at which they begin their academic careers. Married PhD recipients were significantly less likely to begin their academic careers at research institutions than unmarried PhD recipients. Among the STEM PhD recipients with secured academic positions in our sample, 54 percent of men were married, and nearly 50 percent of women were married. Among these married men and women, 78 percent and 74 percent, respectively, had secured academic positions of any type at a research institution (see Figure 5). In contrast, 84 percent and 79 percent of unmarried male and female PhD recipients had secured either a postdoc or faculty position at a research institution.

Notably, married women were the least likely to start academic careers at research institutions compared to their unmarried female peers and their married and unmarried male peers: 73 percent compared with 79 percent, 79 percent, and 84 percent (see Figure 5). Notably, however, among men and women with academic positions at research institutions, those who were married were more likely than their unmarried peers to have secured a faculty position versus a postdoc position.

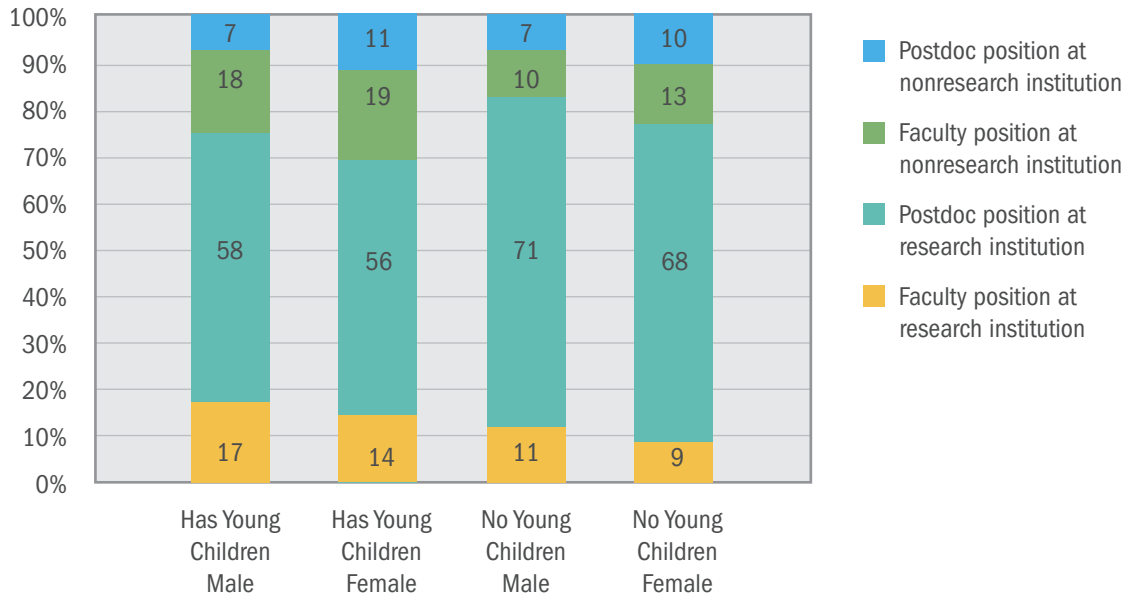
Figure 5. Type of Institution Where STEM PhD Recipients Plan to Work or Study, by Gender and Marital Status: 2009–2010



The differences in the type of institution of first academic position for doctoral recipients with and without young children are more striking than for married doctoral recipients. Having children suggests an even greater disadvantage in getting a position at a research institution than marriage—again, not just for mothers but for fathers as well. In our sample, of those with secured academic positions, 14 percent of women and 22 percent of men had at least one child 5 years of age or younger at the time of earning their degrees. The proportions of women and men with young children with secured academic positions at research institutions were significantly less than the proportions of their peers without young children. Seventy percent of women with young children compared with 77 percent of women with no young children had secured positions at research institutions. Similarly, 75 percent of men with young children compared with 82 percent of men without young children had secured positions at research institutions (see Figure 6).

At the same time, although men and women with young children were less likely to secure a first academic position at a research institution overall, the highest proportions of graduates with secured faculty positions at research institutions were graduates with young children. Among new STEM PhDs with secured academic positions, 17 percent of males with young children and 14 percent of women with young children secured faculty positions at research institutions compared with just 11 percent and 9 percent of their colleagues without young children. The pattern holds true for new PhDs with faculty positions at nonresearch institutions: 18 percent and 19 percent of men and women with young children secured faculty positions at nonresearch institutions compared with 10 percent and 13 percent of their peers.

Figure 6. Type of Institution Where STEM PhD Recipients Plan to Work or Study, by Gender and Parental Status: 2009–2010



Discussion

These results suggest a “good news/bad news” scenario, at least with respect to diversifying STEM faculty and creating academic cultures more conducive to supporting career advancement for faculty with families. First the good: New female PhDs are pursuing and securing first positions that are academic, even those who are married and have young children. In addition, among those with secured positions at research universities, higher percentages of men and women with families than their peers without families had secured faculty positions. But, then there’s the bad: Although higher percentages of women than men reported securing academic positions, smaller percentages of women than men had secured positions at all, and particularly the most prestigious kind: faculty positions at research institutions. In addition, although being married and having children didn’t appear to be holding women back from beginning their careers in academe, those who were married or who had children were overall less likely than their male peers with or without families and their female peers who were not married and not mothers of young children to start their careers at a research institution.

These results seem to affirm (but also complicate) prior scholarship suggesting that women, overall, may be getting pushed out or may be pulling out of research-intensive and more prestigious academic pathways early in their careers. The data also suggest areas for deeper examination, however, particularly on the new PhDs who secured faculty positions at research institutions. Among these select few, why did higher percentages of women and men with families than women and men without families land these positions?

In sum, this brief offers insight into the potential for diversifying the top faculty and leadership ranks of STEM academic departments. The data show there is great potential for increasing the number and proportion of women in the STEM academy, but efforts must be made to ensure that more women PhD recipients who begin their careers in academic positions have opportunities to do so at the top research institutions, and that they are retained and provided with a work environment that challenges the traditionally male-dominated cultures and biases that have plagued many STEM departments and hindered women’s success, advancement, and job satisfaction—and potentially the advancement and success of men with families who also desire a more equitable balance between their professional and personal lives. Institutions of higher education have a critical opportunity to capitalize on women’s early career interest in STEM academic positions, but only if they and their STEM departments are willing and able to create cultures and infrastructures that are welcoming to women and that can promote their successful transition into and retention in rewarding academic careers, even within the most research-intensive environments.

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