Research in Higher Education (2020) 61:628–651
https://doi.org/10.1007/s11162-019-09573-9

Tenure and Promotion Outcomes at Four Large Land Grant Universities: Examining the Role of Gender, Race, and Academic Discipline

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Received: 9 July 2018 / Published online: 22 August 2019

Abstract
Inclusion and diversity are highly visible priorities at many colleges and universities. Efforts to diversify the professoriate have necessitated a better understanding of career outcomes for current female faculty and faculty of color. We measure risk of leaving without tenure and years to promotion from associate to full professor at four large land grant universities. We model career outcomes as competing risks, and compute cumulative incidence functions to discern differences in tenure and promotion outcomes by gender and race. We find incidence rates vary significantly by academic discipline, and in many instances, show larger effects than gender and racial or ethnic differences. Our examination also indicates that in particular academic fields, females are more prone to leave without tenure, and less likely to be promoted to full professor. We also find that racial or ethnic minorities are less likely to be promoted to full professor in certain areas. The analysis suggests that for universities to address systemic issues of underrepresentation in academe, they must account for department level contexts, and align institutional practices to support the goal of inclusion and diversity.

Keywords Tenure · Faculty · Race · Gender · Discipline

The landmark Civil Rights Act of 1964 and the subsequent passage of Title IX in 1972 not only outlawed discrimination in hiring and promotion processes, but also set the stage for the diversification of educational institutions (Ahmad 2017). Prominent efforts in support of a more inclusive professoriate have included the National Science Foundation's ADVANCE and AGEP programs (National Center for Science and Engineering Statistics 2017), with both aiming to increase the number of science scholars and educational administrators from underrepresented groups. In addition, the National Institutes of Health

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provide support for diversifying particularly the biomedical field (National Institute on Minority Health and Health Disparities 2018).

Efforts to diversify the professoriate have recently intensified at many research institutions, with issues of inclusion and diversity garnering increased media and political attention and financial support (Blackwell et al. 2009; Jackson et al. 2017; Matthew 2016; NCSES 2017). Although some institutions have articulated formal goals to diversify the professoriate, female and minority faculty remain underrepresented in certain academic disciplines (Equity, Diversity, and Inclusion 2015; Office of Faculty Development and Diversity 2018; Patel 2015; UCLA 2015). Heightened awareness has brought a new level of exposure to the different experiences of females and people of color in academia and the relatively small gains in representation in tenured positions at highly ranked universities (Ahmad 2017; England 2010; England et al. 2007; Ginther and Kahn 2006, 2012; Goulden et al. 2011; Gumpertz et al. 2017; Morrison et al. 2011; NRC 2001; Umbach 2007).

Fewer than 1% of engineering faculty were women in 1979, rising to 10.8% in 2006. Yet, they still only constituted 5% of full professors in engineering in 2006 (NSF 2008). Mathematics followed a similar trend, increasing from 6.2 to 17.4% between 1979 and 2006, with less than 9% of female mathematics faculty being full professors (NSF 2008). Faculty of color are also underrepresented in tenured and tenure-track positions. Data suggest that as of 2009, about 0.5% of faculty were American Indian/Alaska Native, 3.9% were Latino, 5.5% were African American, and 8.4% were Asian/Pacific Islander (Connolly et al. 2015; Smith et al. 2012). These figures underpin the concerns of student advocates, higher education reformers, and university administrations regarding diversity and inclusivity on college campuses, and specifically in the professoriate.

Although scholars have engaged the issue of faculty diversity, previous studies of differences in career outcomes have not consistently accounted for the role and influence of academic discipline (Abbott 2001, 2005; Xu 2008). With disciplines facing internal and external scrutiny as it relates to their accessibility to women and people of color, it becomes more important to home in on the specific role academic discipline plays in our investigations of barriers to access. This study is relevant to research and practice by providing a more contextualized understanding of deficits in career outcomes by gender and race. More broadly, this line of inquiry supports institutional research efforts to foster more diverse and inclusive campuses.

Failing to incorporate academic discipline into analyses of differences in faculty career trajectories ignores the ways departmental norms influence career outcomes. This tenet motivates our analysis of assistant and associate professor career outcomes for female and underrepresented minority faculty. We investigate disparities in career outcomes by discipline, underrepresented minority status, and gender separately, and then turn our attention to race and gender specifically by stratifying on academic discipline. The study further develops the literature on gender and racial disparities in high-demand fields (e.g. STEM), and underrepresented groups clustered at lower academic ranks (Langan 2018; Li and Koedel 2017).

Literature Review

Consistently low percentages of females and racial or ethnic minorities within the faculty ranks only underpin what is a common theme. Both remain underrepresented within tenure-track positions in institutes of higher education. For instance, in their examination of

the representation of female faculty of color, Ginther and Kahn (2012) state that they represent only 2.3% of tenure-track faculty, even though they make up roughly 12.5% of the U.S. population. In addition to a lack of representation, the authors point out that female faculty of color were less likely to obtain tenure-track positions at research intensive, predominantly white institutions (Ginther and Kahn 2012).

Other research has made the logical connection between underrepresentation and the quality of professional experiences. As a case in point, female faculty exhibit significantly lower retention rates than their male counterparts, and consistently report on disproportionate childcare and family responsibilities, a lack of adequate mentoring, and workplace exclusion (Clark and Corcoran 1986; Ehrenberg et al. 1990; Mason et al. 2013). In semblance, faculty of color report heightened intentions to leave academia, leave at higher rates, and are often treated in ways that isolate and demoralize (Johnsrud and Des Jarlais 1994; Menges and Exum 1983; Rosser 2004). In light of what is known, as well as a national conversation around diversity and inclusion in higher education, many institutions continue to struggle with these efforts. These struggles are at least partially due to difficulties on the part of higher education institutions to contend with issues concerning gender, race, and ethnicity.

The extant literature suggests that both gender and race remain salient factors influencing the experiences of faculty. A portion posits that female faculty and faculty of color are often required to wade through negatively tinted perceptions which may in turn influence career outcomes at academic institutions. For example, Villalpando and Bernal (2002) highlight a perception around faculty of color asserting they predominantly reside in departments considered "less prominent and prestigious within higher education, such as humanities, ethnic studies, women's studies, education, and the social sciences" (p. 252). The authors allude to these perceptions creating hierarchies, and subsequent conditions that inhibit the growth of affected faculty populations. The work presents evidence of one narrative that persists in academia which does not align with the prevailing calls for diversity and inclusion.

Studies have also pointed to an unwelcoming climate, slanted internal processes, and disinterested policymaking as issues that racial or ethnic minority faculty encounter (APA 2005; Iverson 2007; Jayakumar et al. 2009; Pifer 2011). Some faculty may find themselves in situations where they feel a need to affirm their worthiness, or actively negate negative stereotypes. For instance, ethnic minority faculty are in instances disproportionately tasked with service duties in support of students from their own racial or ethnic group, and must navigate the academic environment without the same support and mentorship as majority group colleagues (Baez 1998, 2000; Cora-Bramble 2006; Menges and Exum 1983; Tierney and Bensimon 1996; Tierney and Rhoads 1994). The observations are consistent with the work of other scholars concerned with racial equity within the professoriate. In their work examining equity for black faculty and administrators in the South, Perna et al. (2007) created equity ratios to reflect racial gaps in terms of tenure and promotion. They found that black educators encounter more inequity as they move up in rank (Perna et al. 2007).

Other reports highlight lower odds of female faculty being tenured, and a clustering of female faculty at the junior ranks (NCES 2017; Perna 2001, 2005; Box-Steffensmeier et al. 2015). Some research suggests that many of these disparities diminish after controlling for other factors, like educational attainment, research productivity, and institution type. However, both groups remain in lower academic ranks longer, are less likely to earn tenure, and are less likely to be promoted to full professor at research I institutions (Aguirre Jr. 2000; Armstrong and Jovanovic 2015; Box-Steffensmeier et al. 2015; Connolly et al. 2015; NCES 2017). The results of these analyses do not address differences in representation,

but differences in the achievement of professional milestones. They are important because they speak to the role of institutes of higher education in creating and maintaining inclusive environments, and elicit questions around what processes within institutions produce these outcomes.

In and of themselves, the evidence suggests gender and race influence the experiences, interactions, and career outcomes of female and ethnic-minority faculty. What is equally clear from the existing scholarship is that faculty experiences vary substantially depending on contexts within the institution. We study the influence of academic discipline to account for these institutional contexts. Broadly, we understand that academic discipline reflects professional expectations, measures of productivity, and standards for tenure and promotion (Gardner and Blackstone 2013; Hardre et al. 2010). Disciplines also differ in norms, culture, and standards around professional etiquette, career pathways, and academic publishing (Dennis et al. 2006). These characteristics frame normative guidelines, and in turn influence performance criteria (Hardre and Cox 2009; Wakeling 2007). This work makes it clear that institutions must understand how academic discipline influences patterns in faculty career trajectories if they intend on addressing barriers for female faculty and faculty of color.

Others have detailed how academic discipline has bearing on teaching as well as administration (Del Favero 2006, 2018; Kuhn 1970; Smeby 1996). Jackson et al. (2017) study academic discipline's influence on faculty satisfaction with the tenure and promotion process. They argue that variation in faculty satisfaction is in part a function of academic discipline. The authors attest that high or low consensus within an academic field is a strong predictor of satisfaction with tenure and promotion processes. In their analysis, high consensus fields were the hard sciences, engineering, and mathematics, with the arts and social sciences representing low consensus fields. They analyzed survey data, categorizing faculty by field, to find that high consensus faculty had lower satisfaction levels than peers in low consensus fields (Jackson et al. 2017). They also found that differences in satisfaction with tenure and promotion expectations between women and men were partly explained by differences in work-life challenges.

Research productivity is another critical performance metric which may be viewed differently between disciplines. Rebne and Davidson (1992) study disciplinary groupings as predictors of articles published, observing that being a faculty member in a hard science was a strong positive predictor of articles published. Their findings support that some disciplines put a higher premium on scholarly publication counts, with individuals in the hard sciences generally publishing more (Jung 2012; Yang and Webber 2015). These heightened publishing expectations seem to comport with subsequent studies finding lower faculty satisfaction with the tenure and promotion process in the hard sciences. The results also illustrate the variation in tenure and promotion performance criteria across disciplinary groupings.

Yuret (2018) examines career outcomes more explicitly through an analysis of course catalogs to examine time in position and chances of promotion to full professor at 34 tier I undergraduate institutions. He analyzes time in position at similar institutions to find years in a faculty position can vary by more than 5 years depending on the discipline. The analysis falls in line with other evidence of substantive differences in career expectations and outcomes between disciplines, and further illustrates the need to account for discipline in our diversity and inclusion work.

As a natural progression from the work solely focused on disciplinary differences, researchers have begun to focus on the publication demands of different disciplines in an effort understand how they impact the career trajectories of male and female faculty

in different ways. Hopkins et al. (2013) found that while women lag men in publication impact broadly, a larger gap exists in the social sciences compared to the natural sciences. When examining publications trends by race and ethnicity, the authors observed black and hispanic faculty with comparatively lower h-indexes, when compared to their white peers (Hopkins el al. 2013). These are important metrics that influence female and racial or ethnic minority faculty career outcomes. This is especially important when considered jointly with work that underscores an undervaluing of non-dominant group research, as well as a dearth of quality mentorship opportunities for underrepresented group members (Fenelon 2003; Zambrana et al. 2015).

Webber and Canche (2018) draw upon the Survey of Doctoral Recipients data (2003–2013) to examine gender differences in career paths for graduates of the sciences, finding that "overall results indicated no strong, comprehensive evidence of a gendered path to tenure during the first decade after degree completion." Though interestingly, their multi-state event history analysis provides evidence that female faculty in the physical sciences, biology, agriculture, and engineering fields were less likely to stay employed in higher education compared to peers in the social sciences (Webber and Canche 2018). The authors also found that women in STEM fields had fewer tenure-related appointments compared to women in the social sciences. The findings give rise to important questions around the career longevity of female faculty particularly in the STEM fields. Here we are also reminded that diversity and inclusion investigations that fail to account for the variation in career outcomes across disciplines risk neglecting (or confounding) factors that play an important role in faculty career trajectory.

The STEM fields have become a principal point of focus because of their long-standing lack of student and faculty diversity (Whittaker and Montgomery 2014). Examining faculty rosters in academic medical centers, Nunez-Smith et al. (2012) studied attainment of the associate and full professor rank by race. They employ nonparametric methods to find differences in median promotion rates for white, hispanic, and black faculty from 1983 to 2000. Specifically, they found that the rates of promotion to both ranks were lower for hispanic and black medical faculty when compared to white faculty. The results align with findings for women in similar areas of study.

Blackwell et al. (2009) analyze climate survey data to find that women in STEM fields generally report more negative experiences as compared to women in non-STEM fields. Their findings also show a statistically significant interaction effect between gender and STEM as it relates to their climate indicators. The authors report similar interactions between STEM and race, concluding that ethnically diverse STEM faculty reported more positive attitudes than ethnically diverse non-STEM faculty (Blackwell et al. 2009). Their analysis coincides with other findings suggesting that in STEM specifically, female faculty often have qualitatively different experiences than their male counterparts. For ethnically diverse STEM faculty, their work diverges from findings suggesting that in high consensus fields, faculty have less satisfaction with organizational processes. This research illustrates the complexity of these examinations, with women as a whole reporting very different experiences than non-white STEM faculty, though both navigate an environment in which they are underrepresented. The results also illustrate why scholars have called for a more granular approach to monitoring faculty diversity, suggesting there is a need to examine between-discipline differences to adequately understand career advancement for underrepresented groups (Leslie et al. 2015; Weinberg 2008).

We examine differences in faculty career outcomes by gender and race to (1) test whether promotion and tenure disparities exist for female and underrepresented minority assistant and associate professors, and (2) investigate the influence of academic discipline

on career disparities. We focus specifically on risk of leaving without tenure and years to promotion from associate to full professor at four large land grant universities. We model career outcomes as competing risks and compute cumulative incidence functions to examine differences in tenure and promotion outcomes.

We also analyze clusters of similar disciplines (i.e., STEM fields) to make comparisons within and across disciplinary groups. The purpose of these comparisons is to observe whether faculty disparities remain after accounting for disciplinary differences. Components of both social role theory and critical race theory are highlighted and utilized as theoretical frames to examine disparate experiences and outcomes for female and racial or ethnic minority faculty. Both theories animate our discussion section by focusing attention on contextual realities that many women and people of color must navigate as tenured or tenure-track faculty members. These frames also coincide with the practical aims for colleges and universities. Our intention is not to operationalize and statistically test theoretical constructs associated with the respective theories, but rather to utilize applicable elements of both to unpack and make sense of findings. We briefly review the frameworks below, and later invoke both as theoretical lenses that support extensions from our research findings to practical policy implications.

Social role theory asserts that women and men are differentiated by normative gender roles. These roles arise through divisions of labor, gendered belief systems, and institutionalized behaviors (Eagly 1997). Social role theory is pertinent in discussions of gender gaps in higher education because it sheds light on how professional perceptions are often formed around one's adherence to, or deviation from, conventional gender roles (Eagly and Kite 1987; Eagly and Wood 2012). These perceptions take the form of expectations that are formally and informally codified in policy and practice, and as beliefs around what constitutes hard work and merit. These factors influence processes, decisions, and ultimately tenure outcomes in the professoriate for individuals that do not adhere to conventional male work norms.

Conceptually these expectations together comprise what some scholars have coined the ideal worker norm (Williams 2001). When women are unable to meet requirements devised to highlight male contributions, they fall out of organizational favor. Both social role theory and ideal worker norms are rooted in feminist theory, to examine obstacles inherent in the female experience. This framework is pertinent to the study of gender disparities in the professoriate because it focuses on institutional mechanisms that socially inhibit, or penalize, women relative to their male colleagues. These insights are helpful as universities self-assess in efforts to remove discriminatory barriers to entry.

A critical race perspective considers race as the central construct for understanding inequity (Ladson-Billings 2004). Substantive critiques assert that feminist frameworks often lack the mechanisms to qualify race, or the issues that people, and specifically women, of color face (Crenshaw 1989). In our case, we examine racial disparities in the professoriate with a critical race lens.

Critical race theory originated as legal scholarship that sharply critiqued incrementalism as a viable approach to address inequities, while grounding analyses in the centrality of race and normality of racism (Ladson-Billings 1998). Critical race theory is distinct in its exacting focus on the implications of race but linked to social role theory in its insights into social construction, power, and exclusion (Crenshaw 2011; Lopez 2003). In application, this can equate to marginalized groups not being acculturated into the academic environment in the same way as individuals hailing from the dominant group. More pointedly, critical race theory asserts that whiteness is the dominant paradigm, and people of color are perpetually measured against criteria not only constructed by the dominant group, but

also for the benefit of dominant group members. We draw on critical race theory to highlight approaches to increase diversity and inclusion in higher education.

Method

This article uses institutional personnel data from four large, research extensive, land grant universities (denoted LG1–LG4). The number of years of data varied among the four institutions; two institutions provided data from 1992 to 2015, one from 1997 to 2015, and one from 2002 to 2015. All of the institutions provided data for appointments to tenure-track assistant professor (n = 4352) and all tenure-track and tenured faculty hired or promoted to associate professor (n = 3375) within the time periods available. The cohorts studied were limited to the years 2002 to 2015 in order to include data from all four institutions. This reduces the assistant professors' cohort to 3298 individuals and the associate professors' cohort to 2556 individuals. The dataset was limited to variables collected with historical accuracy across all four of the institutions included in the analysis. Thus, some covariates with analytical value were excluded because they were not collected accurately, or longitudinally, across the institutions for an adequate period of time.

Gender, Race and Ethnicity

Gender and race were self-reported. While each institution had a different system of reporting race and ethnicity data, gender was reported consistently across all four institutions. In order to create a consistent dataset with regards to race and ethnicity, we defined a underrepresented minority (URM) group including those who identify as one or more of the following groups: black, Hispanic, and American Indian. At LG1 and LG3, individuals were allowed to check multiple race and ethnicity categories. If an individual checked a category, they are considered to be a member of that category. Therefore, the sum of all categories is greater than the number of individuals in the dataset.

The number of international faculty in the 2002–2015 cohort who also identified with an URM group is relatively small. Only 1 of 48 international assistant professors at LG1 classified as URM, and none of the 38 international assistant professors at LG2 identified as URM. At LG3 during the same time period, 9 of 72 international assistant professors were classified as URM, and information on citizenship was not available for LG4.

Disciplines

The dataset includes information on all faculty in departments corresponding to disciplines in the Agricultural Sciences and Natural Resources, Biological and Biomedical Sciences, Health and Veterinary Sciences, Physical Sciences, Social Sciences, Engineering, Education, Humanities, Business, and Other fields as catalogued in the 2014 Survey of Earned Doctorates (Chang and Foley 2015). The 2014 Survey of Earned Doctorates was used to categorize academic departments into more encompassing academic fields in order to stratify the analysis by disciplinary categories that represent substantive ontological and contextual overlap between departments.

While other disciplinary typologies exist, the Survey of Earned Doctorates was ultimately chosen used because it remains one of the most comprehensive academic grouping typologies available. For example, Biglan's discipline typology is an alternative to the

Survey of Earned Doctorates. However, Biglan's typology is not as comprehensive as the Survey of Earned Doctorates and has fewer exact departmental matches to aptly categorize academic departments. Stratifying the analyses by academic college was also investigated as an option, but subsequent analyses revealed that the composition of the academic colleges was not commensurate from institution to institution. Therefore, the Survey of Earned Doctorates represented the most appropriate approach conceptually, and as a practical matter.

The Survey of Earned Doctorates does possess limitations. In this paper, we have labeled the "Other" fields as "Miscellaneous." This group includes departments not otherwise categorized, such as agricultural or extension education, community sciences, family studies, architecture, apparel management or merchandizing, construction management, communication, hospitality, tourism and recreation, journalism, landscape architecture, occupational therapy, public administration, social work, visual arts and graphic design.[1] In the small number of cases where the department name did not approximate a listed academic subfield, the academic institution from which the data was generated was consulted as to how to best classify the department, given their institutional context.

For all tenure-track and tenured faculty appointed during the time period available, the faculty member's department was determined by either their department during their first year on the tenure track [three institutions (LG1, 2, and 3)] or the department in which they were promoted (LG4, confirmed via email). For all tenure-track and tenured faculty hired or promoted to associate professor appointments during the time period studied, each faculty member's department was determined by either their latest year as an associate professor (LG1, 2), their first year as an associate professor (LG3) or their most recent department (LG4, confirmed via email).

Statistical Procedures and Analyses

Appointments to tenure-track assistant professor in the 2002–2015 cohort have three possible outcomes. Each faculty member can either earn tenure, leave without tenure, or still be pre-tenure at the end of the study. Earning tenure and leaving without tenure are two non-overlapping outcomes. By definition, earning tenure at an institution prevents a faculty member from leaving without tenure. Similarly, leaving an institution without tenure prevents a faculty member from earning tenure at that particular institution at that point in time. In statistical terminology, these are competing risks (Gray 1988). The associate professors also have competing risks, with outcomes of promotion to full professor, leaving without promotion to full professor, and remaining at the associate professor level.

Cumulative incidence functions are a method for testing the impact of a covariate on the likelihood of a particular outcome (Fine and Gray 1999). A cumulative incidence function represents the probability that a specific event has occurred by a particular time. We use cumulative incidence functions rather than the Kaplan–Meier estimator because Kaplan–Meier is biased when there are competing risks (Fine and Gray 1999). We use Gray's test (Gray 1988) to compare the cumulative incidence curves. When comparing multiple groups with competing risks, Gray's test allows us to test the direct effect of each

[1] The discipline classifications loosely resemble smaller units of Biglan's academic task areas. http://edshare.soton.ac.uk/15017/2/Biglan_-_1973_-_Relationships_between_subject_matter_characteristics_and_the_structure_and_output_of_university_departments.pdf.

covariate on the cumulative incidence curve (Fine and Gray 1999). We examine the effects of URM status, gender, discipline, and institution on the likelihood of leaving an institution without tenure.

We performed eight separate survival analyses for the assistant professors to examine leaving without tenure. The first four compared the incidence of leaving without tenure between disciplines, institution, URM status, and gender. Two additional analyses test for differences in the incidence of leaving without tenure between URM and non-URM faculty while controlling for disciplines and institutions. The final two analyses test for differences in the incidence of leaving without tenure by gender while controlling for disciplines and institutions. We performed the same analyses for associate professors to consider promotion to full professor.

Controlling for discipline and/or institution was accomplished by stratifying the analysis by discipline or institution, respectively, and applying Gray's test (Dignam and Kocherginsky 2008). It is important to control for stratification variables in cases where there is:

(1) An association between the stratification variable (e.g., discipline) and the outcome (e.g., the incidence of leaving without tenure) and
(2) The stratification variable is associated with the groups being compared (e.g., men vs. women).

In the study of faculty success and retention, both of these conditions are likely to hold because retention and success vary by discipline, and the distributions of women and URM faculty vary considerably across disciplines. If the stratification variables are ignored and all the data are pooled together for the analysis, the impact on tests of differences between men and women or between URM and other faculty will be unpredictable. The tests could either show differences where there are none or they could mask differences that are in fact present.

Stratification is not without its own assumptions. In particular, stratification works well when the ratio between the groups being compared (e.g., men and women) in the rate of leaving without tenure is similar among all of the strata (e.g., among all disciplines). In this case, doing a stratified test to compare the rate of leaving for men and women will be more powerful than doing individual tests for each stratum (each discipline). If the ratios of men to women's rates of leaving vary considerably among disciplines, the stratified test will have low power, and performing individual tests within each stratum will yield more powerful tests. Consequently, we performed individual tests by discipline and by institution when it appeared that the relationship between the cumulative incidence curves for men and women or between URM and other faculty were not similar across strata.

Results

Below are the results of our analysis of assistant and associate professor career outcomes. The assistant professor analysis is reported first and is followed by the associate professor analysis. For both analyses, we first examine differences in the cumulative incidence of leaving by academic discipline. Then, differences in the cumulative incidence of leaving for both underrepresented minority and female assistant professors are reported. After observing differences by both discipline and faculty demographics separately, differences in the cumulative incidence of leaving for both female and underrepresented minority

Table 1 Percent black, Hispanic, and American Indian* tenure-track assistant professors hired (number of URM faculty/number of total faculty hired in parenthesis)

Institution	Race	1992–1996	1997–2001	2002–2015
LG1	Black	5% (13/253)	6% (15/251)	6% (49/778)
	Hispanic	1% (3/253)	5% (13/251)	5% (36/778)
	American Indian	2% (4/253)	0.4% (1/251)	1% (8/778)
LG2	Black	0% (0/103)	2% (4/209)	3% (16/636)
	Hispanic	4% (4/103)	7% (15/209)	7% (42/636)
	American Indian	2% (2/103)	1% (2/209)	1% (5/636)
LG3	Black		6% (15/238)	4% (30/824)
	Hispanic		4% (9/238)	6% (47/824)
	American Indian		1% (2/238)	1% (5/824)
LG4	Black			5% (48/1060)
	Hispanic			9% (91/1060)
	American Indian			0.3% (3/1060)

*Note that faculty may identify with more than one racial/ethnic category, so the totals may be larger than the number of URM faculty reported in Table 1

faculty are investigated after stratifying on academic discipline. Results of the stratified analyses are indicative of the need to account for academic discipline in examinations of faculty career outcomes for female and underrepresented minority faculty.

Assistant Professor Analysis

The data for our analyses are provided in the (Appendix Table 4), which provides the counts of tenure-track assistant professors (n = 4352) appointed by each institution by gender and URM status. Table 1 summarizes the percent black, Hispanic, and American Indian tenure-track assistant professors hired at each institution over time. The fraction of black assistant professors hired did not increase over time at LG1 or LG3. In 2002–2015 black faculty hiring averaged about 5% at LG1, LG3, and LG4. At LG2, black faculty hiring increased from 0 in 1992–1996 to 3% in 2002–20015.

There are no significant differences in the cumulative incidence for leaving without tenure across institutions ($p = 0.18$, Gray's test). The final cumulative incidences of exit without tenure are LG1 (29%), LG2 (25%), LG3 (37%), LG4 (38%). Figure 1 shows the cumulative incidence of leaving without tenure by discipline for tenure-track assistant professors hired from 2012-2015. There are significant differences among disciplines ($p < 0.0001$, Gray's test).

The final cumulative incidence of exiting without tenure for business, the miscellaneous category, and the social sciences was 52%, 43%, and 40% respectively. These three academic disciplines had the highest incidences of leaving without tenure for assistant professors at the institutions sampled. The disciplines with the next highest incidences of leaving without tenure were education (38%), the humanities (36%), and health and veterinary sciences (32%). The disciplines with the lowest incidences of assistant professors leaving without tenure were engineering (28%), the life sciences (28%), the physical and mathematical sciences (22%), and biological sciences (21%). The data exhibit some natural

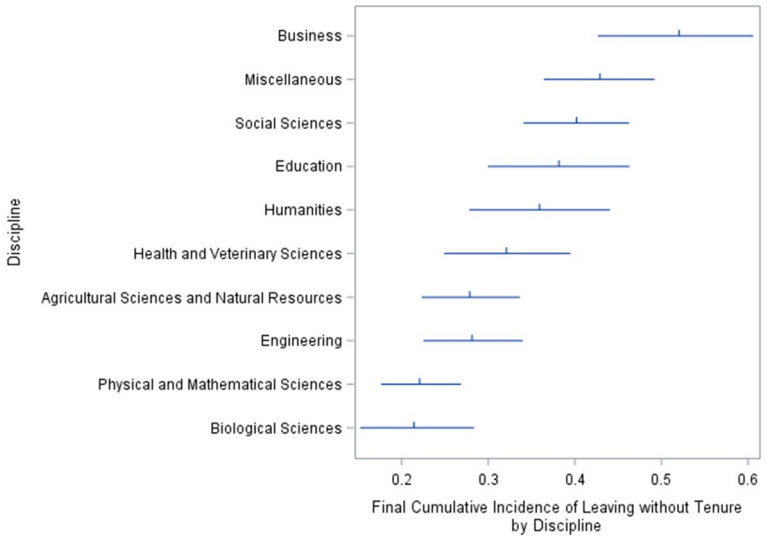

Fig. 1 Cumulative incidence (estimate and 95% confidence interval) of leaving without tenure by discipline for tenure-track assistant professors hired from 2012 to 2015

clustering regarding the incidence of leaving across academic disciplines. In general, the incidence of leaving without tenure is lower in the STEM disciplines, ranging from 21% to 32%, than in the other disciplines. It is over 40% in some of the disciplines that are the most conceptually dissimilar from the STEM fields.

Analysis by URM Status

There are no significant differences in the cumulative incidence of leaving without tenure by URM status when the data are combined across institutions ($p=0.1495$, Gray's test). The estimated final incidence of leaving without tenure is 38% for URM faculty and 33% for other faculty. Stratification by institution (Fig. 2a) or by discipline (Fig. 2b) does not reveal any significant differences in the risk of leaving without tenure for URM versus other faculty ($p=0.1426$ and $p=0.3979$, respectively). However, when separate models are used to test URM versus other faculty within each discipline, differences between URM and other faculty are evident for some disciplines. In the Physical and Mathematical Sciences, URM faculty are *less* likely to leave without tenure than other faculty ($p=0.04$). In fact, in both the Physical and Mathematical Sciences and the Biological Sciences, no URM faculty left without tenure. In the Miscellaneous discipline group, URM faculty are *more* likely to exit without tenure ($p=0.006$). The results are similar when analyzed separately by discipline and stratified by institution. We again see that URM faculty are less likely to leave without tenure than other faculty in the Physical and Mathematical Sciences and the Biological Sciences and more likely to leave without tenure in the Miscellaneous disciplines.

In addition, this analysis makes visible a difference between URM faculty and other faculty in Engineering ($p=.088$). At three of the four institutions, the incidence

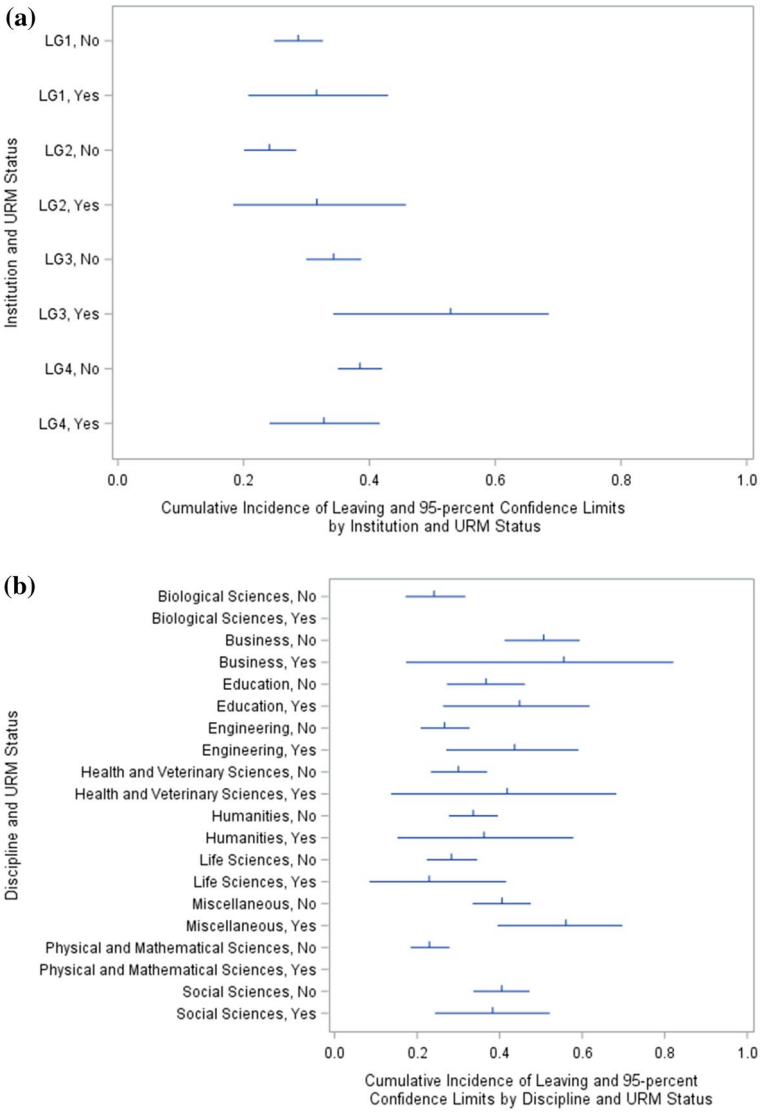

Fig. 2 Cumulative incidence (estimate and 95% confidence interval) of leaving without tenure for tenure-track assistant professors hired from 2002 to 2015 **a** by URM status stratified by institution; **b** by URM status stratified by discipline

of leaving without tenure was higher for URM faculty than for other faculty in Engineering. The cumulative incidence curves for Engineering for each institution illustrate another important point: the confidence intervals are very wide and, correspondingly, the power of tests of hypotheses about URM faculty in any particular discipline are very low. This is because the number of URM faculty in a specific discipline at any one institution is very small.

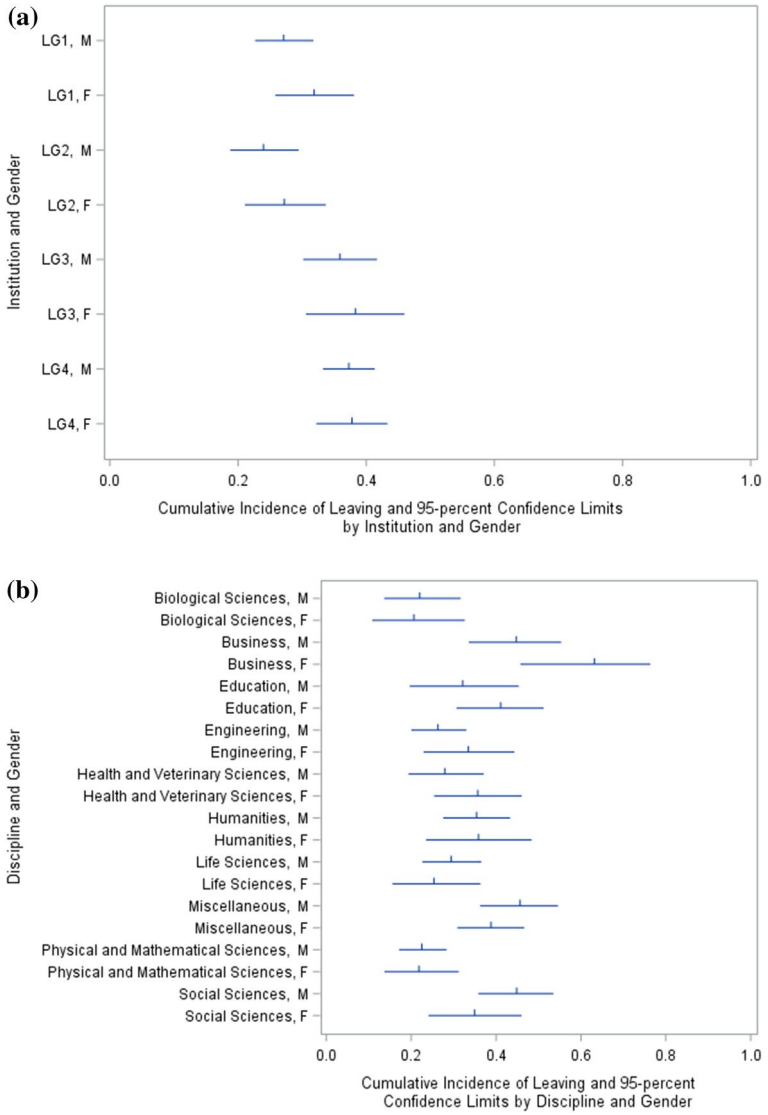

Fig. 3 Cumulative incidence (estimate and 95% confidence interval) of leaving without tenure for tenure-track assistant professors hired from 2002 to 2015 **a** by gender stratified by institution; **b** by gender stratified by discipline

Analysis by Gender

If all disciplines and institutions are pooled together, there is a significant difference between men and women in the cumulative incidence of leaving without tenure ($p = 0.0137$, Gray's test). The final cumulative incidence of leaving without tenure for men is 32% and for women is 36%. Stratification by institution does not explain the difference between men and women (Fig. 3a). The *p* value for the difference between men and women

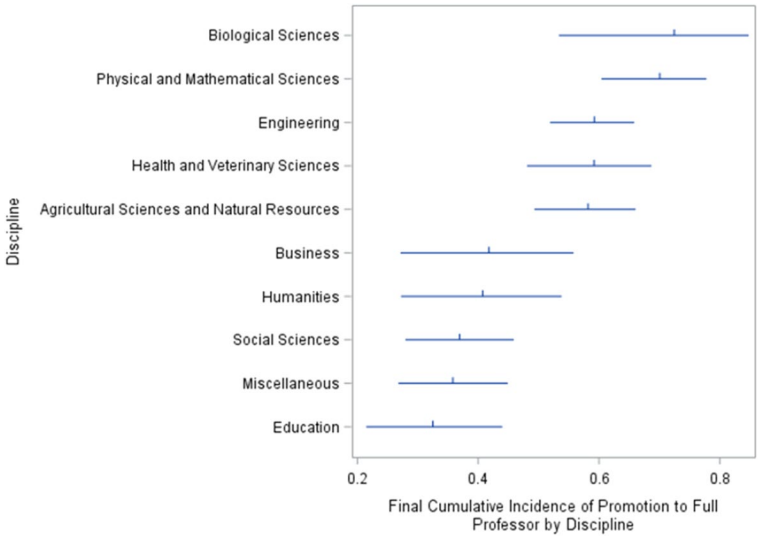

Fig. 4 Estimated proportion with 95% confidence interval promoted to full professor within 13 years by discipline (tenured associate professors hired/appointed from 2002 to 2015)

is 0.0131 even after accounting for the difference between institutions. The final cumulative incidence of leaving without tenure for men and women at each institution:

- LG1: Men (27%); Women (32%)
- LG2: Men (24%); Women (27%)
- LG3: Men (36%); Women (38%)
- LG4: Men (37%); Women (38%)

On the other hand, differences among disciplines appear to account for most of the gap between men and women. After stratifying on discipline, the difference between men and women is no longer significant ($p = 0.4550$). Analyzing each discipline separately shows higher incidence of exiting without tenure for women than men in Engineering ($p = 0.0010$) and Business ($p = .0914$), lower incidence of exiting without tenure for women than men in the Social Sciences ($p = .0621$), and no difference in any other discipline (Fig. 3b).

Associate Professor Analysis

The data for our analyses are provided in the (Appendix Table 5), which provides the counts of tenure-track assistant professors ($n = 3344$) appointed by each institution by gender and URM status.

When considering the proportion of associate professors promoted to full professor by institution, there are significant differences in the cumulative incidence curves among institutions (Gray's test, p value = .0003), with the 13-year incidence ranging from 42.2 to 62.0%.

Figure 4 shows the cumulative incidence of promotion to full professor by discipline. The differences range from 33% in Education to 72% in the Biological and Biomedical

Table 2 Estimated cumulative incidence of promotion of associate professors hired/appointed from 2002 to 2015 by URM

Years to promotion	URM	Other
4	5.8% (3.1–9.8%)	9.0% (7.8–10.4%)
6	17.4% (11.9–23.7%)	30.2% (27.9–32.7%)
8	34.3% (26.3–42.4%)	42.7% (39.9–45.4%)
10	40.8% (31.7–49.7%)	48.8% (45.8–51.7%)
Final	43.0% (33.3–52.4%)	54.2% (50.7–57.7%)

Confidence intervals are in parentheses

Sciences and the Physical and Mathematical Sciences (p value < .0001, Gray's test). The disciplines cluster into two groups of five disciplines:

1. STEM Disciplines: Physical and Mathematical Sciences, Biological and Biomedical Sciences, Engineering, Health and Veterinary Sciences, Agricultural Sciences and Natural Resources. In these disciplines, between 58 and 72% of associate professors are estimated to be promoted to full professor within 13 or fewer years.
2. Other Disciplines: Business, Humanities, Social Sciences, Education, and the Miscellaneous group of disciplines. In these disciplines, between 33 and 42% of associate professors are estimated to be promoted to full professor in this length of time.

Analysis by URM Status

When all disciplines and institutions are pooled together, the cumulative incidence (Table 2) for promotion to full professor are significantly worse for URM faculty than for other faculty (p value = .0079, Gray's test). This disparity is evident at three of the four institutions (Fig. 5a). When stratified by institution, the cumulative incidence curves for URM faculty are still significantly worse than for other faculty (p value = .0055, Gray's test).

When we stratify by discipline, the cumulative incidence of promotion of URM and other faculty are not significantly different (p value = .1448, Gray's test). However, in certain disciplines the promotion rate for URM faculty appears to be lower than for other faculty, while in other disciplines the promotion rate for URM faculty is similar to or higher than for other faculty (Fig. 5b). There appears to be a large disparity, with lower promotion rates for URM than other faculty, in Business, Education, Health and Veterinary Sciences, and Miscellaneous disciplines. In the Humanities, on the other hand, the URM faculty appear to be promoted faster and in higher proportions than other faculty. In the rest of the disciplines (Agricultural Sciences and Natural Resources, Engineering, Biological and Biomedical Sciences, Physical and Mathematical Sciences, and Social Sciences), the cumulative incidence curves are similar for URM and other faculty.

Analysis by Gender

When all disciplines and institutions are pooled together, it appears that men are promoted more quickly than women and that, overall, more men achieve the rank of full professor than women (Table 3, p value < .0001, Gray's test). For any given number of years at

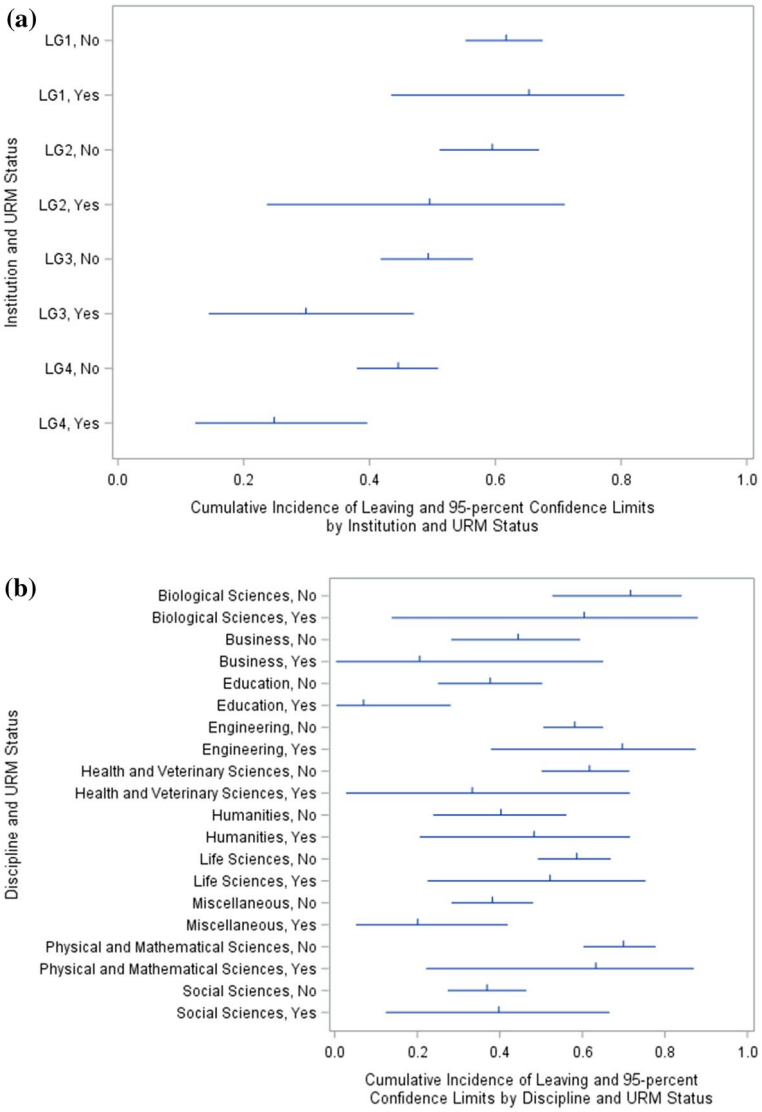

Fig. 5 Final cumulative incidence with 95% confidence intervals of promotion of associate professors hired/appointed from 2002 to 2015 **a** by URM status stratified by institution; **b** by URM status stratified by discipline

the associate professor rank, a higher fraction of men are promoted to full professor than women.

The findings are consistent at all four institutions (p value < .0001, Gray's test), although there is a much larger gap between men and women at LG3 than at the other three institutions (Fig. 6a).

When stratified by discipline, there is still a significant difference between men's and women's cumulative incidence curves (p value = .0021, Gray's test). Testing for gender

Table 3 Estimated cumulative incidence of promotion of associate professors hired/appointed from 2002 to 2015 by gender

Years to promotion	Women	Men
4	5.8% (4.1–7.7%)	10.2% (8.7–11.9%)
6	20.8% (17.3–24.4%)	32.9% (30.1–35.7%)
8	34.3% (29.8–38.9%)	45.5% (42.3–48.6%)
10	39.6% (34.7–44.6%)	52.0% (48.5–55.3%)
Final	46.0% (40.0–51.8%)	56.6% (52.5–60.5%)

Confidence intervals are in parentheses

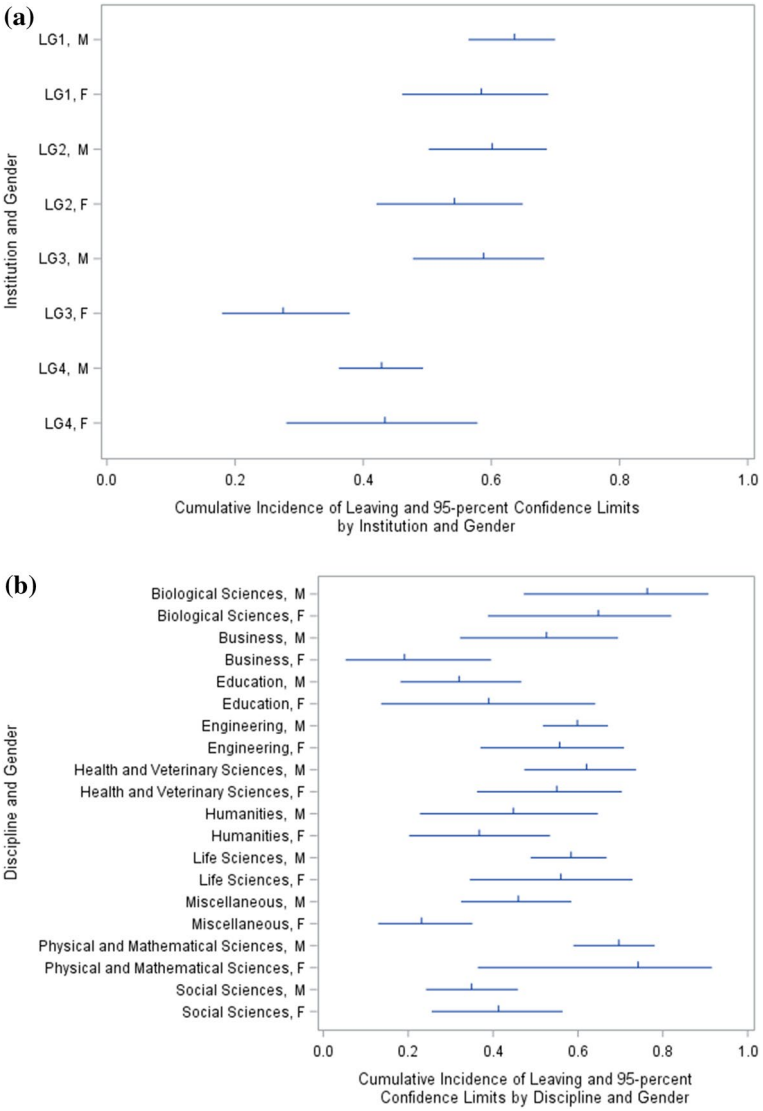

Fig. 6 Final cumulative incidence with 95% confidence intervals of promotion of associate professors hired/appointed from 2002 to 2015 **a** by gender stratified by institution; **b** by gender stratified by discipline

effects for individual disciplines reveals that a significant gap between men's and women's curves for a few disciplines, namely Health and Veterinary Sciences (p value = .0798), Business (p value = .0123), and Miscellaneous disciplines (p value = .0156), but not for other disciplines (Fig. 6b).

Discussion

For the institutions analyzed, organizational climate, location, pay, and prestige may also have played a role in the decisions of women and racial or ethnic minorities to depart. However, the reported differences evidence a necessity to analyze these disparities at the discipline level in order to understand the depth to which diversity and inclusion are a part of institutional culture.

We find that disparities do exist within select disciplines for female and underrepresented minority faculty in the institutions sampled. However, there is considerable variation in outcomes across disciplines, with many disparities washing out after controlling for academic field. The discipline-specific findings reinforce calls for more granular analyses of faculty diversification. For women in particular, when all disciplines are pooled together, the risk of leaving without tenure was significantly higher than for male faculty (36% for women, 32% for men), but most of this disparity disappeared when the data are stratified by discipline. In Engineering and Business, women were still at a higher risk of leaving without tenure than men. These findings are of note when considered in tandem with literature suggesting engineering broadly has lower incidences of leaving without tenure.

This finding suggests that while gender equity seems to be improving in some areas, institutional barriers remain. This is not surprising given historically low representation for female faculty in certain areas, in addition to research findings that have shown female engineering faculty are less likely to stay employed in education compared to female faculty in the social sciences.

It is important to couch these results within the context of diversifying the professoriate at large land grant research institutions. If colleges and universities intend on ensuring all spaces within academe are diverse and inclusive, they must first accept the fact that underrepresentation and disparate career outcomes are fundamentally issues of equity. We observe tenure and promotion outcomes by discipline as a necessary step to parse out the extent to which gender and race influence career outcomes. Institutions that simply focus on institution level analyses, or on recruitment metrics solely, fail to account for the other sides of a multifaceted issue. Institutions will need to unpack biases deeply embedded in societal dynamics, and the ways these dynamics influence general and evaluative organizational processes. This is the utility of social role theory for institutions struggling to advance this work. It can be a tool for institutions to home in on social and institutional issues that underpin gender exclusion. While issues of equity in higher education may look much different than they did thirty, or even 10 years ago, many of the root issues remain.

This is consistent with the recent work of social role theorists asserting that the glass ceiling metaphor is outdated, but not necessarily a reflection of full gender equity. While many disparities were nullified at the discipline level, we found that more men than women were promoted from associate to full professor (56.3% vs. 46.1%), and their promotions took less time. Women may not encounter an impermeable barrier once they have reached a certain level of success, but they still have more difficulty obtaining positions outside of female-dominated fields, often do not advance within their roles as fast as men, and usually

have higher attrition at every stage of career development (Eagly and Carli 2007). Within engineering departments at the institutions studied, male and female incidences of leaving without tenure (n = 105 women, 408 men) show a significant difference (33% for women, 26% for men), and largely support findings highlighting pay and supervisory experience disparities, and fewer career advancement opportunities for women (Jagacinski 1987). Thus, institutions must educate themselves by coupling what we know about the social barriers and experiences of women in academia with institution and discipline-specific analyses to fully understand the gender inclusivity of their campuses.

For URM faculty, we found they were less likely to leave without tenure than other faculty in the Physical and Mathematical Sciences (n = 20), but more likely to leave in the disciplines labeled "Other Fields" (n = 32). Here we see that while both female and underrepresented minorities may encounter challenges as they navigate academia, it is important not to conflate the obstacles both groups potentially face. This is the import of approaching issues of diversity and inclusion on college campuses through the lens of critical race theory as well. While social role theory converges with critical race theory in its focus on disparate socialization processes, the inequitable bestowal of privilege, and structures that reify the status quo, it differs in its incorporation of race and the notion that it is central to situational contexts.

In short, issues of race and gender are related and at times overlap, but we cannot mistake this for them being one in the same. Critical race theory makes this differentiation explicit by not only critiquing frameworks that fail to incorporate the varied perspectives of marginalized people of color but has also set the stage for drilling deeper into the experiences of people that have overlapping identities in an intersectional context (McCall 2005). Much like the incorporation of academic discipline, institutions cannot fully comprehend and address issues of inclusion and diversity without unequivocally naming and investigating the role and import of race and ethnicity.

At three of the four institutions, URM faculty left without tenure at higher rates than their white colleagues within departments of engineering. For associate professor URM faculty, fewer were promoted to full professor than their white peers (42.5% vs. 54.1%), and they were also promoted more slowly. The largest gaps between URM and other faculty reside in Business, Education, Health and Veterinary Sciences, and "Other Fields." Through our lens, these results are potentially indicative of structures that systemically operate as barriers for people that do not hail from dominant group backgrounds.

Thus, the policy implications are straightforward. It is increasingly important for universities to monitor career outcome data at the discipline level. Colleges and universities can benefit from this approach by developing not simply college, but discipline-specific diversity and inclusion plans and action items. Our analysis suggests initiatives to recruit and retain more women and people of color might be more effective if differentiated by academic discipline as well as career level. It is evident that the universities sampled may benefit from a more thorough examination of the promotion process from associate to full professor in specific fields. It also suggests it is prudent to better understand the perspectives and experiences of faculty in affected departments. In finding that trends in promotion to full professor are differentiated by discipline, we also saw they do not perfectly mirror discipline-specific trends in the risk of leaving without tenure. These findings illustrate the complexity of faculty diversity, and the need for nuanced approaches to this area of study (Leslie et al. 2015; Weinberg 2008).

In recognizing that experiences will not be the same given the faculty demographic and discipline-specific factors, we advocate for the collection of research productivity and service data, as well as teacher evaluation and promotion metrics disaggregated by

gender and race and ethnicity. Universities will need to assess whether disparities are as a result of discipline/programmatic differences, biased or slanted processes, both, or perhaps random chance. As shown, universities must understand institutional contexts, and the role that program and department play. If institutions are genuine in their concerns about equal treatment for women and people of color in fields where those groups have historically been underrepresented, institutional transformations rather than technical solutions are needed.

To ensure proposed changes are inclusive, universities would be prudent to seek out and document the experiences of women and URM faculty in disciplines where disparities exist to understand circumstances, relationships, and context. It is incumbent upon colleges and universities that uncover disparities to investigate normalized processes and behaviors that conflict with organizational goals around diversity and inclusion (Ladson-Billings 1998). Our research suggests there is a need to understand the task as many small puzzles, as opposed to one large one. Furthermore, this study contributes to what is a dearth of scholarship concerning career outcomes for racial and ethnic minority faculty. This study enhances the ability of large land grant universities' to accurately self-assess in this area, and contributes to scholarship examining equity gaps within academe specifically. It further evidences that overarching approaches to diversify the professoriate may not include the institutional context, nor conceptual lenses, needed to continue to advance the work of diversity and inclusion.

Appendix

See Tables 4 and 5.

Table 4 Number of assistant professors appointed, by gender and by URM status, For each institution (n = 4352)

Institution	Year of appointment as tenure-track Assistant Professor					
	1992–1996		1997–2001		2002–2015	
	Women	Men	Women	Men	Women	Men
LG1	62	191	90	161	308	470
LG2	48	55	92	117	280	356
LG3	NA		93	145	319	505
LG4	NA		NA		376	684
Institution	1992–1996		1997–2001		2002–2015	
	URM	Other	URM	Other	URM	Other
LG1	20	233	28	223	87	691
LG2	6	97	21	188	63	573
LG3	NA		26	212	81	743
LG4	NA		NA		142	918

Table 5 Number of associate professors appointed, by gender and by URM status for each institution

Institution	Year of Appointment as tenure-track Associate Professor									
	1992–1996		1997–2001		2002–2006		2007–2011		2012–2015*	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
LG1	64	200	43	158	65	149	80	160	100	126
LG2	3	20	47	78	56	103	71	110	90	111
LG3	NA		59	125	74	153	70	144	73	124
LG4	NA		NA		19	90	80	199	111	198
Institution	1992–1996		1997–2001		2002–2015		2007–2011		2012–2015	
	URM	Other	URM	Other	URM	Other	URM	Other	URM	Other
LG1	23	241	18	183	25	189	30	210	21	205
LG2	1	22	10	115	13	146	13	168	20	181
LG3	NA		14	170	20	207	15	199	13	184
LG4	NA		NA		10	99	31	248	49	260

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