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FACTORS IMPACTING THE ACADEMIC CLIMATE FOR LGBQ STEM FACULTY

Eric V. Patridge,[1,]* Ramón S. Barthelemy,[2] & Susan R. Rankin[3]

[1]*Yale Center for Molecular Discovery, Yale University, New Haven, Connecticut 06520, USA*

[2]*Mallinson Institute for Science Education, Western Michigan University, Kalamazoo, Michigan 49008, USA*

[3]*Department of Education Policy Studies, College of Education, Pennsylvania State University, University Park, Pennsylvania 16802, USA*

* Address all correspondence to: E-mail: eric.patridge@yale.edu

There is limited information available regarding factors that contribute to the academic advancement of lesbian, gay, bisexual, and queer (LGBQ) communities. In this project, we employ data from the 2010 State of Higher Education for Lesbian, Gay, Bisexual, and Transgender People, and our aim was to assess the experiences of LGBQ faculty from science, technology, engineering, and mathematics (STEM) disciplines. Survey responses from 279 LGBQ faculty members across multiple departments were analyzed through chi-square and binary logistic regression. Our findings from this national study identify several factors influencing the academic climate and subsequent career consequences of LGBQ faculty, and department-level analyses suggest these climate factors may be particularly relevant to the STEM fields. We propose that the comfort of LGBQ faculty members is a valuable measure for advancing the retention of LGBQ STEM faculty members, and we show that both exclusionary behavior and being "out" are factors that negatively impact this measure. We provide potential best practices to improve the academic climate for STEM faculty members, thereby advancing both their persistence and their influence on mentoring prospective LGBQ STEM students.

KEY WORDS: *LGBT, lesbian, gay, bisexual, transgender, queer, retention, comfort, faculty, STEM*

1. INTRODUCTION

Economic forecasts point to a need for producing, over the next decade, nearly one million more college graduates from the science, technology, engineering, and mathematics (STEM) fields than previously expected, and advisors to the White House propose that this gap can be largely met by increasing the retention of STEM majors from 40 to 50% (President's Council of Advisors on Science and Technology, 2012). In light of this report and others, the President issued several challenges that have prompted renewed interest in advancing the national pipeline for STEM talent.

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Historically, STEM initiatives to advance underrepresented groups have excluded lesbian, gay, bisexual, and transgender (LGBT) people; however, given our need to remain competitive in a global STEM economy, it seems prudent to increase the recruitment and retention of STEM talent from all demographics. The recent *2010 State of Higher Education for Lesbian, Gay, Bisexual, and Transgender People* reported that LGBT people are at risk in higher education (Rankin et al., 2010). In comparison to their heterosexual and cisgender counterparts, LGBT faculty, staff, and students are significantly more likely to have negative perceptions of their campus climate, and as a result, they are more likely to consider leaving their institution. Bilimoria and Stewart (2009, p. 85) found that "while some [LGBT] faculty describe overt hostility toward them, invisibility, interpersonal discomfort, and pressure to 'cover' their sexuality are much more pervasive, as is a felt obligation to be supportive to LGBT students and junior colleagues." These factors offer possible indicators for addressing campus climate and professional advancement for LGBT communities.

Our project examines these same factors, addressing a critical gap in the literature. Due to the paucity of research on LGBT faculty, particularly in the STEM fields, we focus our review of the literature on the advancement of underrepresented communities (i.e., race, gender) in the STEM fields and the importance of mentorship in the STEM fields. Our project uses survey responses from the *2010 State of Higher Education for Lesbian, Gay, Bisexual, and Transgender People* (Rankin et al., 2010), focusing on LGBT faculty across all disciplines, and we reveal differences between STEM versus non-STEM fields. We draw from survey questions to assess the influence of sexual identity on the career consequences of LGBT faculty. In addition, we examine how LGBT faculty members perceive the academic climate, and we analyze their experiences, comfort, and whether they considered leaving their university. Our department level analyses suggest these climate factors may be particularly relevant in relation to the STEM fields.

2. REVIEW OF THE LITERATURE

2.1 STEM Talent in the United States

A skilled STEM workforce is essential for economic success. Since the 1950s, technological innovation has driven more than half of all economic growth in the United States (Bonvillian, 2002; Solow, 1957). Traditionally, the United States has been a leader in innovation, but in the wake of the Information Age, new strategies must be developed to cultivate STEM talent and remain competitive in a global economy. Already, analysts suggest that the United States may be ill prepared for the 21st century; employers and U.S. academic institutions are increasingly recruiting foreign-born over native STEM talent (Gambino and Gryn, 2011; Kurtzleben, 2011; National Science Foundation, 2012). As the United States revises its academic approach, it is important to consider the influence of faculty on student development, and it is critical that U.S. institutions of higher learning focus on the academic climate and retention of quality STEM faculty. Besides positive first-year experiences in classrooms (Ost, 2010), satisfactory student/faculty interactions via mentorships, collaborations, and independent projects can greatly enhance the development and persistence of STEM students (Astin, 1993; Astin and Astin, 1992; Thompson, 2001).

In addition to their influence with students, professors also contribute to the long-term academic landscape through their professional mentorship choices. Serving as stewards of advanced-degree STEM talent, they select those who will be mentored, and this has far-reaching effects on the early professional development of new faculty and research professionals, who will then, in turn, serve as mentors themselves. Some investigators suggest the "chosen ones" are carefully directed in preparation for the professoriate, and studies offer that mentors will often choose protégés of the same race and gender (Eddy and Gaston-Gayles, 2008; Leggon, 2010; Ragins and Scandura, 1994, 1997). Given this tendency, it is vital that U.S. institutions of higher learning be dedicated to mentoring all underrepresented STEM talent; a diverse faculty benefits the pedagogy, culture, and curricula of STEM disciplines (Bassett-Jones, 2005; Leggon, 2010; Malcom et al., 2004). Similarly, it is helpful to consider that having a diverse STEM faculty enhances the persistence of underrepresented STEM students and the retention of underrepresented STEM faculty (Hill et al., 2010; Leggon, 2010; Sonnert et al., 2007; Stout et al., 2011).

2.2 Underrepresented Faculty in STEM

Regarding the history of faculty diversity in the United States, it is well established that women and ethnic minority faculty have long been markedly underrepresented in STEM fields, as compares to the social sciences and humanities. National efforts to counter this trend have led to a number of papers and annual reports documenting changes in the demographics of STEM faculty over time (Clewell et al., 2011; Gambino and Gryn, 2011; Hill et al., 2010; Kuenzi, 2008; Lewis et al., 2009; Lowell and Regets, 2006; National Research Council, 2001, 2006, 2010, 2011; National Science Foundation, 1996, 2012; Price, 2010; Xie and Shauman, 1998). Documents such as these (and their data sets) are invaluable to investigators, educators, and administrators, and the overall findings frequently guide committees as they create strategic plans that direct the future of STEM disciplines (Dietz et al., 2011; President's Council of Advisors on Science and Technology, 2010; Rankin et al., 2010; Weaver et al., 2007).

In the past, institutional efforts to increase the number of women and ethnic minorities entering the STEM professoriate have been met with variable levels of success (Clewell et al., 2011; Hill et al., 2010; Lowell and Regets, 2006; National Research Council, 2011; Sonnert et al., 2007). For example, across all STEM doctorate employees in academia between 1973 and 2008, the percent of women employees rose from 9 to 34%, while the percent of underrepresented ethnic minority employees only rose from 2 to 9%. However, senior faculty positions are still held by noticeably fewer women and underrepresented ethnic minorities, and these trends are increasingly evident in the physical sciences, engineering, and mathematics, whereas the life sciences have made greater strides (National Science Foundation, 2012). To accelerate the development of diverse faculty, researchers have started investigating how academic climate influences productivity, collaboration, and creativeness among STEM faculty. In order to succeed, reports suggest that comprehensive institutional efforts designed to increase the pipeline of STEM talent must also address certain failings within the academic climate (Bilimoria et al., 2008; Settles et al., 2006, 2007; Steward et al., 2007).

A number of conceptual models offered in the literature shed light on the importance of the academic climate, highlighting focal points along the pipeline of STEM talent that affect the quantity and quality of STEM faculty (Bilimoria et al., 2008; Settles et al., 2007; Stout et al., 2011; Xie and Shauman, 1998). Researchers agree that effective socialization of prospective faculty is one of the most crucial components of early professional development because doctoral training with research experience alone is not sufficient to prepare them for the other responsibilities of STEM faculty. In order to learn about faculty life and to actualize their own contributions, emerging faculty members require diverse experiences with a wide range of personally influential people, including peers, friends, faculty and professional colleagues, and family (Austin et al., 2009). The most effective academic climate empowers prospective STEM faculty to invest in the academic climate, both personally and professionally.

As already suggested, mentorship serves an important role in diversifying STEM talent and the professoriate, which includes preparing the next generation of mentors. Studies indicate that STEM faculty members select mentees of the same race and gender, thus selecting who will then, in turn, serve as mentors themselves (Eddy and Gaston-Gayles, 2008; Leggon, 2010; Ragins and Scandura, 1994, 1997). For many women in academia, forming a sense of empowerment and professionalism requires same-gender interactions (Handelsman et al., 2005; Leggon, 2010; Stout et al., 2011). Even when this does happen, studies suggest that the female STEM population divides into those who follow "traditional male" models and those who follow "relational female" models, thus curtailing the effective number of relational female STEM role models (Etzkowitz et al., 1994). This effect highlights the existence of nuanced subgroups within demographics, which could impact apparent outcomes of a study. It is similarly important for ethnic minorities to interact with non-majority peers, friends, and faculty and professional colleagues (Blackwell et al., 2009), and studies indicate the importance of same-gender role models is even more pronounced for women from ethnic minorities (Trower and Chait, 2002).

2.3 LGBT Faculty in STEM

Amid the current nationally led campaign to increase the STEM workforce, there are numerous institutional efforts to support women and underrepresented ethnic minority STEM professionals; however, virtually none of these focuses on LGBT communities. It is widely accepted that LGBT communities are indeed underrepresented and underserved; however, directives to advance underrepresented groups continue to exclude programs and funding opportunities that would also encourage and empower LGBT STEM faculty (National Science Foundation, 2011; Science and Engineering Equal Opportunities Act, 2010). A survey of the literature reveals that data-driven research of LGBT communities has been restricted to the social sciences, humanities, and health fields; there are only a handful of publications focused on LGBT communities in the STEM fields, and none of these are based on empirical data. Qualitative academic discussions report that LGBT populations are discouraged from entering the STEM fields because heteronormative climates are so widespread (Bilimoria and Stewart, 2009; Cech and Waidzunas, 2011; Gunckel, 2009). Our analyses support previous discussions; however, in order to appropriately discuss LGBT research it is important to first examine our choice of language.

3. TERMINOLOGY

In the majority of the literature examining sexual and gender identities, researchers use the acronym LGBT to reference sexual and gender minorities. Our paradigm suggests that sexual and gender identities are fluid. We feel it is important to value individual identities, as opposed to placing people into fixed, socially constructed categories of sexuality or gender. We agree with the Renn (2010) queer theoretical approach, and allowed our respondents to identify along both the sexual and gender identity spectra, which we identify here as a "queer spectrum" and a "transgender spectrum" (trans spectrum), respectively. As noted earlier, most of the extant literature studies do not use this same nomenclature, and for our review of the literature, we honored the nomenclature preferred by the authors. This project incorporated terminology for both queer and trans spectra; however, very few respondents identified along the trans spectrum and therefore were not included in our final subset. For simplicity of discussion throughout the paper, lesbian, gay, bisexual, and queer (LGBQ) refers to our survey respondents.

4. METHODS

4.1 Academic Climate Model

Our purpose was to examine factors that influence the career consequences for LGBQ STEM faculty. Our guiding research questions included the following. (1) What is the academic climate for LGBT STEM faculty in comparison to LGBT faculty in non-STEM fields? (2) What climate factors influence the career consequences of LGBT faculty?[1]

We employed a well-established data set, which is explained in the next section, and we based our empirical analyses on the only (qualitative) model available in the literature regarding LGBT faculty communities in academic institutions (Bilimoria and Stewart, 2009). The model was developed from interview questions regarding the qualitative experiences of LGBT faculty in science and engineering and focused on four themes: (1) perceived departmental work climate; (2) personal and career consequences of a negative climate; (3) identity-based education/mentorship choices; and (4) personal and career consequences of a positive climate. Bilimoria and Stewart (2009) suggested that the academic climate and internal experiences have career consequences for LGBT faculty in science and engineering, and they proposed that individual LGBT identities would modulate the effect of climate on internal experiences. Our analyses were designed from these relationships, incorporating indicators for climate, personal experiences (comfort), identity, and career consequences (consider leaving their university).

4.2 Sampling Method

The data presented in this project are secondary analyses of the data set from the *2010 State of Higher Education for Lesbian, Gay, Bisexual, and Transgender People*. This project examined 498 faculty respondents, who comprised 9.7% of all survey participants from the 2010 data set (Rankin et al., 2010).

To collect the 2010 data set, the research team used a three-contact model to recruit survey participants: (1) national conferences [e.g., the National Gay and Lesbian Task Force (NGLTF) and American College Personnel Association (ACPA)]; (2) direct mail (e.g., LGBT campus organizations and consortiums); and (3) social media (e.g., Facebook and Twitter) (Rankin et al., 2010, p. 41). During participant recruitment for the 2010 data set, researchers also employed snowball sampling, where participants engaged via the three-contact model were encouraged to forward the survey to other students, faculty, and staff who identified as LGBTQ. Participating institutions included colleges/universities from all Carnegie Basic Classifications of Institutions of Higher Education and from all 50 states.

[1]The conceptual model that is used as the foundation for this study was developed based on the responses of all faculty in the data set (e.g., heterosexual and LGBQ). Only LGBQ faculty members are used for the analyses provided in this paper.

4.3 Survey Instrument

The 2010 survey instrument was created using questions from the Rankin (2003) study. The final survey questions "arose from literature reviews, previous surveys, and previous institutional fact finding groups" and were reviewed by both the research team and LGBT community members (Rankin et al., 2010, p. 40). The final survey was distributed online and the project was approved by the Pennsylvania State University Office of Research Protections and the Iowa State University Office for Responsible Research (Rankin et al., 2010).

In order to avoid biasing participants toward responses, survey questions were worded in non-biased and non-leading ways. These precautions ensured the overall validity of the instrument (Rankin et al., 2010). As explained in the report, "The survey aimed to have respondents provide information about their campus experiences, their perceptions of the climate on their campus, and their perceptions of institutional actions, including administrative policies regarding LGBT issues and concerns on campus. These dimensions were derived from the authors' work, examining the campus climate at over 90 college campuses" (Rankin et al., 2010, p. 39).

The reliability of the 2010 data set was tested by examining the internal consistency of responses. "Responses to selected questions about overall campus climate for various groups and those that rate overall campus climates on various related scales were statistically significant, thus indicating a relationship between all selected pairs of responses" (Rankin et al., 2010, p. 40).

4.4 Project Variables

Variables for the secondary analyses in this project were created using the 2010 survey and data set. The following section describes these variables and how they were operationalized for this project.

4.4.1 Climate Variables

To assess how climate is perceived by faculty members, we examined how they reported on exclusionary behavior (EB). In the 2010 survey instrument, EB was defined as conduct that interfered with one's ability to work or learn and included bullying, harassment, feeling ignored, shunned, etc. We incorporated variables for both observed EB and experienced EB, and the 2010 survey responses to these questions were captured with a "yes" or "no" response.

4.4.2 Internal Experiences

To assess internal experiences of faculty members, we examined their comfort across three questions: (1) on their campus, (2) in their department, and (3) in their classrooms. In the 2010 survey instrument, participants answered these questions on a five-point Likert scale, ranging from very comfortable to very uncomfortable. To accommodate for faculty who had no teaching responsibilities at the time of the survey, the question regarding comfort in the classroom included an additional response of "not applicable." At the outset of our study, we examined these three questions by comparing responses of comfortable and uncomfortable across all departments. Responses of very comfortable or comfortable were considered as comfortable, and responses of uncomfortable or very uncomfortable were considered as uncomfortable.

Over the course of our examinations, we identified significant relationships across the three questions, and this prompted a new variable, called comfort, which allowed us to delineate between faculty who were comfortable and those who were not comfortable. Faculty members who responded as either very comfortable or comfortable across each of the three questions (campus, department, and classroom) were considered as comfortable, and those who did not were considered as not comfortable. The statistical significance across the three questions was determined with a chi-square test, revealing that faculty members who were comfortable on campus were significantly more likely to be comfortable in their departments and in the classroom [$\chi^2(16) = 157.309$; $p < .001$; $\chi^2(20) = 132.883$, $p < .001$]. It was also found that faculty members who were comfortable in their departments were significantly more likely to be comfortable in the classroom [$\chi^2(20) = 127.570$, $p < .001$].

4.4.3 Identity

To assess aspects of identity for faculty members, we examined how they reported on their sexual orientation and professional "outness." Both of these are complex aspects of one's identity that were interpreted and incorporated into this project as follows.

4.4.3.1 Sexual Orientation

Sexual orientation is described by The American Psychological Association (2008, p. 1) to be "an enduring emotional, romantic, sexual, or affectional attraction toward others." An individual's own identity is formed on the basis of this attraction, as well as on the actions prompted by this attraction (Beemyn and Rankin, 2011). The labels used for sexual orientation are often limited to three categories: heterosexual, gay/lesbian, and bisexual. However, these three distinct categories are narrow in comparison to the range of identities that may comprise one's sexual orientation.

Many theoretical perspectives argue that sexual orientation exists on a continuum and is not as fixed as once believed (Baumeister, 2000; D'Augelli, 1994; Diamond and Savin-Williams, 2000; Kitzinger and Wilkinson, 1995; Richardson, 1984). In this light, sexual orientation is flexible and develops "continuously over the lifespan out of an individual's sexual and emotional experiences, social interactions, and cultural influences" (Kinnish et al., 2005, p. 32). Sexual orientation is not an immutable demographic but an evolving characteristic.

In the 2010 survey instrument, there were 498 faculty respondents, with 440 (88%) of them falling within four re-coded categories: (1) gay or similar, not queer; (2) lesbian or similar, not queer; (3) bisexual, not lesbian, gay, or queer; and (4) queer. Respondents selected their sexual orientation from a number of options or wrote an alternative identifier of their choice.

For analysis purposes of this project, respondents in the 2010 data set who were assigned male at birth, and whose primary relationships were currently with men, were considered as gay or similar, not queer. Similarly, those who were assigned female at birth, and whose primary relationships were currently with women, were considered as lesbian or similar, not queer. Queer respondents included those who were more fluid in identifying their sexual orientation, for example, queer, omnisexual, or pansexual. Although these categories were used to identify LGBQ respondents for the study, we did not differentiate between them in secondary analyses due to the small *n*'s in several of the categories.

4.4.3.2 Professional Outness

Outness is defined as how open and public individuals are with their various identities, including sexual orientation. In this project, professional outness indicates how out an individual is at work with regard to their sexual orientation.

To report professional outness, responses to the following question were re-coded, such that respondents reporting 4 and 5 were categorized as out and all others as not out: "Place yourself on the following continuum with 5 being out to everyone professionally as an LGBTQQ person or straight ally, 4 being out to most colleagues, 3 being out to some colleagues, 2 being out to a few colleagues, and 1 being not out at all." This created the variable outness.

4.4.4 Career Consequence

To assess the career consequence of faculty members, their consideration to leave their institution was analyzed. This variable was captured with a yes or no response to the following question. "Have you ever seriously considered leaving your campus?"

4.5 Data Analyses

For the first stage of analyses, descriptive statistics were used to indicate how faculty responded to the project variables. The second stage of analyses employed chi-square tests to examine the differences between faculty responses based on department and comfort level. Finally, binary logistic regression was used with the entire LGBQ faculty subset ($n = 279$) to test whether climate, comfort, and outness could predict career consequences (intent to persist).

5. RESULTS

5.1 Description of the Sample Population and Subjects

Of the 5,149 LGBQ participants, 498 identified themselves as faculty members. For the purposes of this project, analyses were focused on a subset of this population, which was chosen to represent departments frequently found on university campuses of all sizes and types. This included 350 faculty members from the following disciplines: STEM (59), social sciences (96), education (57), humanities and liberal arts (107), and fine and performing arts (31). Respondents from the departments of agriculture, engineering, mathematics, and sciences were aggregated into the STEM category. Overall, there were a greater number of women respondents (46.3%), with most identifying as gay (36.9%), lesbian (32%), bisexual (10%), or heterosexual (7.7%). The fewest number of respondents identified with the trans spectrum (3%) or as gender non-conforming (8%).

The majority of respondents were White (86%). A chi-square analysis revealed that the distribution of race by department was not significantly different [$\chi^2(20) = 27$]. The majority of the respondents identified as gay (36.9%) or lesbian (32%). Of the faculty, 10.6% reported being out professionally and included assistant (28%), associate (26%), or full professors (19%). A chi-square analysis revealed the distribution of faculty by rank by department was not significantly different [$\chi^2(24) = 20.1$]. Details of the faculty demographics are presented in Table 1.

5.2 Description of Sample Population and Subjects Used in Secondary Analyses

Due to the low number of respondents identifying in the trans spectrum, they were not included in the analyses. Using a critical queer theoretical lens, heterosexual and asexual faculty members were also omitted from the analysis to focus solely on the experiences of LGBQ faculty (Renn, 2010). This reduced the sample population for secondary analyses to 279 participants from STEM (47), social sciences (83), education (39), humanities and liberal arts (80), and fine and performing arts (30).

TABLE 1: Demographics of all faculty survey respondents

Respondent	All disciplines[a]		STEM		Social sciences		Education		Humanities and liberal arts		Fine arts	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Gender												
Man	148	42.3	35	59.3	29	30.2	19	33.3	42	39.3	23	74.2
Woman	162	46.3	15	25.4	60	62.5	29	50.9	51	47.7	7	22.6
Transgender spectrum	9	2.6	7	11.9	0	0.0	1	1.8	1	0.9	0	0.0
Gender non-conforming	28	8.0	2	3.4	7	7.3	8	14.0	13	12.1	1	3.2
Sexual identity												
Gay	129	36.9	28	47.5	28	29.2	15	26.3	36	33.6	22	71.0
Lesbian	112	32.0	14	23.7	43	44.8	20	35.1	29	27.1	6	19.4
Bisexual	35	10.0	8	13.6	8	8.3	6	10.5	12	11.2	1	3.2
Queer spectrum	38	10.9	3	5.1	11	11.5	6	10.5	16	15.0	2	6.5
Heterosexual	27	7.7	4	6.8	5	5.2	9	15.8	9	8.4	0	0.0
Asexual	6	1.7	1	1.7	0	0.0	1	1.8	4	3.7	0	0.0
Race/ethnicity												
White	301	86.0	50	84.7	87	90.6	51	89.5	88	82.2	25	80.6
Black	8	2.3	1	1.7	2	2.1	2	3.5	0	0.0	3	9.7
Hispanic	14	4.0	4	6.8	1	1.0	1	1.7	6	5.6	2	6.5
Asian	10	2.9	2	3.4	4	4.2	1	1.8	2	1.9	1	3.2
Middle Eastern	2	0.6	1	1.7	0	0.0	0	0.0	1	0.9	0	0.0
Multiracial	9	2.6	0	0.0	1	1.0	2	3.5	6	5.6	0	0.0
Academic rank												
Instructor	31	8.9	6	10.2	9	9.4	3	5.3	11	10.3	2	6.5
Adjunct	25	7.1	3	5.1	9	9.4	3	5.3	8	7.5	2	6.5
Assistant	98	28.0	13	22.0	30	31.3	21	36.8	27	25.2	7	22.6
Associate	92	26.3	16	27.1	25	26.0	14	24.6	26	24.3	11	35.5
Professor	65	18.6	12	20.3	16	17.1	11	19.3	18	16.8	7	22.6
Visiting	7	2.0	0	0.0	3	3.1	0	0.0	3	2.8	1	3.2
Other	31	8.9	9	15.3	3	3.1	5	8.8	13	12.1	1	3.2

Note: Percentages may not add up exactly to 100% due to non-respondents on individual questions.
[a]Percentage (10.6%) reporting being "out" professionally.

The STEM disciplines ($n = 47$) had the fewest respondents identifying as women (29.8%). This is consistent with the dearth of women generally present in STEM disciplines, as discussed in the review of the literature. This is in contrast to the overall sample population ($n = 279$), which consisted of a majority of women (51.3%), with most respondents identifying as either lesbian (34.4%) or gay (44.8%). Of these faculty, 11.1% reported being out. Most respondents identified as White (85.3%), with few respondents in other categories. A chi-square analysis revealed that the distribution of race by department was not significantly different [$\chi^2(20) = 24.17$]. The majority of respondents were assistant (27%), associate (27%), or full professors (20%). A chi-square analysis revealed that the distribution of faculty by rank in each department was not significantly different [$\chi^2(24) = 19.883$]. The specific demographics for the faculty subset ($n = 279$) used across the remainder of this project can be found in Table 2.

5.3 Comfort and Identity of STEM Faculty

In response to questions on internal experiences and identity, STEM faculty ($n = 47$) reported the highest level of discomfort across the three questions included in the survey (campus, department, and classroom) (Table 3), although these differences were not significant. Notably, faculty from STEM departments reported significantly higher levels of professional outness than did those from other departments [$^2(4) = 16.7$, $p < .01$].

Relationships between comfort and identity were also examined within departments. Among out STEM faculty ($n = 47$), 69.2% were uncomfortable, and this is in contrast to the 8.8% of not out faculty who were uncomfortable. A chi-square analysis revealed that STEM faculty who were out were significantly less comfortable in their department than those who were not out [$^2(1) = 20.1$, $p < .01$] (Fig. 1). This relationship between department comfort and identity was persistent but not significant across all departments. Further analyses of the STEM disciplines ($n = 47$) revealed that campus comfort and department comfort each had a significant negative correlation with outness—$r = -.38$, $p < .01$ and $r = -.617$, $p < .01$, respectively—therefore, the more out a STEM faculty member, the more likely it was that he or she was uncomfortable.

5.4 Exclusionary Behavior and Career Consequences by Department

At the department level, examination of observed EB, experienced EB, and career consequences did not reveal any significant relationships. However, responses to questions on experience of EB and observation of EB suggested that faculty members from education departments ($n = 39$) were most likely to observe (74.4%) or experience (28.2%) EB (Table 4). Interestingly, responses to the question on career consequences indicated that education faculty were least likely to consider leaving their institution, while STEM faculty members ($n = 47$) were most likely to consider leaving their institutions (53.2%) (Table 4).

Of the STEM faculty who experienced EB ($n = 10$), seven respondents reported the source of the harassment was an administrator, while three reported that the source of the harassment was a student. Among the STEM faculty who experienced EB, it was reported that the harassment was most often in the forms of derogatory remarks (40%), being deliberately ignored (40%), being intimidated (20%), or feeling isolated or left out (30%). Faculty could respond to more than one form of EB, so the percentages add up to greater than 100%.

TABLE 2: Demographics of the faculty subset for analyses extracted from all faculty survey respondents

Respondent	All disciplines[a]		STEM		Social sciences		Education		Humanities and liberal arts		Fine arts	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Gender												
Man	136	48.7	33	70.2	25	30.1	16	41.0	39	48.8	23	76.7
Woman	143	51.3	14	29.8	58	69.9	23	59.0	41	51.2	7	23.3
Sexual identity												
Gay	125	44.8	28	59.6	27	32.5	14	35.9	34	42.5	22	73.3
Lesbian	96	34.4	12	25.5	40	48.2	16	41.0	22	27.5	6	20.0
Bisexual	28	10.0	5	10.6	8	9.6	3	7.7	11	13.8	1	3.3
Queer	30	10.8	2	4.3	8	9.6	6	15.4	13	16.3	1	3.3
Race/ethnicity												
White	238	85.3	38	80.9	75	90.4	36	92.3	65	81.3	24	80.0
Black	7	2.5	1	2.1	2	2.4	1	2.6	0	0.0	3	10.0
Hispanic	12	4.3	4	8.5	1	1.2	0	0.0	5	6.3	2	6.7
Asian	9	3.2	2	4.3	3	3.6	1	2.6	2	2.5	1	3.3
Middle Eastern	2	0.7	1	2.1	0	0.0	0	0.0	1	1.3	0	0.0
Multiracial	6	2.2	0	0.0	1	1.2	1	2.6	4	5.0	0	0.0
Academic rank												
Instructor	21	7.5	4	8.5	7	8.4	2	5.1	6	7.5	2	6.7
Adjunct	23	8.2	2	4.3	9	10.8	3	7.7	7	8.8	2	6.7
Assistant	75	26.9	10	21.3	26	31.3	13	33.3	20	25.0	6	20.0
Associate	74	26.5	12	25.5	20	24.1	11	28.2	20	25.0	11	36.7
Professor	57	20.4	11	23.4	15	18.1	9	23.1	15	18.8	7	23.3
Visiting	7	2.5	0	0.0	3	3.6	0	0.0	3	3.8	1	3.3
Other	21	7.5	8	17.0	3	3.6	1	2.6	8	10.0	1	3.3

Note: Percentages may not add exactly to 100% due to non-respondents on individual questions.
[a]Percentage (11.1%) reporting being “out” professionally.

TABLE 3: Responses to questions on internal experiences and identity

	All		**STEM**		**Social sciences**		**Education**		**Humanities and liberal arts**		**Fine arts**	
	n	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**
Comfortable												
Campus	166	60	29	62	53	64	22	56	44	55	18	60
Department	213	76	29	62	65	78	31	79	62	78	26	87
Classroom	182	65	24	51	60	72	25	64	50	63	23	77
Uncomfortable												
Campus	56	20	11	23	13	16	9	23	17	21	6	20
Department	36	13	12	26	8	9.6	3	7.7	10	13	3	10
Classroom	34	12	8	17	9	11	6	15	10	13	1	3.3
Identity ($p < .01$)												
Out	31	11	13	28	6	7.2	3	7.7	8	10	1	3.3
Not out	248	89	34	72	80	96	36	92	72	90	29	97

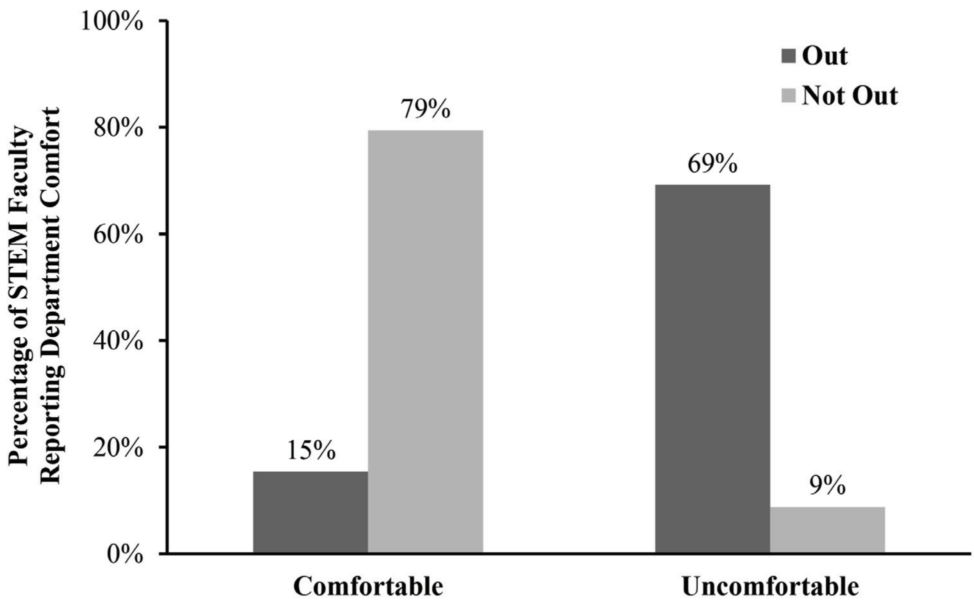

FIG. 1: Outness of STEM faculty by department comfort

TABLE 4: Responses to questions on climate and career consequence by department

	All		**STEM**		**Social sciences**		**Education**		**Humanities and liberal arts**		**Fine arts**	
	n	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**
Climate												
Observed EB	168	60.2	22	46.8	48	57.8	29	74.4	55	68.8	14	46.7
Experienced EB	59	21.1	10	21.3	12	14.5	11	28.2	20	25	6	20
Career consequence												
Considered leaving	126	45.3	25	53.2	35	42.2	14	35.9	37	46.3	15	50

5.5 Faculty across All Departments by Comfortable/Not Comfortable

In order to facilitate further analyses, faculty from all departments (n = 279) were disaggregated into two groups according to their responses regarding questions on comfort: (1) those who reported being comfortable in all three locations (campus, department, and classroom) (n = 125, 44.8%), and (2) those who did not report feeling comfortable in all three locations (n = 154, 55.2%). For the remainder of this project, these two groups are referred to as comfortable and not comfortable, respectively. Table 5 indicates how respondents from each group answered questions regarding climate, career consequence, and identity.

TABLE 5: Climate, career consequence, and identity for faculty from all departments by comfortable/not comfortable

	Climate				**Career consequence**		**Identity**	
	Observed EB		**Experienced EB**		**Considered leaving**		**Out**	
	n	**%**	***n***	**%**	***n***	**%**	***n***	**%**
All (n = 279)	168	60.2	59	21.2	126	45.3	31	11.1
Comfortable (n = 125)	60	48.0	8	6.4	41	32.8	2	1.6
Not comfortable (n = 154)	108	70.1	51	33.1	85	55.2	29	18.8

Among faculty members who were comfortable, 48% reported observing EB, 6.4% experienced EB, 32.8% considered leaving, and 1.6% were out (Fig. 2). In comparison, among faculty members who were not comfortable, 70.1% reported observing EB, 33.1% experienced EB, 55.2% considered leaving, and 18.8% were out. Four separate chi-square analyses offered that each of these differences were significant: $\chi^2(1)$ = 14.1, 29.5, 14.4, and 20.7, respectively (p < .01). Thus, any faculty member who was not comfortable was more likely to observe or experience EB, consider leaving their institution, and be out.

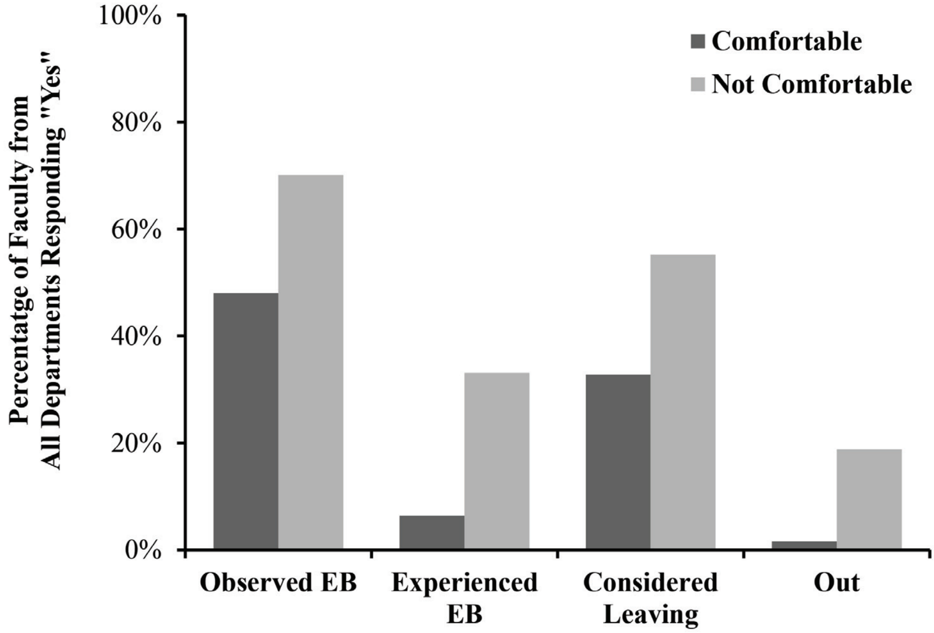

FIG. 2: Experiences of faculty from all departments by comfortable/not comfortable (values are taken from Table 5)

5.6 Career Consequences for Faculty across All Departments

Analyses were performed on the overall sample population (n = 279) to further understand how climate and internal experiences are related to career consequences (Fig. 3). Among faculty who considered leaving, 75.4% observed EB, 34.9% experienced EB, and 67.5% were not comfortable. In comparison, among faculty who did not consider leaving their institution, 47.4% observed EB, 9.9% experienced EB, and 44.7% were not comfortable. Three separate chi-square analyses revealed that each of these differences were significant: $\chi^2(1)$ = 22.6, 25.9, and 14.4, respectively (p < .01). Thus, faculty members were more likely to consider leaving their current institution if they observed EB, experienced EB, or were not comfortable.

In order to investigate the reasons why faculty considered leaving, binary regression analyses were employed for each individual variable. Odds ratio (OR) analyses suggested that those who observed EB were 3.4 times more likely to consider leaving, those who experienced EB were 4.9 times more likely to consider leaving, and those were not comfortable were 2.56 times more likely to consider leaving (Table 6). All of these findings were significant. The direct relationship between comfort and career consequences prompted us to examine the effect of

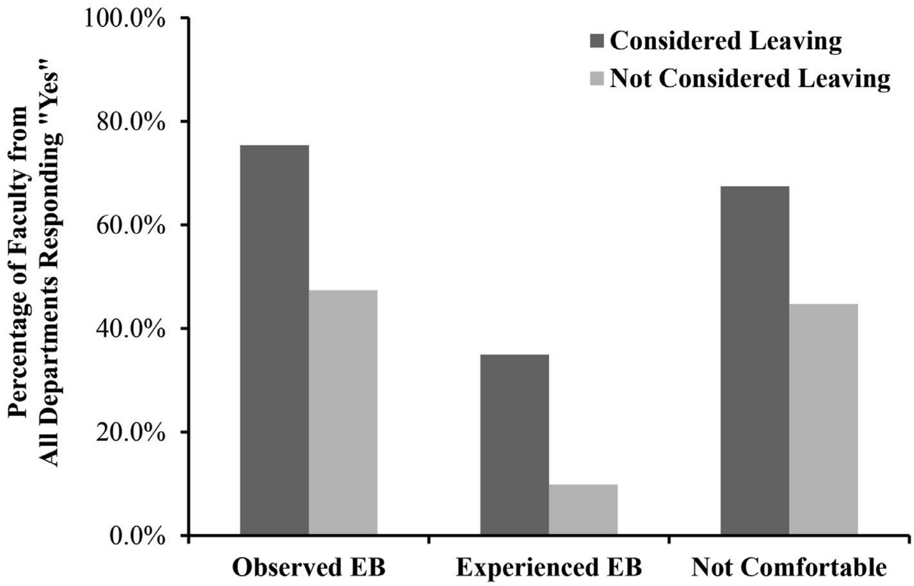

FIG. 3: Experiences of faculty from all departments by consideration to leave

TABLE 6: Odds ratio of climate variables and internal experience to consideration of leaving for faculty from all departments

Variable	B[a]	S.E.[b]	Wald[c]	*p*	Odds ratio
Observe EB	1.225	0.263	21.7	0.0001	3.4
Constant	−0.948	0.212	20.1	0.0001	0.388
Experience EB	1.589	0.33	23.2	0.0001	4.9
Constant	−0.513	0.14	13.314	0.0001	0.599
Not comfortable	0.94	0.251	14.09	0.0001	2.6
Constant	−0.717	0.191	14.1743	0.0001	0.488

[a]B is the estimated logit coefficient; [b]S.E. is the standard error of the coefficient; [c]Wald = $(B/S.E.)^2$

outness on comfort. Faculty members who reported being not comfortable were 14 times more likely to be out, 2.5 times more likely to observe EB, and 7.2 times more likely to experience EB (Table 7). All of the reported ORs were significant ($p < .0001$), thus we incorporated all of them and depicted the relationships between outness, EB, comfort, and career consequences, into a revised conceptual model (Fig. 4).

5.7 Limitation

The primary limitation of our study was the small sample size, which lead to the statistical insig-

TABLE 7: Odds ratio of identity and climate variables to comfort for faculty from all departments

Variable	B[a]	S.E.[b]	Wald[c]	*p*	Odds ratio
Out	2.658	0.742	12.831	0.0001	14.3
Constant	−4.119	0.713	33.39	0.0001	0.016
Observe EB	0.934	0.251	13.822	0.0001	2.543
Constant	−1.521	0.375	16.434	0.0001	0.218
Experience EB	1.98	0.404	24.068	0.0001	7.242
Constant	−3.832	0.772	24.612	0.0001	0.022

[a]B is the estimated logit coefficient; [b]S.E. is the standard error of the coefficient; [c]Wald = $(B/S.E.)^2$

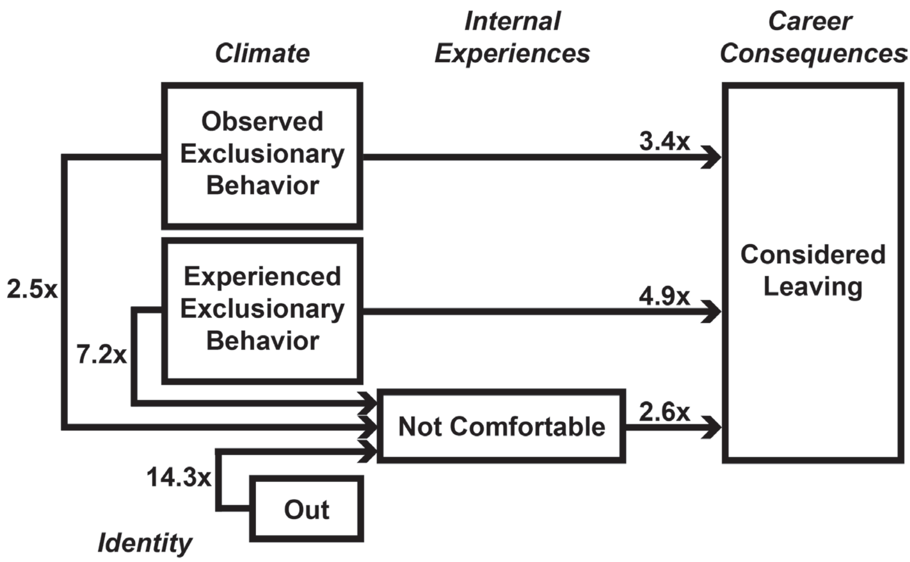

FIG. 4: Relationships between identity, climate variables, internal experiences, and retention for faculty from all departments (n = 279) [shown are outness, exclusionary behavior, comfort, and career consequence; odds ratios are from Tables 6 and 7; adapted from Bilimoria and Stewart (2009)]

nificance in Tables 3 and 5, and prevented us from modeling the academic climate at the department level. Responses to the survey may also have been affected by self-selection of faculty who chose to complete the online instrument. Nonetheless, these limitations are likely negligible; our data set included a large number of closeted respondents, suggesting that while many faculty are affected by climate, a large number want to share their personal experiences. In addition, the dispersion of faculty was not statistically significant among rank and race (Table 2), suggesting there was no significant bias among these demographics.

6. DISCUSSION

In order to be competitive in the global economy, it is essential for the United States to produce more STEM professionals and to further diversify the talent. Historically, efforts to advance underrepresented groups have not examined factors impacting LGBQ communities, which include unique populations of invisible minorities. The current study addresses this critical gap; it is an attempt to recover data for invisible LGBQ faculty, who may have significant potential to affect the pipeline of STEM talent. Our analyses support previous climate predictions and add to the Bilimoria and Stewart (2009) academic climate model for LGBT faculty in science and engineering. The specific indicators identified in our project will be useful for developing strategic initiatives that aim to enhance the retention of LGBQ faculty. It should be re-stated that our overall climate model incorporated responses of LGBQ faculty from all departments; we were unable to construct a model at the department level due to the limited sample size. Despite the limitations, this study is a first step toward addressing the experiences of this invisible population.

6.1 Climate Model for LGBT Faculty

Our findings build upon a climate model presented by Bilimoria and Stewart (2009), in which they suggested that identity, climate, and internal experiences will have career consequences for LGBT faculty in science and engineering. Bilimoria and Stewart (2009) also proposed that individual LGBT identities would modulate the effect of climate on internal experiences. The analyses we present here incorporate specific components of the previous model, and our findings suggest the model applies to LGBQ faculty from across all disciplines. Finally, although we include data from all disciplines, the trends in Tables 3–5 suggest that the Bilimoria and Stewart (2009) model closely describes the academic climate for LGBQ STEM faculty.

6.1.1 Impact of Outness and Comfort on Career Consequence

Our analyses for LGBQ faculty across all departments support only an indirect relationship between outness and career consequence, which supports the model proposed by Bilimoria and Stewart (2009). This relationship suggests that efforts to improve the retention of LGBQ faculty will need to substantively address the academic climate; simply encouraging faculty to openly identify will not improve their retention. Even so, perhaps the most important finding of our study is the striking correlation between outness of LGBQ faculty and their overall comfort (Table 7). Among our participants, out faculty members are 14 times more likely to be not comfortable. This finding, along with the direct relationship between their comfort and career consequence (OR = 2.561), suggests comfort is a valuable measure for advancing the retention of LGBQ faculty. When tabulated by department (Table 3), our analyses indicate that STEM faculty members are significantly more likely to be out than those in other departments, and as expected from the relationship between outness and comfort, they also tend to be the least comfortable. Thus, it is reasonable to speculate that efforts targeting the climate for out LGBQ faculty across all departments may yield greater measurable results for the retention of LGBQ faculty in STEM than those in other departments.

6.1.2 Impact of Exclusionary Behavior on Career Consequences

Beyond comfort, our analyses for LGBQ faculty across all departments also suggest that the occurrence of EB (observed or experienced) may offer additional measures for advancing their retention. In fact, the ORs relating observed (OR = 3.4) or experienced EB (OR = 4.9) to career consequence suggest these may be even more valuable predictors of retention than comfort (OR = 2.561). Our findings support the hypothesis that the climate variables for EB directly affect both the comfort and retention of LGBQ faculty, and therefore reducing EB could enhance both of these outcomes. However, when tabulated by department (Table 5), the results suggest a cautious interpretation of EB as a predictor of career consequences because the trends, although insignificant, differ between departments; LGBQ faculty in education reported more EB than those from other departments but they were also the least likely to consider leaving. In the same vein, LGBQ faculty in STEM reported relatively little EB but were the most likely to consider leaving. One explanation for the different reporting rates of EB is the variability in academic cultures; faculty in education may encourage more personal interactions and incorporate difficult dialogues, which are not necessarily replicated in the STEM fields. This possibility highlights an important institutional lapse for the STEM fields, and it offers an opportunity to develop solutions, which we discuss later.

6.1.3 Relating Exclusionary Behavior, Comfort, and Career Consequences

Overall, the results indicate that EB affects the comfort and career consequences of LGBQ faculty, where observing EB or experiencing EB results in similar effects on career consequence (Table 6), and those who experience EB or observe EB are 7.2 and 2.5 times more likely to be not comfortable, respectively (Table 7). These results suggest that reducing specific incidents of EB may improve the climate for all LGBQ faculty, and the importance of addressing EB is further substantiated in another recent study (Woodford et al., 2012). This study identifies individual psychological and physiological effects of EB in student populations under 25 years of age, indicating that students who heard “that’s so gay” are significantly less likely to feel accepted on campus. Although it is difficult to demonstrate causality, the internal experiences offered in our paper and in the forthcoming study are indicators for EB, and researchers should consider these as possible measures both to gauge the present climate for LGBQ populations and to predict their retention.

6.2 Strategies to Address Climate and Faculty Retention

In order to increase the retention of LGBQ faculty in both STEM and non-STEM academic departments, U.S. institutions of higher learning will need to strategize to enhance comfort and reduce EB. In doing so, it is important to resist solutions that delegate responsibilities to minority groups, such as relying on underrepresented minority faculty to mentor other minority groups or to advance institutional issues. At the same time, while avoiding tokenism, it is critical to call upon LGBQ communities and LGBQ organizations to contribute in focus groups, strategic plans, or even independent consultations because they will offer valuable contributions to bring about effective solutions.

6.2.1 Institutional Strategies

Our secondary analyses suggest the Bilimoria and Stewart (2009) climate model is representative of LGBQ faculty from all departments, highlighting that effective strategies should impact all LGBQ faculty. At the campus level, there are a number of ways to improve climate. For example, institutions can protect and support LGBQ communities by revising non-discrimination statements and other policies to be inclusive of sexual orientation, gender identity, and/or gender expression. Climate can also be improved through dedicated university structures such as LGBT resource centers, offices for educational and employment equity, and diversity councils at both the college and department levels. In addition to these structural changes, administrators can provide support to LGBQ communities, improve climate through community engagement, and challenge departments to address climate, for example, by coordinating difficult dialogues that may already occur in other departments. In approaching institutional climate strategies, U.S. institutions of higher learning would do well to involve their campus communities as well as independent consultants who are experienced with campus climate.

According to our findings, departments will also need to address climate, and they will need to strategize around out LGBQ faculty, who represent 11% of our faculty subset (n = 279). Notably, only 1.6% of comfortable faculty in the subset are also out, and in comparison to their comfort at the campus level, out LGBQ faculty members are equally or less comfortable at the department level, while "not out" LGBQ faculty are more comfortable. This relationship is particularly relevant for out LGBQ STEM faculty, who were the most likely to be out (Table 3), the least comfortable (Fig. 1), and the most likely to consider leaving (Table 4). Here, we offer qualitative responses from study participants regarding discomfort for LGBQ faculty from STEM departments:

> *[University] has rather a don't ask don't tell climate—I don't tell, people don't ask—but, for example, I don't have photos of my partner on my desk—it would prompt questions—this is uncomfortable.*

> *While most people in my classes and department are supportive, there remain a small number of individuals who are so disapproving as to negatively impact the overall atmosphere. This is especially true in my department where the more negative people are in a position of administrative authority.*

> *Shortly after coming out in my job, some people's attitudes changed. My chair is a conservative Roman Catholic and his personal religious views seem to impact his relationships with some people.*

Responses such as these, focused at the campus and department level, offer valuable insight for administrators, grantors, and government officials who can improve the academic climate for LGBQ faculty across all disciplines. In addition to the institutional strategies already mentioned, departments should seek resources such as the *Best Practices Guide for the Inclusion of LGBT+ Faculty* (Atherton et al., 2013), which offers advice focused at the department level.

6.2.2 Community Strategies

Whereas institutional strategies can impact the academic workplace for LGBQ faculty, some climate issues are more difficult. For example, student/faculty and faculty/faculty interactions may present challenges that administrators, structures, and policies are less able to address. Here is a survey response from one STEM faculty member, describing how one's level of outness can also cause discomfort in the classroom and related student/teacher interactions:

> *A student of mine would come regularly to my office with questions about the work from class and we would go over some homework problems and so forth. I have a picture of my partner on my desk. One day, the chair he sat it allowed him to see the picture on my desk. He kept looking at it and clearly past me. I didn't think too much of it until a week went by and he did not return to my office. Since that day he has not*

come again for extra help or to ask any question and when he comes to class he sits in the back, he avoids me in the hall and he very rarely if ever talks to me other than to answer a specific math question in class...so no, 'hi prof how are you?,' which he used to do often prior.

Although it can be straightforward to address specific incidents of EB, it is more difficult to find a solution when EB limits access to professional relationships, such as the one above. This response, in particular, brings clarity to how subtle occurrences of EB can impact everyday interactions. To address faculty retention when EB limits access to professional relationships, it seems useful to consider resources from education departments, which may facilitate an academic climate that attenuates the effect of EB (Table 3). Likewise, universities should track retention or specifically ask why STEM faculty considered leaving, and those from our data set offered a variety of additional reasons:

Community surrounding college is small and conservative.

I've stayed due primarily to inertia.

Homophobic culture. Stayed due to difficulty finding another position close to family.

Possibility of better opportunities elsewhere. Stayed through inertia and love of off-campus area.

Altogether, these qualitative responses support the hypothesis that the professional culture, the community, and having access to quality opportunities are important to LGBQ STEM faculty, which indicates that both social and professional factors will influence the retention of LGBQ STEM faculty. In particular, STEM departments and those who fund STEM research should be especially concerned that some of the respondents lack passion for their positions; research and education will not reach a maximum potential when faculty members are disengaged.

6.3 Pipeline for LGBQ Communities in STEM Fields

Our analyses support the hypothesis that heteronormative climates contribute to LGBQ faculty members seeking alternative employment options, and department level analyses suggest this closely describes LGBQ STEM faculty. In fact, there have already been examples where institutions have lost millions of dollars in research funding when LGBQ STEM faculty members leave for more supportive academic climates, and their lack of persistence impacts more than just funding (Foley, 2005; Twohey, 2006). When faculty members leave an institution, the pipeline of STEM professionals and future STEM mentors is disrupted; institutions lose valuable opportunities to recruit or retain students, staff, and faculty colleagues with similar demographics. This not only hinders the development of STEM talent, which already suffers from a leaky pipeline, but for LGBQ communities this also leads to an increasingly heteronormative climate (Kaminski and Geisler, 2012).

The loss of current and future faculty mentors for LGBQ communities is particularly problematic because there are so few resources that support LGBQ students. While there are countless organizations dedicated to the development of women and minority STEM talent, there are only two national organizations that encourage the development of LGBQ STEM talent. The first of these is a national professional society for students, Out in Science, Technology, Engineering & Mathematics (*o*STEM), and the second group is the National Organization of Gay and Lesbian Scientists and Technical Professionals (NOGLSTP). Both organizations encourage the development of LGBQ STEM talent across the United States, and their work is especially relevant as the country mobilizes to address the decline of STEM talent.

6.4 Conclusions and Implications for Future Research

The small sample size forced us to exclude trans spectrum participants from our analyses, but we would like to highlight an important finding from Table 1. As seen across most of the academic disciplines, only 0–2% of faculty respondents in the data set identified with the trans spectrum; however, this is in stark contrast to the STEM fields, where 12% of STEM faculty identified within the trans spectrum. The reason for this significant increase is unclear, but the data suggests that the STEM fields would especially benefit from a data set that is sufficiently large to include analyses of trans spectrum respondents. It is also important for such analyses to evaluate LGBQ faculty as a subset, alongside heterosexual and cisgender participants.

Our empirical analysis offers the first metrics for LGBQ faculty in the STEM fields, and our findings expand on the academic climate model by Bilimoria and Stewart (2009). We propose that heteronormative climates in higher education may decrease the retention of LGBQ faculty, and we offer a number of valuable personal experiences, as well as important next steps for administrators, grantors, and government officials. Institutions interested in the retention of LGBQ faculty would benefit from having larger data sets that institutionally follow their retention, and future studies should evaluate which of these measures (observed EB, experienced EB, or comfort) most accurately represents the experiences of LGBQ faculty within each department.

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