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THE SOCIAL IS PROFESSIONAL: THE EFFECTS OF TEAM CLIMATE ON PROFESSIONAL OUTCOMES FOR LGBTQ PERSONS IN ENVIRONMENTAL SCIENCE

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Following decades of research on gender and racial/ethnic inequality in science, technology, engineering, and math (STEM), a new line of scholarship has emerged that centers the experiences of lesbian, gay, bisexual, transgender, and queer (LGBTQ) persons in STEM. This research has tended to focus on experiences of social marginalization within STEM contexts such as exclusion and harassment, but LGBTQ persons may also face a myriad of career-related disadvantages that are likely tightly entwined with social marginalization. In this article we ask, do negative social dynamics in LGBTQ professionals' work environments foster professional disadvantages by LGBTQ status? Drawing on survey data from an insightful case of environmental scientists working in academic teams, we find that LGBTQ scientists were less likely to experience professional respect, had more frequent encounters with negative authorship practices, and were less likely to experience positive career mentoring than their peers. LGBTQ scientists were less likely than cisgender-heterosexual scientists to experience positive interpersonal climates in their teams (in the form of procedural justice and inclusivity) and we find that these more negative team climate experiences significantly mediated (i.e., helped account for) LGBTQ status differences along two of the three professional outcomes (professional respect and authorship experiences). These findings underscore the importance of accounting for how negative social environments for LGBTQ STEM professionals can translate into negative professional outcomes. We end by discussing the implications of these results for LGBTQ inequality research and for advancing more equitable team contexts in STEM.

KEY WORDS: *LGBTQ inequality, team climate, environmental science*

1. INTRODUCTION

Social and cultural mechanisms that hinder the respect and inclusion of marginalized and minoritized populations in science, technology, engineering, and math (STEM) are concerning not only for social justice reasons but also for scientific innovation and problem-solving (Hall et al., 2018; Hofstra et al., 2020; Page, 2007; Woolley et al., 2010). For over three decades, scholars have studied the ways that privilege and disadvantage are conferred along the lines of gender and race/ethnicity in STEM. Yet, due to analytic limi-

tations, research oversight, and at times overt resistance to the inclusion of gender expression and sexual identity considerations in studies of inequality in STEM (cf. Powell et al., 2020), much less scholarly attention has been paid to the ways that lesbian, gay, bisexual, transgender, and queer (LGBTQ) persons are disadvantaged in STEM. Of particular urgency is the need to understand not only the types of inequalities LGBTQ persons might face, but the mechanisms that produce those inequalities (Cech and Waidzunas, 2021).

Emergent research on LGBTQ inequality in STEM has indicated that LGBTQ-identifying persons often experience interpersonal marginalization by colleagues, such as being left out of informal gatherings, excluded from workplace social networks, or being silenced in group setting (Bilimoria and Stewart, 2009; Cech and Pham, 2017; Linley et al., 2018; Yoder and Mattheis, 2016). In addition to this social marginalization, some research has suggested that LGBTQ persons may also experience disadvantages that undermine their *professional* trajectories, such as the devaluation and disrespect of their expertise (Cech and Waidzunas, 2011; Patridge et al., 2014). A pressing but unexplored question relates to the interconnection of these factors: *what forms of career-related disadvantages do LGBTQ STEM professionals face, and how might the interpersonal dynamics within scientific contexts facilitate these disadvantages?* Drawing from an interdisciplinary set of social science literatures, we argue that the dynamics of *social* marginalization within the interpersonal climates of scientists' workplaces may be a key catalyst of *professional* inequalities for LGBTQ-identifying individuals.

Using survey data from environmental scientists working in academic research teams, we examine potential disadvantages by LGBTQ status along three professional outcomes: disrespect from team members, negative authorship practices, and lack of career mentoring. We then investigate the impact of the interpersonal dynamics in their "team climate" (the values and expectations espoused by their team members that impact respondents' sense of inclusion and fairness (Ostroff et al., 2012) on these career-related outcomes. We argue that interpersonal processes of inclusion within these team climates—specifically, the extent to which processes are fair and responsive to team members' perspectives (i.e., procedural justice) and people from all backgrounds feel included on the team (i.e., inclusive climate)—may not only affect LGBTQ scientists personally but also have important implications for them professionally by undermining their access to important career-related resources like respect and authorship.

Our examination of the potential mediating effects of team climate on career-related outcomes for LGBTQ persons among a sample of environmental scientists is illuminating. Environmental science, which encompasses both natural and social scientists who study the environment, tends to have greater demographic diversity and attract more socially progressive individuals than most other STEM fields (National Research Council, 2011; Slaton, 2012). As such, patterns of disadvantage found among this comparatively diverse and progressive disciplinary context are likely echoed (if not amplified) in less diverse and more culturally traditional STEM disciplinary contexts (Cech and Pham, 2017).

2. BACKGROUND

Prior research on inequality in STEM has found that women and people of color often report that their colleagues not only exclude them from day-to-day social interactions in their STEM work spaces, but also question their scientific competence and performance (Moss-Racusin et al., 2012; Steele, 2003). Professional disadvantages like devaluation, lack of respect, and limited access to career mentoring can be harmful to the careers of individual scientists and can exacerbate underrepresentation, marginalization, and attrition in STEM education and careers (Collins and Evans, 2007; Nelson and Brammer, 2010; Shapin, 1996; Steele, 2003). Despite inroads into understanding gender and racial/ethnic inequality in STEM over the last several decades, the experiences of other marginalized and minoritized populations have been comparatively (and sometimes purposefully) overlooked. In particular, scholars are only beginning to understand the experiences of LGBTQ individuals in STEM.

Research on LGBTQ inequality in the US labor force broadly hints at the kinds of inequalities that may exist for LGBTQ individuals who work in STEM fields. LGBTQ workers in the US experience persistent discrimination in hiring (Horvath and Ryan, 2003), inequity in income (Blandford, 2003), lack of legal protections (Ragins and Cornwell, 2001), and sexual harassment in the workplace (Konik and Cortina, 2008), among other negative outcomes. Prior studies of higher education specifically have found negative climates for LGBTQ faculty and students. One campus climate study of students, faculty, and administrators, for example, revealed that 31% of LGBTQ students and faculty reported that they were not comfortable with the climate on their campus and 20% even feared for their physical safety (Rankin et al., 2010). Another study examined the array of "microclimates" experienced by those in different campus roles and found that, although people's experiences varied based on the specific contexts in which they resided, "all of the participants agreed that heterosexism, homophobia, transphobia, and genderism shaped their campus experiences" (Vaccaro, 2012, p. 434).

Early research suggests that these disadvantages may be even more exaggerated in STEM contexts than in other fields. In studies of academic institutions, LGBTQ-identifying faculty and students in science and engineering departments reported more extreme experiences of marginalization than those in non-STEM departments (Bilimoria and Stewart, 2009; Cech and Waidzunas, 2011; Gunckel, 2009). Research on federal employees found that those in STEM–related agencies had more negative workplace experiences than those in other agencies (Cech and Pham, 2017). Studies focused specifically on STEM have similarly found evidence that LGBTQ professionals and students frequently face interpersonal marginalization and unfair treatment compared to their non-LGBTQ peers (Cech and Rothwell, 2019; Linley et al., 2018; Matthies et al., 2019; Patridge et al., 2014; Yoder and Mattheis, 2016).

2.1 Professional Outcomes

Most of the research on the experiences of LGBTQ persons in STEM has focused on *social* exclusion and marginalization—the ways that LGBTQ-identifying persons are

isolated from social networks and colleagues' gatherings, and the negative day-to-day workplace experiences that accompany such marginalization (e.g., Cech and Rothwell, 2020; Mattheis et al., 2019). Less attention has focused on whether LGBTQ individuals may experience *professional* devaluation at the hands of their colleagues (Cech and Waidzunas, 2011; Cooper et al., 2018). Yet, such career-related disadvantages may be especially consequential for long-term participation and success of LGBTQ-identifying individuals in STEM (Cech and Waidzunas, 2021). We focus on three such professional outcomes: whether their colleagues treat them with respect; whether they perceive equitable authorship practices in their teams; and whether they receive positive career-related mentoring.

The first of these outcomes, *professional respect*, captures the extent to which individuals feel that others see them as equally skilled scientists. As with other marginalized groups in STEM, broadly held negative cultural beliefs about the competence and worthiness of LGBTQ-identifying persons may shape their colleagues' expectations of their abilities and their work performance (Johnson et al., 1995; Ridgeway, 2011, 2014; Wilkins-Yel et al., 2019). Similar to other status characteristics, LGBTQ status is a devalued characteristic (Johnson et al., 1995) that is accompanied by common negative beliefs that include stereotypes about LGBTQ individuals as untrustworthy, incompetent, and aloof (Dovidio and Fiske, 2012), along with more malevolent beliefs that LGBTQ individuals are lazy, irresponsible, and immoral (Herek, 2007; Ragins, 2008).* As a result of colleagues' negative status beliefs, LGBTQ scientists may enjoy less professional respect from their team members than their non-LGBTQ colleagues (Lewis and Pitts, 2017).

Authorship is another domain where previous scholarship has found that marginalized and minoritized individuals in STEM face negative professional outcomes; however, this limited body of work has not yet examined LGBTQ scholars' experiences. Focusing almost exclusively on gender dynamics, existing authorship research has shown that women are more likely than men to report concerns or conflicts regarding decisions in their collaborations about who to include as authors and how the list of authors is ordered (Sandler and Russell, 2005; Smith et al., 2020b). Evidence also suggests that women in many STEM fields are more likely to be underrepresented in the prestigious first and last authorship positions (e.g., Bendels et al., 2018; Filardo et al., 2016; West et al., 2013), feel they must work harder to earn authorship (Feldon et al., 2017; Smith et al., 2020a), and worry that their contributions will be diluted by honorary authorship (i.e., naming people as authors even though they did not make adequate contributions to justify that designation; Elliott et al., 2017; Settles et al., 2018). These concerns are supported by evidence indicating that women's contributions to collaborative papers are given less credit than the contributions of men (Sarsons et al., 2021). These findings exemplify what some scholars have called the "Matilda Effect," whereby women's

*Lesbian, gay, bisexual, transgender, and queer identity categories may each act as their own status characteristics that are accompanied by certain status beliefs. We speak of "LGBTQ status" here because LGBTQ individuals are often aggregated into a single category in public opinion and discourse (Gates, 2012) and because of concerns about confidentiality among smaller subsamples in our data.

contributions to scientific work are undervalued or overlooked relative to men's (Ghiasi et al., 2015; Lincoln et al., 2012; Rossiter, 1993). While no known previous research has focused specifically on the authorship experiences of LGBTQ scientists, we suspect they may face analogous disparities in authorship experiences compared to their cisgender-heterosexual peers. Given the overwhelming importance of publications for advancing academic careers (Babor et al., 2017; Smith et al., 2020a), authorship-related disadvantages would be particularly problematic for the trajectories of LGBTQ scholars.

Career-related mentorship is a third professional outcome along which LGBTQ scientists may be disadvantaged. Mentoring, which consists of formal or informal relationships focused on the mentee's professional or psychosocial development, can impact scientists' career outcomes, attitudes, and commitment (Eby et al., 2010). For example, mentors can assist their mentees in developing networks and foster visibility by providing opportunities that promote skill development. Mentoring relationships are not always beneficial. Mentoring may result in negative experiences that "minimize, negate, or undermine the personal or professional growth of one or both members" (Eby, 2008, p. 324). Negative mentoring has also been associated with negative psychological outcomes and poorer job outcomes (Eby et al., 2004, 2010). Given the proportionally small number of LGBTQ individuals working in academic STEM, it may be difficult for LGBTQ scientists to find positive mentors who are familiar with their specific experiences and challenges and are willing to help them advance their careers. Moreover, LGBTQ STEM professionals may be more likely than their peers to encounter insensitive or even discriminatory mentors. Given the significance of positive mentoring for career advancement and the lack of existing literature on the mentorship experiences of LGBTQ scientists, it is important to examine these career-related mentoring experiences.

2.2 Team Climate

Research examining LGBTQ persons' climate experiences has usually focused on the climate of their workplaces or campuses overall (see, e.g., Rankin, 2005). In organizational settings outside of STEM, for example, Trau (2015) found that gay and lesbian employees reported receiving more psychosocial support from co-workers when they perceived their workplace climate as nondiscriminatory, and this greater support was associated with higher job and career satisfaction. Similarly, a meta-analysis found that LGBTQ employees who perceived a more supportive workplace climate reported less psychological strain and more positive work attitudes (e.g., job satisfaction; Webster et al., 2018). These broader conceptualizations of climate provide insights into the experiences of LGBTQ persons in their organizations and institutions overall, but do not necessarily capture what they encounter among the groups of people they work with most directly on a day-to-day basis.

One potentially vital part of how LGBTQ academic scientists experience their work on a day-to-day basis is the climate of their research teams. *Team climate* is an individual's perceptions of the values and expectations of their team's practices and routines, which are shaped by regular interpersonal interactions among members of that team

(González-Romá et al., 2009; Ostroff et al., 2012). Team climate may be an especially important mechanism producing differential career-related outcomes by LGBTQ status, as scientific work, especially in academia, is increasingly done in collaborative teams (Stephan, 2015). As such, the interpersonal environment of the teams in which they are embedded is likely highly impactful for LGBTQ scientists' social experiences.†

Interpersonal interactional dynamics within research teams may be especially relevant for understanding how team climate impacts LBGTQ persons' professional outcomes. In particular, positive and inclusive team climates likely involve high-quality relationships among team members, which are, in turn, associated with more equitable access to resources, support, and information (Gregersen et al., 2016; Tordera et al., 2008; Tse et al., 2008). More negative team climates, on the other hand, may facilitate a range of negative experiences for LGBTQ members. In our study, we examine two such facets of team climate: team procedural justice and team inclusion. *Team procedural justice* refers to the extent to which individuals perceive team policies and procedures to be fair and the extent to which all members have a voice in team practices and decision-making (Colquitt, 2001). *Team inclusion* refers to the extent to which respondents perceive that their team values its members regardless of their sociodemographic identities (Nishii, 2013).

Compared to privileged group members, individuals from marginalized sociodemographic groups tend to be more attuned to the climate around interpersonal treatment due to personal and collective histories of exclusion and discrimination (Driscoll et al., 1996; Purdie-Vaughns and Eibach, 2008). Researchers have found that members of marginalized and minoritized groups perceive the climates in their teams more negatively than those from majority groups and subsequently have worse career outcomes (McKay et al., 2007; Mor-Barak and Cherin, 1998). In contrast, those who experience supportive climates that value fairness, diversity, and inclusion tend to have more positive career outcomes, including lower turnover intentions, greater commitment, and higher career satisfaction (e.g., Chrobot-Mason and Aramovich, 2013; Gonzalez and DeNisi, 2009; McKay et al., 2007; Newman et al., 2018). Therefore, teams with climates that are procedurally just and inclusive are likely to be perceived by marginalized individuals—possibly including LBGTQ persons—as being more welcoming and supportive of their careers and professional goals (McKay and Avery, 2015; Pichler et al., 2017).

We use data from environmental scientists embedded in academic research teams to assess whether LGBTQ scientists are more likely than their cisgender-heterosexual peers to experience negative professional outcomes, and whether team climate helps account for those negative outcomes. Specifically, we hypothesize that:

> **Hypothesis 1:** LGBTQ persons are more likely to have negative professional outcomes than their cisgender-heterosexual peers, even controlling for demographic characteristics (e.g., race, age), discipline, and career stage.

†In addition to examining the climate of people's departments or organizations overall, scholars have increasingly focused on specific aspects of climate (i.e., climate facets), theorizing that doing so allows researchers to more accurately characterize and understand the many dimensions of climate (Schneider et al., 1994, 2013).

Hypothesis 2: LGBTQ persons are less likely to report positive team climates than their cisgender-heterosexual peers.

Hypothesis 3: The more negative professional outcomes LBGTQ persons experience compared to their cisgender-heterosexual peers will be mediated by (i.e., be partly accounted for by) the more negative interpersonal team climates LGBTQ persons encounter.

3. METHODS

3.1 Data

Data for this paper were drawn from a survey of 266 individuals from 105 National Science Foundation (NSF)-funded interdisciplinary environmental science teams.‡ We identified potential teams from the NSF public database of awardees from three interdisciplinary NSF programs in environmental science.§ After receiving IRB approval, we contacted project principal investigators (PIs) and co-PIs of each team and requested contact information for all of their team members. This resulted in a potential pool of 1727 individuals from 229 teams. We sent emails (and two reminders) to all individuals inviting them to take part in an online survey using Qualtrics. Response rate across the teams was 15.4%. Five respondents were randomly selected to receive $100 Amazon gift cards.

From the 266 respondents, we used data from the 233 individuals with complete information on gender, sexual identity, and racial/ethnic identity measures. We created a dichotomous LGBTQ status variable that distinguished LGBTQ respondents (those who identified as trans or genderqueer for gender, and/or asexual, bisexual, gay, lesbian, pansexual, or queer for sexual identity) from cisgender-heterosexual respondents (n = 23 LGBTQ; n = 210 cisgender-heterosexual respondents).¶ See below for operationalization. Although the survey included more detailed information on respondents' specific LGBTQ category, we did not disaggregate the LGBTQ categories here to protect respondent confidentiality.

Despite the small number of LGBTQ individuals and modest sample, we find robust empirical patterns (see below). The representation of LGBTQ respondents here is also higher (9.1%) than the LGBTQ representation in the general population (approximately 5%; Gates and Newport, 2012). Unlike most large-scale surveys of scientists, these data provide us with the opportunity to focus on team dynamics in academia, rather than broad workplace or department-wide factors, while also holding constant the science subfield of participants. And, unlike most surveys of STEM professionals, these data also include LGBTQ self-identification measures. Overall, these data provide a unique

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§We do not list the names of these NSF environmental science programs to protect respondent confidentiality.

¶The term cisgender refers to individuals who identify as the gender they were assigned at birth.

opportunity to identify potential axes of professional disadvantage for LGBTQ scientists and the possible team-based climate issues that may mediate these outcomes.

3.2 Authors' Positionalities

The six authors of this paper work at three different institutions and represent five disciplines: psychology, sociology, environmental science, history, and philosophy. The first author is a White cisgender queer woman trained in both sociology and engineering who studies cultural mechanisms of inequality. The other authors include a White cisgender-heterosexual woman who is a historian of science focusing on issues of inclusion and diversity and the history of field sciences; a Black biracial cisgender-heterosexual woman working from a feminist, intersectional psychological framework; a White cisgender-heterosexual man who engages in philosophical scholarship on the roles of ethical and social values in science; a White cisgender-heterosexual woman who conducts data-intensive environmental science research in large and interdisciplinary teams; and a White cisgender bisexual woman also working from a feminist, intersectional psychological framework. Although our research team encompasses multiple perspectives, we recognize that our positionalities may have led us to focus on particular factors that might not have been as salient to teams with a different disciplinary and demographic compositions. As a team, we are also keenly interested in intersectional processes of disadvantage in STEM, but we are limited in our ability to speak to such intersectional processes with this particular analysis because of the size of LGBTQ subsamples (see below).

3.3 Operationalization

In order to assess a number of important team science experiences without making the survey overly long, some published scales were abbreviated by selecting the most appropriate items for the study population or adapted in their wording to fit the context of work in academic science teams. These instances are noted in the description of each measure. Tests of Cronbach's alpha (noted below) indicate that the scales retained strong reliability.

3.3.1 Professional Outcomes

We assessed professional outcomes through three measures. First, we measured *professional respect* using the most direct and relevant item from the Interpersonal Justice subscale of Colquitt's (2001) Organizational Justice Scale. Participants indicated "to what extent have your project team leaders treated you with respect?" on a scale that ranged from 1 (Not at all) to 5 (Always). Second, we assessed *exclusionary authorship practices* in the team through a measure created for this study that asked participants to report how much they thought their team "excluded people from being authors even though they contributed sufficiently to the paper" on a 5-point scale from 1 (Never)

to 5 (Always). Third, we measured how much *career-related mentoring* participants received from the person who provided the most mentoring to them from among their team members. We used five items from the Career Mentoring subscale of Ragins and McFarlin's (1990) Mentor Role Instrument scale. In order to capture the full range of career mentoring activities, we selected one item from each of the career mentoring subscales from this instrument: sponsorship, coaching, protection, challenging assignments, and exposure. These items assessed how much the mentor on the team engaged in each mentoring behavior (e.g., "Uses his/her influence to support my advancement in my profession," "Gives me opportunities that push me into developing new skills") on a scale from 1 (Strongly Disagree) to 5 (Strongly Agree) (alpha = 0.804). Items were averaged such that higher scores indicated that the participant perceived their mentor to provide more career mentoring. Discriminant validity tests revealed that measures cohered more strongly with items in their own scales than with the measures included in different scales.

3.3.2 Team Climate Measures

We assessed two aspects of interpersonal team climate. First, *team inclusiveness* assessed the extent to which participants viewed their teams as supporting people from diverse sociodemographic and scientific backgrounds. We used Pugh et al.'s (2008) 5-item measure of diversity climate, adapted to the academic context (e.g., "Team leaders demonstrate through their actions that they want a diverse team"). We added to this an item to assess the climate related to scientific diversity ("Team leaders do a good job of managing people with differing scientific backgrounds [in terms of discipline, career stage, or institution]"). Participants responded on a 5-point scale that ranged from 1 (Strongly Disagree) to 5 (Strongly Agree). Items were averaged such that higher scores indicated a more inclusive team climate (alpha = 0.870). Second, *team procedural justice* assessed the extent to which participants felt that their team had fair and transparent policies and practices. We used four items adapted from the 7-item Procedural Justice subscale of Colquitt's (2001) Organizational Justice Scale (e.g., "Have you been able to express your views and feelings?", "Have policies been applied consistently and equally to everyone?"). We selected the items from the instrument that best suited an academic context and adjusted them accordingly. Responses ranged from 1 (Not at all) to 5 (Always) and we averaged responses such that higher scores indicate greater perceptions of procedural justice on the team (alpha = 0.841). Discriminant validity tests indicate that these two team climate scales are two distinct measures.

3.3.3 LGBTQ Status

The survey included questions that asked separately about respondents' gender identity and sexual identity. Respondents were asked, "which of the following best describes your gender," and could choose from genderqueeer, gender fluid, gender non-conforming, man, nonbinary, woman, trans man, trans woman, none of these categories describe

me, or prefer not to answer. They were also asked their sexual identity: asexual, bisexual, gay, lesbian, pansexual, queer, straight/heterosexual, none of these categories describe me, or prefer not to answer.** Respondents who reported "prefer not to answer" or that the category did not describe them on gender and/or sexual identity questions were excluded from the analysis, as we did not wish to assign respondents to categories to which they did not affirmatively identify (Cech and Waidzunas, 2021). Respondents who identified as both non-transgender men or non-transgender women and as straight/heterosexual were coded as cisgender-heterosexual. All others were coded as LGBTQ.

3.3.4 Controls

We included a number of control variables in our analyses. Participant race was categorized as "person of color" and "White person." We included Asian participants in the same category as underrepresented racial minorities because, although Asians are not numerically underrepresented in STEM, they still are subjected to anti-Asian racism and career limitations compared to Whites. We also controlled for age (in years), place of birth (US vs. elsewhere), and whether they had been a first-generation college student. In the models, we contrast cisgender and transgender women with cisgender and transgender men and gender nonbinary respondents because we do not have sufficient statistical power to include gender nonbindary as its own category in the models, and because (presumed) femininity is another devalued axis of difference in the context of STEM. We also controlled for length of time respondents had been on the team (in years), career stage (1 to 11: post-baccalaureate research assistants and staff, technician, Master's student, PhD student, post-doctoral researcher, assistant professor/scientist, associate professor/scientist, or full professor/scientist), and discipline (whether they were trained in an environment-focused natural science, an environment-focused social science, a non-environment-focused STEM field, or another discipline).

3.3.5 Protection of Vulnerable Populations

Given the small number of LGBTQ-identifying persons in our sample and related issues of statistical power, and the resultant potential risks to participants of disclosure of their LGBTQ identity, we followed several practices to protect respondent confidentiality. We do not disaggregate LGBTQ status into its component subcategories in our analysis. Nor do we provide more disaggregated data beyond the descriptives in Table 1. Additionally, we use a dichotomous indicator for race/ethnicity rather than a desegregated ordinal measure. While these aggregations foreclose more nuanced intersectional analysis of our focal measures by race/ethnicity or LGBTQ subcategory, protecting the confidentiality of LGBTQ-identifying respondents, especially LGBTQ respondents of color, was more important than the additional insights such disaggregation might provide.

**We chose to offer options for both "women" and "men" and "trans women" and "trans men" to allow for as inclusive a range as possible of response options. Some trans advocates prefer identification as trans men or trans women because it makes visible their transgender status in a way not visible in the "men" and "women" labels (cf. Schilt, 2010).

TABLE 1: Univariate and bivariate statistics for all respondents and for LGBTQ and cisgender-heterosexual respondents separately

	ALL N = 233	Cisgender-heterosexual N = 210	LGBTQ N = 23	p
Demographics and Employment Controls				
LGBTQ	9.92%	—	—	
Women (cisgender and transgender)	42.1%	40.4%	61.9%	*
Men (cisgender and transgender)	57.8%	59.6%	39.0%	
White	78.9%	78.2%	90.5%	
Persons of color	21.1%	21.8%	9.5%	
US born	73.6%	75.0%	73.2%	
Duration of project involvement	1.79	1.73	1.67	
First-generation college student	47.3%	46.6%	66.7%	
Education level	8.57	8.57	8.57	
Career stage	7.19	7.44	6.19	**
Age	46.07	46.74	42.81	*
Natural sciences, environment-focused	65.65%	64.93%	71.43%	*
Social science, environment-focused	18.45%	18.48%	19.05%	
Other, non-environment focused	15.88%	16.61%	9.50%	*
Professional outcomes and climate measures				
Professional respect	4.56	4.60	4.14	*
Exclusionary authorship	1.56	1.52	1.90	*
Career mentorship	3.38	3.42	2.93	*
Team inclusiveness	4.17	4.23	3.71	*
Procedural justice mean	4.14	4.19	3.59	**

Notes: *p < 0.05; **p < 0.01; two-tailed *t*-test comparing LGBTQ and cisgender-heterosexual respondents. See operationalization and unit descriptions in the Methods section. Gender categories for women and men include both cisgender and transgender persons who identify as women and men, respectively. Gender non-binary persons are not presented as a separate category in this table to protect confidentiality.

3.4 Analytic Strategy

We first conducted bivariate statistics (two-tailed *t*-tests) to compare LGBTQ and non-LGBTQ respondents on each measure. To test H1 and H2, we used ordinary least-squares (OLS) regression models predicting each of the professional outcome and team climate measures with LGBTQ status and controls. In the OLS models, we used the multiple

imputation chained technique in Stata v.15 with five imputations to handle missing data. No more than 10% of responses were missing on any given imputed variable. To test for mediation effects of team climate on the professional outcomes measures (H3), we used structural equation modeling (SEM) with residual indirect effects in Stata v.15. We describe several supplemental tests at the end of the results section.

4. RESULTS

Table 1 presents the means for all respondents and for LGBTQ and cisgender-heterosexual respondents separately. The rightmost column indicates the significance of two-tailed difference of means tests (i.e., *t*-tests) comparing LGBTQ and cisgender-heterosexual respondents on each measure. LGBTQ-identifying persons were about four years younger on average than their cisgender-heterosexual colleagues and were more likely than cisgender-heterosexual persons to identify as women. Although proportionally more LGBTQ respondents than their cisgender-heterosexual peers identified as White and were first-generation college students, these differences were not statistically significant. LGBTQ-identifying respondents were at a slightly less advanced career stage and were more likely than their colleagues to be trained in environmentally focused natural sciences (versus having training in a non-environment-focused field outside of STEM). The final rows of Table 1 suggest that LGBTQ persons experienced significantly more negative professional outcomes and team climates than their cisgender-heterosexual peers. The next analyses test whether these differences were robust to variation in age, career stage, STEM specialty, and other controls.

We hypothesized (H1) that LGBTQ scientists would be less likely than their cisgender-heterosexual peers to experience positive professional outcomes across the three measures (professional respect, exclusionary authorship, and career-related mentoring), while controlling for variation by other demographic and employment characteristics. Table 2 presents the coefficients and significance levels of LGBTQ status and controls in OLS models predicting these three professional outcomes. As expected, LGBTQ scientists were significantly less likely to report that their team members respected them. For example, over two-thirds (68%) of cisgender-heterosexual respondents said their team members always treat them with respect, compared to less than half (46%) of LGBTQ-identifying respondents.

LGBTQ respondents more frequently reported that their team engaged in exclusionary authorship practices than did cisgender-heterosexual respondents. Sixty percent of cisgender-heterosexual respondents reported that such exclusionary authorship practices never happened, compared to only 40% of LGBTQ respondents. The results in Table 2 illustrate that these LGBTQ differences in professional outcomes are robust to variation in respondents' age, career stage, discipline, and other controls. Third, we found that LGBTQ scientists were significantly less likely to report having access to career-oriented mentoring than their cisgender-heterosexual peers, holding other demographic and job characteristics constant (see Table 2, column 3). Although the sample

TABLE 2: OLS regression models predicting professional outcome measures, with LGBTQ status and controls

	Professional respect		Exclusionary authorship		Career-related mentorship	
	Unst.Coeff. and (SE)	**p**	**Unst.Coeff. and (SE)**	**p**	**Unst.Coeff. and (SE)**	**p**
LGBTQ	–0.318 (0.159)	*	0.361 (0.171)	*	–0.479 (0.203)	*
Women (cisgender and transgender)	–0.121 (0.218)		0.068 (0.098)		–0.030 (0.143)	
Persons of color	0.061 (0.652)		–0.124 (0.140)		0.076 (0.156)	
US born	–0.067 (0.127)		–0.161 (0.129)		0.156 (0.191)	
Duration of project involvement	–0.119 (0.045)	**	0.169 (0.048)	**	0.048 (0.067)	
First-generation college student	0.033 (0.096)		0.059 (0.099)		0.050 (0.156)	
Education level	–0.044 (0.006)		0.047 (0.061)		0.148 (0.075)	+
Career stage	0.030 (0.027)		–0.003 (0.029)		–0.078 (0.043)	
Age	–0.001 (0.006)		0.001 (0.007)		–0.004 (0.009)	
Social science, environment-focused	0.100 (0.128)		0.057 (0.129)		–0.078 (0.200)	
Other, non-environment-focused	0.133 (0.135)		0.050 (0.145)		0.161 (0.175)	
Constant	5.081 (0.543)	***	–0.608 (0.569)		2.759 (0.721)	***

Notes: N = 233; + p < 0.1; *p < 0.05; **p < 0.01; ***p < 0.001; Men and gender non-binary respondents are comparison categories for women; environment-related natural science is comparison category for discipline.

size is small, these LGBTQ status differences are both statistically significant and substantively large.

Our second hypothesis (H2) suggested that LGBTQ respondents experience more negative team climates than their peers. In OLS regression models (see Table 3), we found that LGBTQ-identifying respondents were significantly less likely than their peers to experience their team as inclusive and procedurally just. This result indicates that LGBTQ respondents experience their team climate as significantly more negative than how cisgender-heterosexual peers experience their research teams.

Our final set of models examined whether the disparate professional outcomes documented above are partly explained by these more negative climates that LGBTQ scientists experience in their research teams. We theorized (H3) that negative interpersonal environments within teams may have deleterious effects on LGBTQ scientists' career-related outcomes. We used Structural Equation Modeling (SEM) with direct and indirect effects to assess the possibility of these mediation effects. To

TABLE 3: OLS regression models predicting team climate measures, with LGBTQ status and controls

	Team inclusiveness		Team procedural justice	
	Unst.Coeff. and (SE)	**p**	**Unst.Coeff. and (SE)**	**p**
LGBTQ	–0.335 (0.147)	*	–0.383 (0.169)	*
Women (cisgender and transgender)	–0.213 (0.090)	*	–0.283 (0.143)	**
Persons of color	0.045 (0.125)		–0.075 (0.143)	
US born	0.134 (0.116)		–0.027 (0.134)	
Duration of project involvement	–0.204 (0.041)	***	–0.243 (0.048)	***
First-generation college student	0.025 (0.088)		0.041 (0.101)	
Education level	–0.098 (0.056)	+	–0.011 (0.062)	+
Career stage	0.017 (0.024)		0.031 (0.029)	
Age	0.001 (0.006)		–0.001 (0.007)	
Social science, environment-focused	0.110 (0.118)		–0.081 (0.135)	
Other, non-environment-focused	0.205 (0.125)		0.158 (0.143)	
Constant	0.896 (0.543)	+	4.667 (0.582)	***

Notes: N = 233; + p < 0.1; *p < 0.05; **p < 0.01; ***p < 0.001; Men and gender non-binary respondents are comparison categories for women; environment-related natural science is comparison category for field.

isolate the mediation effects of each pairing of team climate (team inclusiveness or procedural justice) with each professional outcome (professional respect, exclusionary authorship, or career-related mentoring), we ran six separate SEMs, one for each measure of team climate mediating each professional outcome. The focal coefficients from those models are summarized in Table 4. Specifically, Table 4 presents the direct effects of LGBTQ status on the three professional outcome measures in these models (column A) and the direct effects of LGBTQ status on the two team climate measures (column C). Table 4 also presents the direct effects of the team climate measures on the professional outcome measures (column B), and the indirect effect of LGBTQ status on the professional outcomes through the team climate mediators (column D).

These SEM results indicate that, across all respondents, those who perceived that the interpersonal dynamics in their teams were inclusive and procedurally just were more likely to feel respected and to have positive career-related mentoring, and observed exclusionary authorship practices less frequently than their peers who were exposed to less inclusive and less just team climates (see column B). This result suggests the importance of positive team climates for *all* members of research teams, not just LGBTQ persons.

We test H3 via analysis of the indirect effects of LGBTQ status on the professional outcomes measures *through* the team climate measures (column D). In the first row

TABLE 4: Direct effects of LGBTQ status and team climate measures, and indirect effects of LGBTQ status through team climate measures, predicting professional outcome measures using structural equation models

	Column A	**Column B**	**Column C**	**Column D**
Mediator: Team Inclusiveness	**Direct effect: LGBTQ → Professional outcomes (Coeff/p)**	**Direct effect: Inclusiveness → Professional outcomes (Coeff/p)**	**Direct effect: LGBTQ → Inclusiveness (Coeff/p)**	**Indirect effect: LGBTQ → Inclusiveness → Professional outcomes (Coeff/p)**
Outcome: Respect	–0.089	0.653 ***	–0.450 **	–0.294 **
Outcome: Exclusionary authorship	0.173	–0.384 ***	–0.508 **	0.195 **
Outcome: Career-related mentoring	–1.29 **	0.536 **	–0.055	–00.031
Mediator: Team Procedural Justice	**Direct effect: LGBTQ → Professional outcomes (Coeff/p)**	**Direct effect: Proced. justice → Professional outcomes (Coeff/p)**	**Direct effect: LGBTQ → Proced. justice (Coeff/p)**	**Indirect effect: LGBTQ → Proced. justice → Professional outcomes (Coeff/p)**
Outcome: Respect	–0.050	0.592 ***	–0.536 **	–0.318 **
Outcome: Exclusionary authorship	0.130	–0.402 ***	-0.597 **	0.240 **
Outcome: Career-related mentoring	–0.372 +	0.322 ***	–0.371 +	–00.119

Notes: N = 233; + p < 0.10; **p < 0.01; ***p < 0.001. Direct and indirect effects produced through structural equation models (SEM) in Stata v.15. All models include controls for the demographic, STEM discipline, and job controls listed in Table 1.

of coefficients, for example, the indirect effect is significant and negative (–0.294, $p < 0.01$), indicating that part of the negative effect of LGBTQ status on experiences of professional respect can be accounted for by LGBTQ respondents' less positive experiences of team inclusiveness. Supporting H3, we found that LGBTQ scientists' lower likelihood of experiencing team inclusiveness and procedural justice helped account for their experiences of less respect and more frequent observation of exclusionary authorship compared to cisgender-heterosexual peers.

Interestingly, however, although LGBTQ respondents were less likely than cisgender-heterosexual peers to experience career-oriented mentoring (Table 2), we did not find significant mediating effects of team inclusiveness or procedural justice on this mentorship outcome (*p*-values for these indirect effects were 0.88 and 0.24, respectively).[††] These results suggest that the quality of career-related mentoring that LGBTQ respondents receive can be disconnected from the climate of the team overall: LGBTQ team members can experience substandard career mentoring even in teams with inclusive and procedurally just climates. In other words, although respondents who are part of inclusive and just team climates reported more respect from colleagues and more equitable authorship practices overall, the climate of the team does not help explain LGBTQ scientists' lower likelihood of experiencing career-related mentorship.

Due to our modest sample size, we opted to present the most parsimonious models with only the most relevant demographic and employment-related controls. In supplemental analyses, we tested for the possible effects of two other control variables related to the composition of respondents' teams: the length of time the team had existed and the number of disciplines the team represented. These controls did not alter the outcomes reported above. Additionally we re-ran the models using robust standard errors to accommodate the nesting of respondents in teams. As this use of robust standard errors did not affect the results noted above, we present simplified (i.e., non-nested) models in the tables.

5. DISCUSSION

The goal of this paper was to contribute to a more robust understanding of LGBTQ inequality in STEM by examining LGBTQ status differences across three professional outcomes and two interpersonal team climate factors that may help foster those outcomes. Burgeoning literature has suggested that LGBTQ scientists experience more negative interpersonal environments relative to their peers (Cech and Waidzunas, 2021; Rankin, 2008). Although some previous research has indicated that LGBTQ workers in STEM contexts do not perceive their work to be respected as highly as that of their cisgender-heterosexual colleagues (Cech and Pham, 2017), no previous studies on LGBTQ inequality in STEM had attended to professional outcomes related to career-related mentorship or equitable authorship practices. Moreover, no previous research had examined the relationships between the climate that LGBTQ scientists experience among their immediate colleagues (in this case, their research teams) and their likelihood of experiencing negative professional outcomes. Our results suggest that LGBTQ persons experience career disadvantages on these three professional outcomes and further identified a mediating role of team climate on two of the three outcomes.

Our study breaks new ground by illustrating how these career-related outcomes differ by LGBTQ status. Consistent with Hypothesis 1 and prior literature reviewed above

††Table 4 presents the focal coefficients from six SEMs. All have fit statistics (Chi-squared and comparative fit index [CFI]) within acceptable ranges for this sample size (cf. Byrne, 2010) except for the two models where career-related mentoring was not a significant mediator.

on the heteronormavity, heterosexism, cisnormativity, and cissexism common in many STEM environments, LGBTQ scientists perceived more exclusionary authorship practices and less respect from their colleagues than their cisgender-heterosexual colleagues. This is particularly worrisome, as both professional respect and authorship are central to success in academia (Smith et al., 2020a). It is also troubling that LGBTQ scientists experienced less career-oriented mentoring than their cisgender-heterosexual colleagues, given how vital effective mentoring is to help scientists build developmental networks and advance their careers (Higgins and Kram, 2001). Our results also build on the growing LGBTQ inequality literature illustrating that bias and discrimination towards LGBTQ persons extends beyond psychological and social consequences to include professional ones as well (Cech and Waidzunas, 2021). In addition to adverse social experiences, adverse career-related experiences like the ones in our study may contribute to the underrepresentation of LGBTQ scholars in STEM fields (Hughes, 2018).

We also found that LGBTQ-identifying team members reported experiencing less just and inclusive team climates than their cisgender-heterosexual peers (Hypothesis 2), consistent with previous research indicating that other marginalized groups (e.g., racially minoritized individuals) experience more negative climates in organizational settings (e.g., McKay et al., 2007; Mor-Barak and Cherin, 1998; Wilkins-Yel et al., 2019). Partially supporting Hypothesis 3, we found that professional respect and experiences of inclusive authorship were mediated by two facets of team climate—procedural justice and inclusiveness. Our study's demonstration of a connection between team climate and feelings of professional respect highlights how the quality of interpersonal settings can amplify feelings of (de)valuation among LGBTQ scientists. These results also reveal an important linkage between the interpersonal climates LGBTQ scientists encounter in their teams and their experiences of equitable authorship practices. Insofar as inclusive climates involve positive interpersonal dynamics, it makes sense that more inclusive team climates would be associated with increased professional respect and less authorship exclusion. Similarly, because procedural justice involves fair and transparent team policies and practices, increased procedural justice might undermine disrespect and authorship exclusion by lessening the potential for problematic power dynamics within teams. In sum, these more negative team climate experiences among LGBTQ scientists are not benign: feeling less included among one's colleagues and being less likely to believe that team practices are fair may have long-term negative consequences for LGBTQ scientists' careers.

The final part of Hypothesis 3 related to mentoring was not supported. We found that team climate (although perceived more negatively by LGBTQ scientists) was not related to whether LGBTQ respondents received career-related mentorship in those teams. This result suggests that individual mentors' treatment of their LGBTQ mentees may be decoupled from the team climate. This indicates that engaged mentors can have a significant and positive impact on their LGBTQ mentees even in the context of a negative team climate, providing support to their LGBTQ colleagues they might not find among others on their team. However, this result suggests that career-related mentoring can be absent for LGBTQ scientists even in the context of an otherwise positive team

climate. In short, LGBTQ scientists' experiences on research teams appear to be sensitive both to the behaviors of individual mentors in teams and to the interpersonal team climate overall.

It is notable that we found these results among a sample of environmental scientists—an interdisciplinary field that may be more demographically diverse and socially progressive than other STEM disciplines (Cech and Pham, 2017; National Research Council, 2011). Although we cannot generalize to other STEM disciplines, the fact that we found these patterns within this context suggests that the patterns of LGBTQ inequality we observed may be equally or more salient in other STEM fields. Further, our study included a numerically small subsample of LGBTQ individuals. As such, we were unable to examine processes of intersectionality or delineate differential experiences of persons within specific subcategories of the LGBTQ umbrella. However, the emergence of these results even with a modest sample speaks to the strength and prevalence of these patterns. Future studies of LGBTQ STEM professionals across a wider array of disciplines may find even stronger relationships between team climate and professional outcomes than we document here. Studying a broader set of variables related to mentoring across a range of STEM contexts would also help to determine whether some aspects of mentorship experiences might indeed be related to team climate.‡‡ Finally, future research using longitudinal data would help assess how the negative professional experiences that we documented for LBGTQ scientists affect longer-term career outcomes.

5.1 Implications

Our results suggest that science teams can promote more positive professional outcomes for LGBTQ-identifying scientists specifically, and all team members generally, by fostering inclusive team climates and positive mentoring relationships among team members. Such team contexts are a counterforce to the status biases, exclusion, and devaluation that LGBTQ persons may encounter in STEM environments in general.

There are many strategies for creating and maintaining inclusive teams, such as deliberately building diverse teams and providing interpersonal skill training (e.g., Cheruvelil et al., 2014). More specific to the professional outcomes studied here, previous work has found that team leaders wishing to avoid conflict may inadvertently promote authorship decisions that disadvantage lower-status team members (Elliott et al., 2017; Settles et al., 2018). Therefore, there is an opportunity to positively influence both team climate and LGBTQ persons' career outcomes by increasing professional development in areas of effective communication, conflict negotiation, and navigating power dynamics among team members and leaders (Eigenbrode et al., 2007).

Structural changes within teams, such as co-creation of team authorship policies and team inclusion statements, would also be advantageous (Button, 2001; Henson et

‡‡For example, negative perceptions of team climate might be related to negative mentoring experiences even if they are not closely associated with career mentoring (Eby, 2008).

al., 2020; Oliver et al., 2018). As academic science continues to move toward large, interdisciplinary teams, there is an opportunity to drastically increase the size of mentoring networks, which, in turn, have the potential to positively influence career outcomes (Behar-Horenstein and Prikhidko, 2017; de Janasz and Sullivan, 2004). Members of other traditionally underrepresented groups have benefited from shared or team mentoring experiences, as they offer support from a broader array of individuals (Johnson-Bailey, 2004; Meschitti and Lawton-Smith, 2017). For LGBTQ persons, mentors whom they trust and who can help them develop navigation and response strategies to anti-LGBTQ mistreatment within an academic landscape that often silences conversations about LGBTQ inequality (Cech and Waidzunas, 2021), may be especially important. Further, team mentoring can generate networking opportunities that provide a platform for launching or advancing institutional change initiatives to address embedded anti-LGBTQ bias (Thomas et al., 2015). As individuals and teams implement such policies and practices, it is important for institutions, such as professional societies and universities, to employ an equity mindset that centers the experiences and voices of LGBTQ persons, recognizes and works to remove the structural and cultural barriers facing LGBTQ scientists, and calls on reflexive allies to share in the work of institutional change (Drury and Kaiser, 2014; Madera et al., 2013). More generally, structural change that promotes greater representation of LGBTQ persons in science and their leadership on science teams is critical to providing role models that can promote careers of current and future LGBTQ scientists and creating positive team environments that allow all professionals to thrive. Taking these steps to promote more positive experiences and career outcomes will not only promote a more just and ethical scientific community, but also help advance innovation in scientific research.

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