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Can Program Structure Advance Equity in Graduate Education?

Jue Wu[1,3] · Laura Guzman[2] · Colette Patt[3] · Andrew Eppig[4] ·
Rodolfo Mendoza-Denton[2]

Abstract

The importance of creating diverse and equitable environments in higher education has gained growing recognition in recent years (Allen, 2005). While individual-level bias training has shown limited efficacy, this study proposes that program structure—characterized by clear, transparent, and uniformly applied standards, expectations, and norms—may be a more effective route to equity. Leveraging data from a large U.S. public university, we present evidence from multi-level modeling that demonstrates the positive relationship between program structure and equity-related outcomes, including psychological well-being and academic performance. Notably, these effects appear to disproportionately benefit women and underrepresented minority students, suggesting that structure may be particularly impactful for marginalized students, who are often excluded from informal informational networks within their departments. This research contributes to the ongoing dialogue on practical strategies for achieving equity in higher education, offering an alternative to individual-focused interventions. We discuss the theoretical implications for research on marginalized groups and provide actionable recommendations for practitioners. The study highlights the potential of structural approaches in fostering more equitable and inclusive learning environments in higher education.

Keywords Clarity · Structure · Graduate education · Equity · Attributional ambiguity · Minorities

✉ Jue Wu
  juewu@coe.ufl.edu

1 College of Education, University of Florida, 2705B Norman Hall, P.O. Box 117049, Gainesville, FL 32611-7042, USA

2 Department of Psychology, University of California-Berkeley, Berkeley, CA, USA

3 Division of Mathematical and Physical Sciences, University of California-Berkeley, Berkeley, CA, USA

4 Equity and Inclusion, University of California-Berkeley, Berkeley, CA, USA

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Introduction

Research indicates that diverse and equitable environments can be more successful, innovative, and productive by introducing new ideas and perspectives (Nishii et al., 2018; Pitts & Recascino Wise, 2010; Selden & Selden, 2001; Smith & Fernandez, 2010). However, achieving this goal remains challenging, as significant disparities persist for women and underrepresented minority (URM) students in higher education, especially in graduate education. These inequities span enrollment, retention, degree completion, and overall experiences (Posselt & Grodsky, 2017). For instance, while racial and ethnic minorities accounted for over 30% of the U.S. population in 2020 (U.S. Census Bureau, 2022), they represented less than 20% of doctoral degree recipients (National Science Foundation, 2022). Women and URM students face barriers to success including discrimination, lack of belonging, feelings of isolation, experiences of microaggressions, and low levels of satisfaction and productivity (Dortch & Patel, 2017; Ong et al., 2011; Rodriguez & Blaney, 2021). These disparities extend into career trajectories, with women and URM individuals underrepresented in tenure-track faculty positions (Li & Koedel, 2017).

Traditional approaches to addressing these disparities have largely focused on individual-level interventions, such as bias training or mentorship programs. However, recent research suggests that these approaches may be of limited use in achieving equity goals (Robinson, 2022; Vaught & Castagno, 2020). This has led to calls for a shift away from individual-level explanatory variables towards understanding how institutions themselves may be targeted for intervention (e.g., McGee, 2020; Mendoza-Denton et al., 2023; Wu et al., 2024).

In response to these calls, we propose that educational environments that are characterized by clear and uniformly applied standards, expectations, and norms—what we refer to here as program structure—may be more successful in achieving equity in important student outcomes. This approach represents a significant departure from individual-focused interventions and addresses a critical gap in our understanding of how organizational-level factors impact equity outcomes in graduate education.

Prior research, albeit in workplace settings, provides a strong foundation for exploring the potential impact of structure in academic environments. Research in this area has shown that organizational structure—such as having clear, agreed-upon behavioral norms and transparency of expectations and standards—positively impacts various outcomes, including job satisfaction, motivation, psychological well-being, performance, organizational justice, and diversity (e.g., Churchill et al., 1976; Finlay et al., 1995; Hackman & Oldham, 1976; Tsaur et al., 2014). Transparency and consistency in how standards are applied provides employees with a clear understanding of their roles and responsibilities, facilitates efficient work processes, promotes effective communication, and reduces conflicts (Chen et al., 2009; Dischner, 2015). Moreover, it contributes to psychological safety, encourages innovation, and promotes fairness in resource allocation and opportunity distribution (Edmondson, 2019; Özşahin & Yürür, 2018).

Structure in Graduate Education

Although research on organizational structure provides a foundation for the current work, it is crucial to acknowledge the fundamental differences between academic and workplace settings. Higher education institutions represent a unique organizational context that Birnbaum (1988) characterizes as "loosely coupled systems" with distinct governance structures and professional norms. Unlike traditional hierarchical organizations, universities operate with distributed decision-making, professional autonomy, and what Cohen and March (1974) termed "organized anarchy." In graduate education specifically, the tension between structure and autonomy is particularly salient as programs must balance consistent standards with the cultivation of independent scholars. This balance differs from workplace environments where organizational goals may be more uniformly defined. As Golde and Walker (2006) argue, graduate education serves as both professional preparation and scholarly apprenticeship, creating unique considerations where faculty maintain significant autonomy and departments operate semi-independently (Kezar & Eckel, 2004).

While recognizing the balance that exists in graduate education between autonomy and structure, the "looseness" that results from this balance can result in educational environments marked by a distinct *lack* of clarity and equal treatment for graduate students. Many graduate students, in fact, characterize their graduate education as a maze, where not even their professors know the program requirements and where the rules for success are vague and inconsistently applied across the student body (Gardner, 2007).

We recognize at the outset that structure can take many different forms within graduate programs—from course progressions, to lab rotations, to deadlines and requirements for academic milestones. Regardless of their specific manifestation, we propose that these program practices need to be clearly articulated, available to everyone in the community, and consistently applied to all students. These features are at the core of our conceptualization of structure. Indeed, studies suggest that programs with clear policies and student-friendly procedures experience lower attrition rates, helping students understand expectations (Ehrenberg et al., 2007; Golde, 2005; Hirt & Muffo, 1998; Valero, 2001). Structured processes developed by academic programs can also increase doctoral degree attainment (Bauer, 2004; Bégin & Géarard, 2013; Bourner et al., 2001; Lovitts, 2001; Nerad & Cerny, 1993; Pauley, 1998). Without clear guidelines, students may over-commit to non-required activities, potentially delaying degree completion and leading to dropout (Gittings et al., 2018). Even during the less structured dissertation phase, setting strict submission deadlines and organizing feedback seminars has been shown to increase completion rates and reduce time to degree completion (Hatley & Fiene, 1995; Skopek et al., 2022).

While retention is a crucial metric for graduate programs, it represents just one facet of their success. Graduate education encompasses a comprehensive learning journey, and various factors can impact degree completion, including productivity, satisfaction, and sense of belonging. These factors are often interconnected. For instance, dissatisfaction with the trajectory of graduate school not only correlates with attrition and delays (Bair et al., 2004) but also with lower productivity (Pyhältö

et al., 2009). Conversely, productivity and intentions to quit are negatively related (Rooij et al., 2021). Simultaneously, a sense of belonging has been extensively studied and linked to satisfaction and retention in higher education (Freeman et al., 2007; O'Meara et al., 2017; Zhao et al., 2007).

Besides its influence on academic performance, structure in graduate programs may also relate to students' mental health and overall well-being. Graduate school can be a stressful time for students, as graduate students are often juggling coursework, research, and teaching responsibilities, facing financial pressures, while also trying to maintain a social life and personal relationships (Evans et al., 2018; Levecque et al., 2017). When graduate programs provide clear guidelines, well-defined milestones, and transparent expectations, it can help reduce uncertainty and anxiety among students (Hyun et al., 2006; Posselt, 2018). Having a structured roadmap for completing coursework, research projects, and other program requirements can provide a sense of direction and control, which can positively influence mental well-being (Pyhältö et al., 2012; Stubb et al., 2011). Moreover, structure might foster collaborative environments and help students feel connected to their peers and faculty members by reducing suspicion and worry that one is not "in the know" or that one is being treated unfairly. This social support and sense of belonging can serve as a protective factor against mental health challenges and promote overall well-being (Cornwall et al., 2019; Jairam & Kahl, 2012; Sverdlik et al., 2018).

Structure and Equity

A lack of structure for how to advance and succeed in one's graduate program may be particularly damaging for marginalized students. Indeed, one of the key markers of the experience of marginalized groups is that they are often left out of the informal networks and social capital opportunities that others enjoy. These "soft opportunities" are where social capital is fostered and developed, and which then lead to further knowledge and opportunity. In the educational context, for example, scholars note that minoritized students often come to the educational institution without the "invisible knapsack" that allows students to know how to navigate graduate school (e.g., Elliot et al., 2016; Gardner & Holley, 2011; Orón Semper & Blasco, 2018). This predicament is likely compounded by the fact that stigmatized identities themselves can create a state of attributional ambiguity—that is, the condition of not knowing whether a given outcome (e.g., not being included in a group lunch, negative performance feedback, a bad grade) is the result of one's group identity or something specific to oneself. Attributional ambiguity has been shown to lead to suspicion about one's treatment, and eventually, less affiliation with the organization or institution, as well as less motivation to complete difficult tasks (Cohen et al., 1999). In short, research on ambiguity suggests that a lack of clarity is more likely to be detrimental for marginalized students as they pursue their degree.

In an investigation into race- and gender-based disparities in STEM graduate programs, Mendoza-Denten and colleagues (Mendoza-Denton et al., 2018) found that three factors—clear, evenly applied procedures, having multiple people invested

in a student's progress, and clear expectations—promoted equity in graduate students' opportunity to become involved in the publication process. These practices may democratize access to important information, create a set of shared norms where academic milestone achievement is the norm, and minimize the likelihood that students get lost in the shuffle. As such, it may not be enough for a department's standards to be clear—they need to be shared by the community and evenly applied to all students as well (Fisher et al., 2019).

The Current Research

Despite these potential benefits, notable research gaps exist regarding the relationship between structure and equity-related outcomes (e.g., psychological well-being, sense of belonging, identity exclusion). Here we consider equity-related outcomes as those directly contributing to disparities in graduate education, such as discrimination, identity exclusion, or a lack of belonging experienced by gender minorities and racial/ethnic minorities (Park et al., 2022).

Building on the identified research gaps, two critical questions emerge: 1) What is the relationship between structure as defined here and equity-related outcomes, such as identity-based exclusion and sense of belonging? 2) Does the relationship differ between majority and minority groups? To address the above-mentioned questions, we set out to conduct the current research to further examine the relationships between structure and individual outcomes, with a particular focus on equity-related outcomes and whether the relationship differs between different identity groups. We assessed a dataset from a campus climate survey from a large public university in the U.S., and we tested the following research hypotheses:

1) Perceived structure will be positively related to equity-related outcomes, such as psychological well-being and academic performance.

Specifically, psychological well-being was measured by identity exclusion, mental health, bullying, and belonging, and academic performance was measured by job satisfaction, job productivity, shared vision, and collaboration. We hypothesized that structure would be negatively related to frequency of identity exclusion, mental health problems, and bullying, but positively related to feeling of belonging. At the same time, we also hypothesized that structure would be positively related to belonging, job satisfaction, job productivity, shared vision, and collaboration.

2) The relationship between structure and equity-related outcomes will differ by identity groups, such as gender, race/ethnicity, and socioeconomic status.

Methods

Sample

The data we used came from responses from a campus climate survey from a state university on the West Coast of the United States in Spring 2019. The survey was structured around several key areas, including academic, interpersonal, health, basic needs, and professional development, and received a response rate of 20% among graduate students. As is typical with large institutional surveys, women had higher response rates relative to the larger population (Porter & Umbach, 2006). Otherwise, however, response rates did not show significant bias across groups.

We only included departments that had more than 10 responses in our analytical sample because we wanted to account for the nested structure of our data and the within-department differences. As a result, our final sample was made up of responses from 1787 graduate students across 31 departments (see Table 1 for a departmental breakdown). The sample was fairly diverse with regards to gender, race, and socioeconomic status. Of the 1787 respondents, 857 were men (48.0%) and 723 were women (40.5%). In terms of race, we dummy coded race by aggregating African Americans, Hispanic Americans, American Indians, Alaska Natives, Native Hawaiians, Pacific Islanders, and multi-races as underrepresented minorities (URM) following NSF's categorization, and we ended up with 180 URM students (10.1%) in our sample. As for socioeconomic status, 148 respondents were low-income or poor (8.3%), 269 were working-class (15.1%), 572 were middle-class (32.0%), 574 were upper-middle or professional-middle (32.1%), and 54 were wealthy (3.0%).

Variables

Program Structure

Recall that we use the term structure here to refer not only to the transparency of norms, expectations, and standards, but also to the even application of those standards and to the sharing of those standards by the community. Based on our prior qualitative work (Mendoza-Denton et al., 2018), the research team was able to introduce three items into the campus-wide survey tapping into program structure ($\alpha = 0.84$). The items were on a 6-point Likert scale from strongly disagree to strongly agree. Specifically, the three items included were worded as follows: 1) My department articulates clear expectations and guidelines relevant to competing my degree; 2) If a student is falling behind in the program, department faculty will take action to get them back on track; and 3) Degree requirements are taken seriously and systematically applied to all students.

Table 1 Department mean structure from the analytical sample

Department	College	n	Department mean structure
Integrative Biology	L&S Biological Sciences	137	2.81
History	L&S Social Sciences	103	3.46
Education	Graduate School of Education	95	3.56
Statistics	L&S Math & Physical Sci	66	3.58
Social Welfare	School of Social Welfare	98	3.71
Environmental Science, Policy & Management	College of Natural Resources	392	3.75
Political Science	L&S Social Sciences	303	3.91
Chemistry	College of Chemistry	236	3.92
Psychology	L&S Social Sciences	118	3.97
Anthropology	L&S Social Sciences	92	4.00
Mathematics	L&S Math & Physical Sci	199	4.02
Nuclear Engineering	College of Engineering	48	4.04
Physics	L&S Math & Physical Sci	257	4.14
Geography	L&S Social Sciences	25	4.23
Linguistics	L&S Social Sciences	50	4.25
Sociology	L&S Social Sciences	152	4.27
Chemical Engineering	College of Chemistry	198	4.31
Architecture	College of Environmental Design	141	4.34
Economics	L&S Social Sciences	259	4.38
Bioengineering	College of Engineering	140	4.39
City & Regional Planning	College of Environmental Design	64	4.41
Electrical Engineering & Computer Science	College of Engineering	707	4.43
Molecular & Cell Biology	L&S Biological Sciences	330	4.43
Mechanical Engineering	College of Engineering	250	4.47
Law	School of Law	329	4.50
Material Science	College of Engineering	97	4.57
Civil & Environmental Engineering	College of Engineering	230	4.62
Agricultural & Resource Economics	College of Natural Resources	36	4.74
Public Health	School of Public Health	173	4.76
Business	School of Business	356	4.80
Plant & Microbial Biology	College of Natural Resources	86	4.98

Identity Exclusion

The identity exclusion subscale consisted of 21 items ($\alpha = 0.91$) measuring the frequency of exclusionary behaviors on campus within the past year on a 6-point frequency scale. Example exclusionary behaviors asked included "I was the target of racial/ethnic profiling" and "Someone assumed I was admitted/hired/promoted due to my identity."

Mental Health

The mental health subscale consisted of 10 items ($\alpha = 0.91$) measuring the frequency of mental health problems during the past two weeks on a 5-point frequency scale. Example items included "During the past two weeks, how much (or how often) you have been bothered by little interest or pleasure in doing things" and "During the past two weeks, how much (or how often) you have been bothered by feeling down, depressed, or hopeless."

Bullying

The bullying subscale consisted of 17 items ($\alpha = 0.94$) measuring the frequency of bullying behaviors on campus during the past twelve months on a 6-point frequency scale. Example items included "Within the past 12 months, how frequently have you personally experienced demands/threads" or "Within the past 12 months, how frequently have you personally experienced insults/put-downs/personal attacks?"

Belonging

Belonging is a composite variable formed from 3 items ($\alpha = 0.85$) based on the results from a factor analysis. The items were on a 6-point Likert scale from strongly disagree to strongly agree. Specifically, the three items included were worded as follows: 1) I feel valued by faculty in the classroom/learning environment; 2) I feel valued by other students in the classroom/learning environment; and 3) Members of the department taken as a whole treat me with respect and dignity.

Job Satisfaction

Job satisfaction is a single-item variable on a 4-point Likert scale from strongly disagree to strongly agree. The item asked about agreement with the statement "My main satisfaction in life comes from my work."

Job Productivity

Job productivity is a single-item variable on a 4-point Likert scale from strongly disagree to strongly agree. The item asked about agreement with the statement "Conditions on my job allow me to be about as productive as I could be."

Shared Vision

Shared vision is a composite variable formed from 3 items ($\alpha = 0.84$) based on the results from a factor analysis. The items were on a 4-point Likert scale from strongly disagree to strongly agree. Specifically, the three items included were worded as follows: 1) In my department, there is a shared vision; 2) In my department, every

one shares in making important decisions; and 3) In my department, all graduate students are encouraged to participate in strategic planning for the direction of the department.

Collaboration

Collaboration is a composite variable formed from 3 items ($\alpha = 0.87$) based on the results from a factor analysis. The items were on a 4-point Likert scale from strongly disagree to strongly agree. Specifically, the three items included were worded as follows: 1) In general, my graduate student colleagues in my department maintain a supportive working environment; 2) In general, my graduate student colleagues in my department work collaboratively; and 3) In general, my graduate student colleagues in my department are collegial.

Additional Covariates

Besides key independent variable and outcome variables, we also included demographic variables (e.g., gender, race/ethnicity, socioeconomic status), STEM status (whether the department is in a STEM discipline), advisor guidance on structure (a 6-point item on the agreement of "My advisor has helped guide me through departmental, organizational, and administrative changes"), and comfort with campus climate (a 6-point item on overall comfort with campus climate) as our covariates.

Analytical Approach

Our hypotheses were tested using multilevel modeling from the nlme package (Pinheiro et al., 2023) with maximum likelihood in R (R Core Team, 2024) after confirming the model assumptions were met. Specifically, our fitted models included coefficients for our main independent variable (structure) at both the individual student level (level-1) and the department level (level-2). Demographic variables were entered as covariates, along with additional control variables such as disciplinary differences (STEM status), advisor guidance on structure, and comfort with campus climate. Cross-level interaction of structure (level-1 structure x level-2 structure) and interactions between structure and demographic variables were further tested, too. All the outcome variables and the independent variables were mean centered.

Results

We fitted multilevel models to predict a series of student outcomes (identity exclusion, mental health, bullying, belonging, job satisfaction, job productivity, shared vision, collaboration) with level-1 structure (individual perception of structure), level-2 structure (department mean structure), as well as gender, race, and socioeconomic status (formula: outcomes ~ level-1 structure + level-2 structure + gender

Table 2 Multilevel regression results

	Mental health	Identity exclusion	Bullying	Belonging	Job satisfaction	Job productivity	Collaboration	Vision
(Intercept)	0.326***	−0.022	−0.030	0.016	0.417***	0.085	−0.036	0.073
	(0.097)	(0.046)	(0.054)	(0.092)	(0.113)	(0.098)	(0.083)	(0.088)
Structure (Level-1)	−0.161***	−0.039***	−0.058**	0.333***	0.145***	0.214***	0.141***	0.292***
	(0.025)	(0.011)	(0.020)	(0.029)	(0.028)	(0.023)	(0.021)	(0.024)
Structure (Level-2)	−0.113*	−0.019	−0.075*	0.159*	0.066	0.263***	0.201**	0.510***
	(0.054)	(0.029)	(0.034)	(0.073)	(0.072)	(0.068)	(0.062)	(0.059)
SES	−0.119***	−0.035***	−0.014	0.064***	−0.067**	−0.009	0.029 +	−0.043*
	(0.022)	(0.010)	(0.012)	(0.019)	(0.025)	(0.021)	(0.017)	(0.019)
URM	−0.097	0.098**	0.063 +	−0.112*	−0.262***	0.064	−0.000	0.054
	(0.066)	(0.030)	(0.035)	(0.056)	(0.075)	(0.063)	(0.051)	(0.058)
Gender	0.002	0.015**	0.010 +	−0.038***	−0.036**	−0.021*	−0.008	−0.014
	(0.011)	(0.005)	(0.006)	(0.009)	(0.012)	(0.010)	(0.008)	(0.009)
STEM	0.020	0.029	0.038	−0.035	−0.024	0.075	−0.023	0.089 +
	(0.044)	(0.025)	(0.028)	(0.064)	(0.061)	(0.059)	(0.054)	(0.050)
Advisor Guidance	−0.077***	−0.021**	−0.040***	0.092***	0.118***	0.105***	0.052***	0.096***
	(0.017)	(0.008)	(0.009)	(0.015)	(0.019)	(0.016)	(0.013)	(0.015)
Campus Climate	−0.080***	−0.100***	−0.087***	0.195***	0.096***	0.161***	0.183***	0.197***
	(0.021)	(0.010)	(0.011)	(0.018)	(0.024)	(0.020)	(0.016)	(0.018)
Num.Obs	1181	1174	1172	1199	1194	1188	1153	1076

Standard errors within parentheses

● +p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

+ race + SES + STEM + advisor control + campus climate). The model included level-1 structure as random effects (formula: ~ 1 + level-1 structure | department).

As shown in Table 2, gender-wise, female students were significantly more likely to experience identity exclusion ($\beta = 0.015$, $p < 0.01$), and significantly were less likely to report higher levels of belonging ($\beta = -0.038$, $p < 0.001$), job satisfaction ($\beta = -0.036$, $p < 0.01$), and job productivity ($\beta = -0.021$, $p < 0.05$). Race-wise, URM students were significantly more likely to experience identity exclusion ($\beta = 0.098$, $p < 0.01$), and significantly less likely to report higher levels of belonging ($\beta = -0.112$, $p < 0.05$) and job satisfaction ($\beta = -0.262$, $p < 0.001$). Results regarding socioeconomic status were not as consistent as gender and race. In particular, students from higher SES backgrounds reported significantly higher levels of belonging ($\beta = 0.064$, $p < 0.001$). At the same time, they were significantly less likely to experience identity exclusion ($\beta = -0.035$, $p < 0.001$), mental health problems ($\beta = -0.119$, $p < 0.001$) and reported lower levels of job satisfaction ($\beta = -0.067$, $p < 0.01$) and shared vision ($\beta = -0.043$, $p < 0.05$).

Effect of Program Structure

Overall, both the effect of individual perception of structure (level-1 structure) and the effect of department mean structure (level-2 structure) were statistically significant with $p < 0.05$ for all the outcome variables, except for identity exclusion (in which level-1 structure was significant with $p < 0.001$ while level-2 structure was not significant) and job satisfaction (in which level-1 structure was significant with $p < 0.001$ while level-2 structure was not significant). Specifically, both individual perception of structure and department mean structure were negatively related to identity exclusion, mental health, and bullying, meaning that graduate students were less likely to experience instances of identity exclusion, mental health problems, or bullying if they individually perceived more structure in their department and their department overall had better structure. On the other hand, both individual perception of structure and department mean structure were positively related to belonging, job satisfaction, job productivity, collaboration, and shared vision, which means that graduate students reported higher levels of belonging, job satisfaction, job productivity, collaboration, and shared vision when they individually perceived more structure in their department and their department overall had better structure. Detailed regression coefficients and standard errors are reported in Table 2.

Cross-Level Interaction

We then included a cross-level interaction term (level-1 structure x level-2 structure) into our model testing for all the outcome variables. Overall, the effect of structure and the effect of demographic variables remained the same, as shown in Table 3. Among all, cross-level interaction was statistically significant for belonging with $p < 0.01$ and marginal significant for mental health and shared vision with $p < 0.1$. That is to say, for graduate students who were in departments with the same level of department mean structure, those who individually perceived more structure were

Table 3 Multilevel regression results with cross-level interactions

	Mental health	Identity exclusion	Bullying	Belonging	Satisfaction	Productivity	Collaboration	Vision
(Intercept)	0.322***	−0.023	−0.030	0.018	0.419***	0.084	−0.035	0.078
	(0.097)	(0.046)	(0.054)	(0.092)	(0.113)	(0.098)	(0.083)	(0.087)
Structure (Level-1)	−0.158***	−0.038***	−0.057**	0.331***	0.144***	0.215***	0.141***	0.291***
	(0.024)	(0.011)	(0.020)	(0.026)	(0.028)	(0.023)	(0.021)	(0.023)
Structure (Level-2)	−0.104 +	−0.012	−0.053	0.125	0.073	0.268***	0.176*	0.505***
	(0.055)	(0.030)	(0.042)	(0.074)	(0.073)	(0.069)	(0.072)	(0.059)
SES	−0.119***	−0.034***	−0.014	0.064***	−0.067**	−0.008	0.029 +	−0.044*
	(0.022)	(0.010)	(0.012)	(0.019)	(0.025)	(0.021)	(0.017)	(0.019)
URM	−0.102	0.096**	0.063 +	−0.109 +	−0.261***	0.062	0.001	0.054
	(0.066)	(0.030)	(0.035)	(0.056)	(0.075)	(0.063)	(0.051)	(0.057)
Gender	0.003	0.015**	0.010 +	−0.038***	−0.036**	−0.021*	−0.008	−0.014
	(0.011)	(0.005)	(0.006)	(0.009)	(0.012)	(0.010)	(0.008)	(0.009)
STEM	0.019	0.029	0.038	−0.036	−0.025	0.075	−0.023	0.090 +
	(0.044)	(0.025)	(0.028)	(0.064)	(0.061)	(0.059)	(0.054)	(0.050)
Advisor Guidance	−0.076***	−0.021**	−0.040***	0.091***	0.118***	0.105***	0.052***	0.095***
	(0.017)	(0.008)	(0.009)	(0.015)	(0.019)	(0.016)	(0.013)	(0.015)
Campus Climate	−0.081***	−0.100***	−0.087***	0.197***	0.097***	0.161***	0.183***	0.197***
	(0.021)	(0.010)	(0.011)	(0.018)	(0.024)	(0.020)	(0.016)	(0.018)
Structure (Level-1) × Structure (Level-2)	−0.090 +	−0.027	−0.037	0.142**	0.030	−0.019	0.029	0.090 +
	(0.049)	(0.023)	(0.043)	(0.053)	(0.057)	(0.046)	(0.043)	(0.047)
Num.Obs	1181	1174	1172	1199	1194	1188	1153	1076

Standard errors within parentheses

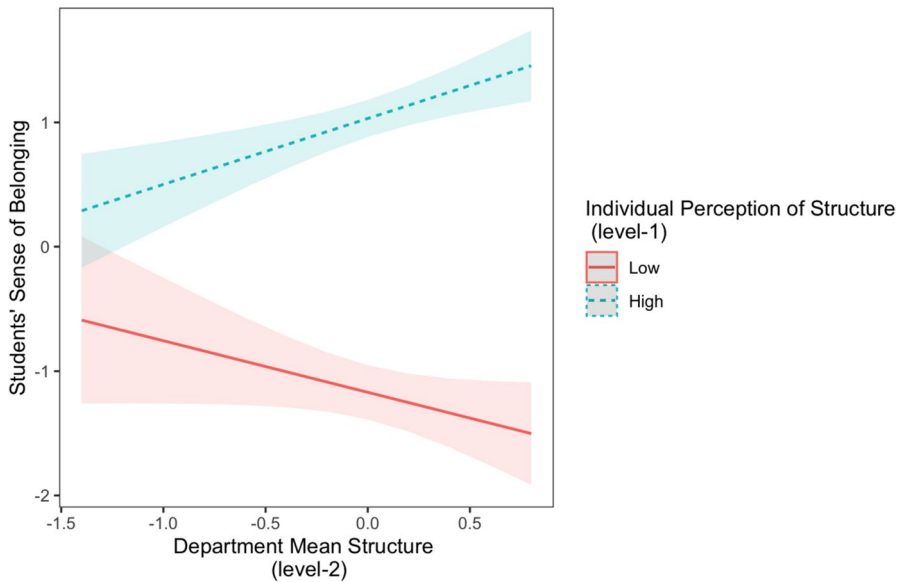● $+ p < 0.1$, $* p < 0.05$, $** p < 0.01$, $*** p < 0.001$

Fig. 1 Cross-level interaction effect of program structure on graduate student sense of belonging

less likely to experience mental health problems and more likely to report higher levels of belonging and shared vision. For example, in Fig. 1, the simple interaction analysis of belonging showed that the slope of department mean structure (level-2) was negative at lower level of individual perception of structure (level-1) and positive at higher level of individual perception of structure (level-1), meaning that department-level structure has different effects depending on students' individual perceptions. Students who personally perceive high structure in their program experience belonging benefits. However, students who perceive low structure individually may feel even more alienated in departments with higher average structure scores, possibly due to a disconnect between their personal experience and the department's overall environment.

Interactions Between Program Structure and Demographic Variables

Additionally, interaction terms between structure and demographic variables (gender, race, SES) were added to test whether demographic variables moderate the effect of structure (either at level-1 or level-2) on various outcomes. That is, whether the effect of structure on various outcomes differs by identity membership group. For gender, significant interaction was found between level-2 structure and gender on shared vision. For race, significant interactions were found on identity exclusion (both with level-1 structure and level-2 structure), bullying (with level-1 structure), and job productivity (with level-2 structure). As shown in Fig. 2, the effect of department mean structure was stronger for URM students than non-URM students, represented by the steeper slope for URM students. That is to say, when URM
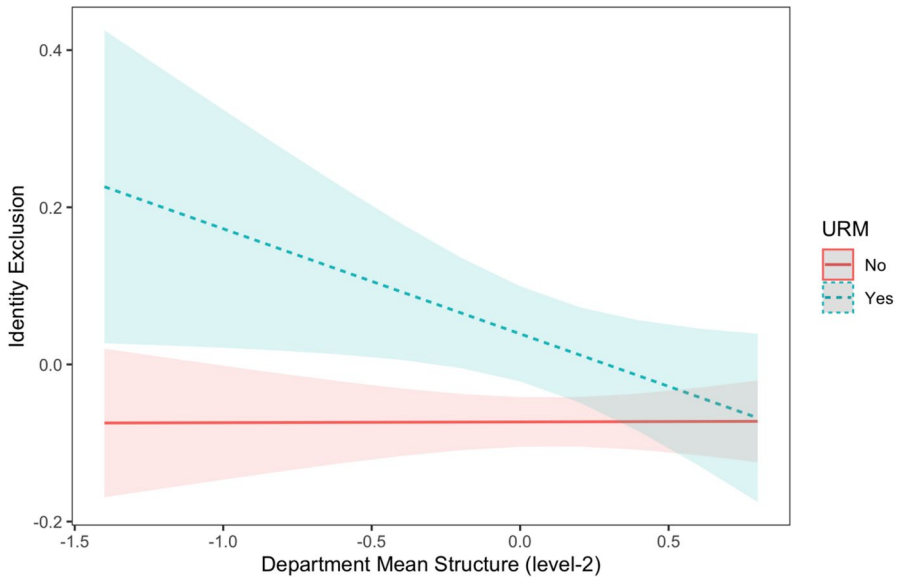
Fig. 2 Interaction effect between level-2 structure and race on student identity exclusion

students are in departments with low structure, they are more vulnerable and more like to experience identity exclusion than non-URM students. However, when URM students are in departments with high structure, they appear to experience the same level of identity exclusion as their non-URM counterparts. The results can be interpreted similarly for bullying and job productivity, which means that URM students suffer more when they are in departments with low structure, but they benefit more when they are in departments with high structure. For SES, significant interactions were found on identity exclusion (with level-2 structure), belonging (with level-2 structure), bullying (with level-2 structure) and collaboration (with level-1 structure). However, as with the main effect of SES, results were not as consistent in directions as with gender and race.

Discussion

The purpose of this research was to gain a better understanding of the influence of program structure in graduate education. In particular, we hoped to uncover whether program structure may advance equity through impacting people with different identities differently. The results of the present study support our hypotheses that program structure has a significant effect on individual outcomes in graduate education. Specifically, there are three key overarching findings in this paper. First, program structure is positively related to psychological well-being (as measured by frequencies of identity exclusion, mental health issues, bullying, feeling of belonging) and academic performance (as measured by job satisfaction, job productivity, shared vision, and collaboration). Second, in almost

all the outcome variables we examined, both individual perception of structure and department-level structure affect individual outcomes. Third, cross-level interaction between level-1 and level-2 structure sometimes exists, and so does interaction between structure and demographic variables.

The results of the positive and significant influence of program structure on individual outcomes are consistent with previous research in higher education. For instance, our findings further contribute to the existing literature in higher education by providing supporting evidence that structure in graduate programs are associated with positive student outcomes and well-being. The pattern of the results is also consistent with previous studies concerning graduate students (e.g., Fisher et al., 2019; Gardner, 2007; Overall et al., 2011).

More importantly, our results present the first direct demonstration that both individual perception of structure and department-level structure play a significant role in affecting individual outcomes. Past research concerning structure in higher education often approaches structure using individual-level self-report data, neglecting the potential effect of department-level structure. Our findings, on the other hand, highlight the importance of department-level structure, which strongly implies that individual outcomes can be improved by uniformly setting clear expectations, guidelines, and support, even if sometimes individuals may not be fully aware of the program structure (as evidenced by the cross-level interaction). This has significant policy implications and can be extremely useful in informing how academic departments design their programs and environments.

Additionally, it is interesting and important to note that we obtained some evidence on the interactions between structure and demographic variables. One interpretation of such a finding is the notion of attributional ambiguity (Crocker et al., 1991; Mendes et al., 2008). Attributional ambiguity describes the difficulty that stigmatized groups (e.g., URM or female students) face when attributing treatment or outcomes to their own competence versus discrimination. That is to say, some groups may suffer more when situations are ambiguous or uncertain, which can be exactly the case when organizations or academic programs lack structure. In our study, we presented evidence that URM students or female students claimed better psychological well-being and academic performance when program structure (either level-1 or level-2 structure) was high, which is consistent with what suggested by the lens of attributional ambiguity.

While the focus of this study was on higher education, it is worth noting that these findings may have implications for other organizational contexts as well. In fact, a parallel study we conducted in workplace settings yielded similar results, where organizational structure was found to be positively associated with psychological well-being, psychological safety, and organizational inclusive climate (Wu et al., in preparation). Importantly, these effects were observed at both the individual and team levels, mirroring our findings in the higher education context. This parallel finding suggests that structural interventions aimed at providing clear, transparent, and uniformly applied standards and expectations may be a powerful tool for advancing equity and diversity work more broadly.

Limitations

Although the present results provide clear evidence of the significant and positive impact of program structure on equity-related outcomes in graduate education, it is important to acknowledge several potential limitations. A first limitation concerns the measurement of our variables. Relying on a secondary dataset constrained by the nature of the survey limits our ability to use questions specifically designed to measure relevant variables. For example, our index of the independent variable—program structure—may not capture all relevant aspects of program structure, even though we obtained a reliable Cronbach's alpha for this variable. Similarly, our outcome variables are constrained by availability of data in the secondary dataset. Some of the potential factors that might impact the relationship we examined, such as master's versus doctoral level and student funding availability, were also not available in the dataset. A second potential limitation is the aggregation of African Americans, Hispanic Americans, American Indians, Alaska Natives, Native Hawaiians, Pacific Islanders, and multi-races into one underrepresented minority (URM) group in the study. This choice of aggregation was driven by theoretical considerations, as attributional ambiguity theory differentiates majority from minority groups without further disaggregation, as well as practical concerns related to sample size, which allowed for inferential analysis. Notably, this aggregation is by no means intended to suggest that these groups are identical or that there are no meaningful differences among them. Rather, this approach should be seen both as a potential limitation of our study and as a reminder that U.S. higher education must be intentional in developing talent among a more diverse pool of graduate students. Future research could address this limitation by examining each racial group separately. Additionally, exploring the intersectionality of race and gender may offer further insights. Lastly, the cross-sectional nature of our data limits causal inferences, and the mechanism through which program structure influences equity-related outcomes was beyond the scope of the current research. Future research should consider using longitudinal data to establish more reliable inferences and explore potential mechanisms.

Implications and Recommendations

Despite some limitations, the results from this research suggest several theoretical and practical implications. First of all, associations between structure and demographic variables warrant more attention in future research and may benefit from further theoretical-driven hypothesis testing. Our results of significant interactions between structure and gender, race, and SES suggest that attributional ambiguity may play a role on equity-related outcomes, and we feel that further research that specifically addresses the effect through the lens of attributional ambiguity might shed light on research on racial and gender disparities in graduate education. Moreover, meta-analyses of existing literature devoted to organizations or graduate programs and identity-based groups' experiences would also help guide future study in this area. Furthermore, instruments designed specifically to assess other facets of structure in graduate education would be a welcome addition to the literature in

this area. Program structure in graduate education carries more than just a set of clear expectations and guidelines, but also clear communication channels, appropriate support, and agreed-upon norms. Therefore, a designated instrument that specifically measures structure is warranted. We hope that our study will stimulate further investigation of this important area.

More importantly, results from our research have heightened awareness so that graduate programs can identify and address potential barriers to success for their students. This is extremely critical given that our results point out that both individual perception of structure and department-level structure matter when it comes to individual outcomes. There are also a number of actions that graduate programs can take to provide better structure for students:

Create Clear Expectations

Graduate programs can provide better clarity for students by creating a detailed program handbook that outlines the requirements for each course, the grading system, and the evaluation process. The handbook should be easy to understand and accessible to all students. This can help to reduce stress and anxiety, as students will know what is expected of them and how they will be evaluated. Besides providing a program handbook, clear expectations can also be set by hosting a new student orientation, laying out specific requirements and preparation guidelines for comprehensive exams and annual progress review.

Ensure Faculty Support

Graduate programs can provide supportive faculty by asking faculty members to be available to meet with students regularly to discuss their progress, provide feedback, and answer questions. Faculty members should also be willing to help students navigate through their graduate education journey. This can help students to feel supported and motivated, and it can also help them to develop the skills they need to succeed in their program.

Standardize Treatment

Because students from stigmatized groups may encounter difficulties in accurately attributing feedback, outcomes, and progress, inadvertently activating harmful effects stemming from attributional ambiguity, graduate programs should therefore apply uniform and standardized treatment to all student populations, avoiding any potential ambiguity and unfairness. This can include professors applying standards evenly across all students, and departments distributing important information and opportunities relevant to academic success (e.g., guest lectures, seminars) to all students equally. Rather than standardizing treatment in a way that ignores the inherent diversity of graduate education, departments should strive for transparent consistency within relevant contexts. Graduate education, particularly at the doctoral level, encompasses significant heterogeneity in funding arrangements

(grant-funded assistantships, departmental funding, fellowships, self-funding), research approaches, and degree requirements.

Implement Regular Feedback Mechanisms

Establish regular feedback mechanisms where students can voice their concerns and suggestions about the program. This can help departments to continuously improve their organizational processes and address any issues that may be disproportionately affecting certain groups of students.

For program structure to effectively advance equity, clear accountability mechanisms must be established. Department chairs bear primary responsibility for establishing and maintaining clear expectations, ensuring faculty provide consistent mentorship, and addressing instances where structural elements break down. However, accountability should extend beyond department leadership. Individual faculty members must take responsibility for consistently applying departmental standards in their interactions with all students. At the institutional level, graduate divisions and diversity offices should provide oversight through regular assessment of departmental practices via climate surveys and program reviews. This multi-level approach to accountability creates a system of checks and balances that helps ensure structural improvements are sustained and equitably benefit all students.

Conclusion

In conclusion, this study highlights the critical role of structure in promoting equity in graduate education. By implementing clear, transparent, and uniformly applied standards and expectations, higher education institutions can create environments where all students, particularly those from marginalized groups, can thrive academically and personally. Future research should continue to explore the nuances of how structure impacts different student populations and how it can be optimized to create more equitable educational outcomes.

Declarations

Competing interests The authors declare that they have no conflict of interest.

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Jue Wu Jue Wu is an Assistant Professor in Higher Education Administration and Policy at the University of Florida. Before joining UF, she was a postdoctoral scholar at the University of California, Berkeley. She obtained her Ph.D. in Learning Sciences and her M.S. in Statistics from Northwestern University. Her research focuses on addressing diversity and educational disparities in STEM higher education. Her work not only examines models of college student learning for underrepresented populations in STEM, but also investigates organizational and structural inequities that hinder the success of underserved populations in STEM.

Laura Guzman Laura Guzman is a postdoctoral researcher at UC Berkeley, where she also earned her Ph.D. in social and personality psychology. Her research focuses on two main areas. First, she investigates how culture shapes well-being—both by influencing ideas of flourishing and by shaping experiences of self-transcendent emotions—and how these emotions contribute to individual and collective flourishing. Second, she examines barriers to opportunity and success faced by individuals from historically underrepresented groups.

Colette Patt Colette Patt is the assistant dean for academic success at the College of Computing, Data Science, and Society (CDSS) and also serves as an assistant dean at the Mathematical & Physical Sciences Division (MPS) at the University of California, Berkeley. Her scholarly work focuses on academic life and institutional change in higher education. Patt received her bachelor's degree in English and women's studies in 1985 and her Ph.D. in social and cultural studies in education at UC Berkeley in 1995.

Andrew Eppig Dr. Eppig is the inaugural Director of Equity Data Initiatives in Equity & Inclusion at UC Berkeley. He oversees institutional research to understand and eliminate inequalities in higher education. His work encompasses program assessment and evaluation; survey design and analysis; demographic data collection and reporting methodology; and institutional data governance and infrastructure. Andrew has a PhD in Physics from the University of Michigan where he worked on high energy experimental particle physics at the ATLAS experiment at CERN and the CDF experiment at Fermilab.

Rodolfo Mendoza-Denton is professor of psychology at the University of California, Berkeley. He received his BA from Yale University and his PhD from Columbia University. Mendoza-Denton's professional work covers stereotyping and prejudice from the perspective of both target and perceiver, intergroup relations, as well as how these processes influence educational outcomes.