Sex Roles (2022) 86:208–232
https://doi.org/10.1007/s11199-021-01262-1

ORIGINAL ARTICLE

"*I can't push off my own Mental Health*": Chilly STEM Climates, Mental Health, and STEM Persistence among Black, Latina, and White Graduate Women

Kerrie G. Wilkins-Yel[1] · Amanda Arnold[2] · Jennifer Bekki[2] · Madison Natarajan[1] · Bianca Bernstein[2] · Ashley K. Randall[2]

Accepted: 15 November 2021 / Published online: 21 January 2022
© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2021

Abstract
Drawing on 12 semi-structured interviews with Black, Latina, and white graduate women who either continued or discontinued their STEM doctoral degrees, the present study examined the psychological impact of navigating marginalizing experiences in white male-dominated STEM environments. Using thematic analysis grounded in a social constructivist paradigm, researchers identified three emergent themes: 1) institutional challenges as contextual barriers, 2) impact on wellbeing and STEM persistence, and 3) contextual supports and coping. These findings indicate that challenging STEM encounters within the higher education environment contributed to increased stress, depression, anxiety, and suicidal ideation among graduate women in STEM from diverse racial/ethnic backgrounds. The compound effect of these STEM stressors and their subsequent psychological toll contributed to decreased STEM persistence among participants. Study implications highlight the need for faculty and university administrators to challenge and address institutional norms that operate as contextual barriers, destigmatize discussions surrounding mental health, and adopt a "whole person" approach to supporting graduate women in STEM.

Keywords Mental health · STEM · Graduate · Doctoral · Women · Women of color · Persistence

"*I can't push off my own Mental Health*": Chilly STEM Climates, Mental Health, and Stem Persistence among Black, Latina, and White Graduate Women

Graduate students are six times as likely as the general population to meet the clinical criteria for depression and anxiety (Evans et al., 2018; Garcia-Williams et al., 2014; Okahana, 2015). In fact, more than 39% of graduate students endorsed experiencing moderate to severe depression and 41% of graduate students reported experiencing symptoms of anxiety (Evans et al., 2018). Moreover, 10% of graduate students reported that they considered suicide during the prior 12 months (Louden & Skeem, 2008). Graduate students in science, technology, engineering, and mathematics (STEM) disciplines appear to be at an especially high risk for experiencing mental health concerns (Deziel et al., 2013; Saravanan & Wilks, 2014; UC Berkeley Graduate Assembly, 2014), with one study showing that 43–46% of graduate students in the Biosciences experienced depression during their graduate studies (UC Berkeley Graduate Assembly, 2014). Not only is this disconcerting for the health and wellbeing of graduate students, but these mental health concerns also have large-scale implications for STEM advisors, professors, and university administrators, including reduced research output, significant financial cost to institutions and research teams, and adverse impacts to efforts to broaden participation in STEM due to students discontinuing doctoral pursuits prematurely (Golde, 2005; Levecque et al., 2017; Nagy et al., 2019; Posselt, 2018).

Precipitated by events such as the loss of students to suicide, the focus on graduate student mental health within the STEM environment has become increasingly salient among university administrators (Evans et al., 2018; Nature, 2019; Posselt, 2020). Studies such as Nagy et al. (2019) illustrate the extent to which doctoral students in

✉ Kerrie G. Wilkins-Yel
kerrie.wilkins@umb.edu

[1] University of Massachusetts at Boston, Boston, USA

[2] Arizona State University, Tempe, USA

STEM experience high levels of burnout, depression, and anxiety, resulting in thoughts of discontinuing their doctoral pursuits. These reports are particularly concerning because only a subset of students receive mental health services (Hyun et al., 2007; Mousavi et al., 2018). Reports such as the National Academies of Sciences (2018) recommend greater support for graduate student mental health, and efforts to eliminate existing power structures that may cause undue stress to students. Similarly, Suzanne T. Ortega, President of the Council of Graduate Schools (CGS) regarded mental health as "a high-priority issue for CGS and the graduate education community more broadly" (Council of Graduate Schools, 2019). Likewise, Evans et al. (2018) put forth several calls to action for departments and administrators to address the growing mental health crisis plaguing STEM graduate education.

Calls for action are especially salient for women in STEM, with evidence suggesting higher levels of stress, anxiety, and lower overall mental health in comparison to their male counterparts (Deziel et al., 2013; Saravanan & Wilks, 2014). Not only do graduate women in STEM navigate the rigor of STEM programs, they must do so while also contending with a myriad of institutional barriers (i.e., structural biases, sexism) and unsupportive environments (Bernstein, 2011; Wilkins-Yel et al., 2019c). Notably, these barriers are more pronounced for Women of Color (WOC) in STEM. Women who hold racially/ethnically minoritized identities (i.e., Latina, Black, Indigenous, and Asian women) frequently report experiencing rampant acts of sexism and racism, including harassment and microaggressions in STEM (McGee, 2020; Ong et al., 2018; Wilkins-Yel et al., 2019b). These negative interpersonal interactions have been shown to heighten feelings of isolation, decrease feelings of belonging, and increase intentions to discontinue STEM graduate programs (Ong et al., 2018).

Yet, there is a dearth of research that has examined the psychological consequences of the STEM environment and their impact on STEM persistence (i.e., persistence to degree completion within a STEM doctoral program). To date, UC Berkeley Graduate Assembly (2014) is the only university known to have extensively examined and published data related to mental health in the context of the STEM climate. Similarly, few studies have examined the experiences of graduate women in STEM using an intersectional approach, especially as it relates to mental health and academic persistence. As such, the focus of the current study was twofold. First, we sought to understand the ways in which challenges experienced within the STEM graduate programs influenced the mental health and STEM persistence of U.S. based STEM graduate women from diverse racial/ethnic backgrounds. Second, we sought to understand the institutional sources of support that mitigated the psychological toll of these STEM challenges.

Theoretical Framework: Intersectionality and Social Cognitive Career Theory

Two theoretical frameworks served as the underlying foundation for this work: the intersectionality framework (Collins, 2002; Crenshaw, 1990) and social cognitive career theory (SCCT; Lent et al., 1994). For more than three decades, Black feminist scholars have consistently noted that people's lived experiences are shaped by interlocking systems of oppression (e.g., sexism and racism) (Combahee River Collective, 1977). In 1990, Kimberlé Crenshaw coined the term *intersectionality* to make explicit the nuanced ways in which marginalization is rooted in dynamics of difference and sameness with regards to axes of power and privilege. Collins (1990, 2000) further characterized intersectionality as a 'matrix of oppression' to highlight the ways in which socially constructed structures such as race, class, and gender disadvantage those who are multiply marginalized (e.g., WOC) and bestows advantages to those who are at the top of these hierarchies. WOC, individuals who hold intersecting identities as both women and People of Color, must simultaneously navigate a myriad of race- and gender-based experiences in STEM because these milieus remain largely dominated by white, heteronormative, continuing generation, and economically privileged men (McGee, 2020; Wilkins-Yel et al., 2019a). This intersectional experience is aptly captured in the following statement by a Black woman in computing who stated, "as far as being a woman, I don't think they expect too many women to be in that area; as far as being a [B]lack woman, they don't expect you to be there at all" (Varma et al., 2006, p. 310). Despite these calls to focus on people's intersecting identities, women in STEM have historically been examined as a monolith, without any regard to how gender is raced in STEM. To address this pervasive erasure, we adopted an intersectional approach (McGee, 2021) to investigate the ways in which STEM climates differentially impact the mental health and STEM persistence of WOC and white women in STEM doctoral programs.

In addition to intersectionality, this study draws on SCCT because of its theoretical focus on examining the factors that influence academic persistence. SCCT characterizes structural barriers and supports as contextual factors that contribute to constraining or enhancing educational and career progress (Lent et al., 1994). In line with SCCT, we regard marginalizing encounters or encounters that delegitimize WOC's credibility in STEM as contextual barriers that manifest themselves through structural racism and sexism within the STEM higher education environment. We posit that these contextual barriers contribute to increased psychological distress and that this decreased mental health stymies graduate women's STEM persistence. On the other hand, SCCT posits that

contextual supports such as support from advisors, peers, professors, and/or university staff, may mitigate the effect that both contextual barriers and the corresponding psychological toll levy on graduate women's STEM persistence intentions. SCCT has received extensive empirical support on samples of women and Students of Color in STEM (e.g., Byars-Winston et al., 2010; Lee et al., 2015; Navarro et al., 2014). To date, the psychological consequences from navigating negative STEM milieus has not been examined as a mechanism through which contextual barriers impact academic persistence within the context of SCCT. Consequently, the current examination represents an extension of this theoretical approach. In keeping with SCCT's emphasis on persistence, we sought to understand the psychological costs of contextual barriers and the mitigating role of support among graduate women who chose to discontinue their STEM doctoral studies and those who chose to continue to degree completion.

Contextual Barriers in STEM and Associations with Mental Health

There is growing evidence to suggest that chilly STEM climates are key contributors to heightened psychological distress among graduate students (Arnold et al., 2020a; Evans et al., 2018; Posselt, 2020). This association is consistent with a model of threatening academic environments proposed by Inzlicht et al. (2009), who suggested that a negative campus climate and social identity threats existing within STEM may heighten psychological disengagement, perceived lack of control, and decreased self-esteem for underrepresented groups (Casad et al., 2018). STEM departments and laboratories have historically been regarded as unsupportive and unwelcoming for Black, Latina, Asian, and white women (Alexander & Hermann, 2016; Barthelemy et al., 2016; Bernstein, 2011; Castro & Collins, 2021; Ong et al., 2011; Wilkins-Yel et al., 2019b). The climates within these spaces are often rife with systemic racism and sexism, and typically perpetuate a dominant white and masculine hegemony characterized by competitiveness and individualism (Dutt, 2020; Edge, 2020; Hurtado & Figueroa, 2013). These STEM climates exclude, isolate, and other students from minoritized backgrounds, which, in turn, heightens depressive symptoms and lowers science performance (Settles, 2004; Settles et al., 2009).

WOC, women who reside at the intersection of marginalized gender and racial/ethnic identities, must contend with the multiplicative toll of both gendered and racialized encounters in chilly STEM milieus. These include experiences of both gendered and racialized microaggressions (Barthelemy et al., 2016; Charleston et al., 2014; McGee, 2020; Wilkins-Yel et al., 2019b). Although gender and racial microaggressions are subtle forms of sexism and racism, respectively, we have chosen to use these terms interchangeably to simultaneously call attention to the larger structural barriers affecting students while also staying true to how participants describe their lived experiences. Black women reported that microaggressions had a magnified effect on their mental health because of the dual dilemmas of their gendered and racialized underrepresentation (Brown et al., 2015). One participant explained the double bind by saying, "It's not just a racial issue but also an issue of sex" (Brown et al., 2015, p. 167). Similarly, Latina women report experiencing racism and sexism within academia, including isolation and alienation, microaggressions, and lower expectations of one's capabilities (Camacho & Lord, 2011; González, 2007; Solórzano, 1998). O'Brien et al. (2016) found that interpersonal discrimination within STEM academic settings increased students' perceived stress, thereby worsening their academic performance. Similarly, greater experiences of ostracism and incivility among early-career women in STEM, especially those perpetrated by male colleagues, were linked to negative psychological outcomes (Miner et al., 2019).

Extant research in psychology links marginalizing encounters to a myriad of negative mental health outcomes, including increased life stress, anxiety, depression, and suicidal ideation (Bernard et al., 2017; Hwang & Goto, 2009; Torres et al., 2010). Within STEM, experiences of marginality and the accompanying psychological toll likely contribute to the significant attrition among women in STEM. Research shows that the seven-year attrition rate is 34% for WOC in STEM, including half of those withdrawing from their doctoral studies in the first two years of their program (Sowell et al., 2015). Given the relatively nascent nature of examining mental health in STEM, more work is needed to understand the ways in which STEM climates differentially impact the mental health and STEM persistence of both WOC and white women as well as women who chose to discontinue and those who chose to continue their STEM doctoral pursuits.

Buffering Effects of Contextual Supports

Extensive literature on stress and coping from social and health psychology fields supports the mitigating role of support in combating the impact of psychological distress and difficult life experiences (e.g., Cutrona & Russell, 1987; Uebelacker et al., 2013; Van der Doef & Maes, 1999). Within academic settings, support has been linked to greater academic performance (DeBerard et al., 2004), academic satisfaction (Lent et al., 2007), and intentions to persist (Nicpon et al., 2006). Support from advisors and mentors especially is a key factor in reducing the negative effects of contextual, institutional barriers (Bernstein et al., 2010; Lovitts, 2001; Primé et al., 2015). For example, in a sample

comprised of more than 30% graduate students in STEM, O'Brien et al. (2016) found that support from advisors/supervisors lessened the effect of interpersonal discrimination on perceived stress. Similarly, in Posselt's (2018) study of STEM doctoral students from minoritized backgrounds, participants reported that advisor support was especially meaningful in normalizing struggle and navigating challenges related to one's social identities, including race and gender. Kram (1983), and more recently Sheehy (2019), identified two types of advisor support: *instrumental* (i.e., direct, active, material, and operational assistance such as providing financial help or giving practical dissertation advice) and *psychosocial* (i.e., providing encouragement, affirmation, recognition, comfort, and empathy, related to academic, career, or personal domains). Both types of advisor support have been found to be important in promoting graduate women's STEM persistence (Dawson et al., 2015; Posselt, 2018).

In addition to social support from advisors, support from other institutional resources (e.g., university staff, counseling centers) has also been found to be helpful in promoting mental health and STEM persistence (Grandy, 1998; Ong et al., 2018). Support spaces outside of the academic department – including student organizations and institutional offices that serve students from minoritized communities – provide an outlet for students to discuss both personal and professional concerns and share struggles without fear of being viewed as incompetent (Ong et al., 2018). These spaces are often referred to as *counterspaces*. Case and Hunter (2012) regarded the creation and use of counterspaces as a form of adaptive responding – "the process by which marginalized individuals maintain psychological well-being despite oppressive conditions" (p. 259). Rosenthal et al. (2011) found that support from same-gender counterspaces for women in STEM promoted feelings of belonging, which, in turn, has been found to increase psychological wellbeing (Hoyle & Crawford, 1994).

Another example of a non-academic counterspace is the University Counseling Center (UCC). Several studies have demonstrated the salience of UCCs as a source of support for graduate students experiencing psychological distress (Arnold et al., 2020b; Hyun et al., 2007). Reports suggest that women traditionally seek counseling services at higher rates than men (Hyun et al., 2007; Mojtabai, 2007; Oliver et al., 2005). However, an intersectional examination highlights the ways in which this trend may differ for WOC (Collins & Bilge, 2016; Crenshaw, 1991; Ong et al., 2011). WOC must contend with cultural stigmas about mental health, navigate therapists' lack of cultural understanding (Thompson et al., 2004), and counteract cultural messages such as the "strong Black woman" trope, which requires Black women to be strong, tenacious, and put others' needs before their own (Watson & Hunter, 2016a, b). Pressure to conform to this expectation creates an additional barrier to Black women's help seeking, despite evidence that this schema contributes to increased psychological distress and decreased self-esteem (Abrams et al., 2019; Donovan & West, 2015; Stanton et al., 2017; Watson & Hunter, 2016a, b). Further, WOC might be less inclined to engage in help-seeking behaviors out of concern that others may perceive these actions as additional evidence to discount their credibility and capability to succeed in STEM. While mental health services have been shown to promote well-being and academic persistence, institutional and cultural barriers may prevent students from obtaining the support they need.

An abundance of research illustrates the buffering effect of social support on the association between negative interpersonal interactions and negative mental health and academic outcomes (Hyun et al., 2006; Mallinckrodt & Leong, 1992; O'Brien et al., 2016; Ong et al., 2018; Primé et al., 2015). Whether support originates from within the academic department (e.g., advisors, mentors, peers) or other institutional settings (e.g., UCCs), the receipt of support during times of distress has been shown to mitigate the psychological cost, and related persistence decisions, that results from negative encounters within the STEM environment. However, more work is needed to understand the departmental and institutional supports used by doctoral WOC and white women in STEM to buffer the price of navigating negative STEM climates.

The Present Study

The purpose of the present study is twofold. First, we sought to understand the ways in which STEM climates may impact the mental health and STEM persistence of graduate women in STEM doctoral programs. Second, we examined the sources and types of departmental and institutional support that doctoral women sought to mitigate the psychological toll of navigating negative STEM climates. Given the extensive efforts to broaden STEM participation among women in STEM, the work presented here is important to increasing our understandings of the ways in which psychological distress might be an invisible but salient byproduct of chilly STEM climates that undercuts efforts to promote persistence.

Method

Participants

The current study draws on a sample of 12 doctoral women in STEM, six of whom discontinued their STEM doctoral programs before completing and six of whom completed their STEM doctoral programs. Eligible participants were women who identified as Black and/or Latina, and/or white

and who met one of the following two criteria: 1) chose to prematurely leave their STEM doctoral program within three years of the data collection (i.e., since 2015), or 2) completed their STEM doctoral program within three years of data collection (i.e., since 2015). The date of 2015 was selected on the basis of providing a three-year retrospective window from the time of data collection in 2018, which the research team felt would be recent enough for participants to recall the specific details of their experiences in their respective STEM programs. The 12 participants attended eight different universities from across the United States and represented eight STEM disciplines. Participants identified as Black American ($n=2$), Latina ($n=2$), white ($n=5$), and as Bi/Multi-racial ($n=3$). Additional participant demographic information is given in Table 1.

Procedures

Participants who completed their degrees were recruited using email and social media posts at academic departments, professional associations, STEM organizations serving minoritized students, professional listservs, and alumni networks. Participants who discontinued their PhD programs were recruited using snowball sampling, referrals from academic departments, emails, and social media posts to professional networks. Recruitment fliers invited eligible participants to reflect on the instances of interpersonal support they experienced or would like to have experienced while in their STEM PhD program and described the process for participation, including that all participants would receive a $50 gift card upon completion of their study activities.

Participants first completed a screening and demographic survey to determine eligibility and collect background information. After completing this survey, eligible participants then took part in a 60 to 120-min semi-structured interview (average 82-min in length) using the Zoom video conferencing platform. Interviews were led by one of the following research team members: faculty PIs on the research project, graduate student research assistants in counseling psychology, or a full-time research staff member with a background in higher education and public policy. Among the interviewers were women who identified as Black, Latina, and white. Given that the data that was collected was culturally sensitive and potentially difficult for research participants to talk about, the cultural knowledge of the researcher was especially important (Razon & Ross, 2012; Tillman, 2002). Correspondingly, wherever possible, the race/ethnicity identity of participants was matched to that of the interviewer.

The interview protocol had five questions and related probes designed to elicit participants' perceptions of support episodes in response to challenging experiences during their STEM doctoral programs. Supporting probes included questions such as "Did you talk to anyone about it then? If so, to whom?" and "How was this helpful/not helpful to you?" Participants were also asked about the role of various social identities in their perceptions of support, with the probe, "In what ways do you think gender, race, ethnicity or other identity aspects played a role in whom you talked with/what they said?".

A commercial transcription service was used to transcribe interviews, and member checking was conducted to allow participants to add additional comments, redact any portion of the interview, or clarify any statements they made during their interview. This participant check adds credibility to the research process (see Morrow, 2005).

Positionality Statement

The data analysis and writing team consisted of the first five authors of this study. The first author identifies as a Black

Table 1 Participant Demographic Information

Pseudonym	Race/Ethnicity	CTC/CTD[a]	Degree Field	Institutional Carnegie Classification	Institutional Region of the United States
Bethany	White	CTC	Engineering	Very High	Southeast
Felicia	Black	CTC	Mathematics	High	Southeast
Fernanda	Latinx, White	CTC	Engineering	Very High	Southwest
Kathleen	Black, Biracial	CTC	Biological Sciences	Very High	Northeast
Monique	Black, Latinx	CTC	Engineering	Very High	Northeast
Emma	White	CTC	Biological Sciences	Very High	Southwest
Ashley	Black	CTD	Engineering	Very High	Northeast
Diane	White	CTD	Physical Sciences	Very High	West
Emily	White	CTD	Physical Sciences	Very High	Southwest
Sofia	Latinx	CTD	Biological Sciences	Very High	Northeast
Alejandra	Latinx	CTD	Mathematics	Very High	Southwest
Bahar	White	CTD	Engineering	Very High	Southwest

[a]CTC—Chose to Complete; CTD—Chose to Discontinue

immigrant woman who is an Assistant Professor in counseling psychology. Her positionality was informed by her experiences as Black woman working and residing in predominantly white spaces, her expertise as a trained counseling psychologist, and her intersectional approach to promoting holistic persistence among graduate WOC in STEM. The second author identifies as a white cisgender woman who is a master's level counselor and doctoral student in counselor education. Her experience in the mental health field, specifically related to trauma and interpersonal violence, informs her understanding of systemic factors that influence psychological wellbeing. The third author is an Associate Professor in engineering and engineering education who identifies as a white woman. Her PhD is in engineering, and she brings this to the work on this manuscript, along with years spent researching the experiences of and trying to promote persistence among women in STEM doctoral programs. The fourth author is a clinical mental health counselor and current doctoral student in Counseling Psychology who identifies as a biracial Woman of Color. She brings her past experience working on diversity, equity, and inclusion initiatives in STEM professional environments to her work on this manuscript. The fifth author is a senior faculty member in counseling psychology whose identities as a white, immigrant, intersectional feminist, and first-generation college graduate, along with specializations in counseling women, persistence of women in STEM, and graduate education reform, and past professional work with largely minoritized populations, inform her perspectives on the interpretation and implications of this study. Collectively, the team brought to the analysis a strong belief in the importance of mental health as well as a prior understanding of the ways the STEM environment can be hostile to women, People of Color, and WOC. All five members of the analysis team also share the identity of women who pursued and/or completed graduate studies and have familiarity with the ways in which stressors that occur in graduate education can influence mental health. A strength of the team is its interdisciplinarity, including representation and expertise from fields in both mental health and STEM. We believe this strength helped promote multiple ways of looking at the experiences shared by participants and helped manage the prior understandings we brought to the data analysis activities.

Analytic Approach

The thematic analysis (Braun & Clarke, 2006) conducted for this work was grounded in a combination of post-positivist and social constructivist paradigms. A constant-comparative, open coding process was used to identify meaningful statements within the data that represented each code (Glaser, 1965; Saldaña, 2015). First, open coding of the transcribed interviews was conducted to identify meaningful units of data related to mental health challenges in the STEM environment from across the transcribed interviews with participants. Second, pattern coding was used to organize these meaningful units into themes along three dimensions: (a) institutional norms that served as contextual barriers within the STEM environment, (b) impact of these difficulties on students' mental health and/or persistence decisions, and (c) coping strategies implemented, and institutional support provided to counteract the effects of these difficulties. The organization of these themes formed the basis of the codebook for this study. Table 2 provides the codes contained within each theme, along with the definition, a sample quote, and the total frequency of occurrence for each code across all participants. Additionally, during independent coding, research team members participated in memoing and were mindful of ways that their own identities influenced their interpretation of the data.

Transcripts were de-identified to maintain participant confidentiality prior to being uploaded for analysis. The research team utilized Dedoose, a web-based data analysis application, to support coding and analysis of the interview data. To establish interrater reliability between the coding members of the research team, Krippendorff's alpha (α) was calculated based on coding a subset of three transcripts using the KALPHA SPSS macro (Hayes & Krippendorff, 2007). Krippendorff's α measures the degree of reliability in the application of a code to each individual unit of data on a scale of 1.00 (perfect reproducibility of results across coders) to 0.00 (absence of reproducibility across coders). Krippendorff (2004) indicates that values of $\alpha \geq 0.80$ are customary, and that when tentative conclusions are still acceptable, $\alpha \geq 0.67$ can be used. For the findings reported here, $\alpha > 0.67$ were determined to be acceptable. As illustrated in Table 4, the alphas reported in the current study ranged from 0.74 to 0.96. Using 1000 bootstrapped samples, the probability, q, of failing to achieve a reliability of at least 0.67 was also calculated for each code, and q values less than 0.05 were considered acceptable. For codes that did not have sufficient Krippendorff's α values, the coding team discussed their interpretations of the data and application of the code. Based on these discussions, edits were made to the codebook to improve clarity and to account for additional interpretations of data. For the codes that did not meet inter-rater reliability standards during the first round of coding, two additional pilot transcripts from the sample were then coded, and Krippendorff's α and q-values were recalculated. At the conclusion of the second round of pilot coding, all codes were at suitable levels of inter-rater reliability. Krippendorff's α values and associated q-values for each code are in Table 3. Following the establishment of sufficiently high inter-rater reliability across all codes, the full set of transcripts was coded. Each transcript was coded by two members of the research team; having more than one person

Table 2 An overview of the definitions, frequency, and sample quote for the study's themes and subthemes

Theme	Subtheme	Definition	Sample Quote
Institutional challenges as contextual barriers	Lack of interpersonal support in academic setting	Lack of support from professors, advisors, peers, and/or general program climate	I feel like if a staff member or an advisor sees or notices transgressions, he or she is mandated to report that to the school officials and I feel like the other staff, not all of them but most of them, were reporting that. However, my advisor didn't seem to care about it much or is being supportive of me about it. [Bahar]
	Impact of Gendered, Racialized, & Cultural Encounters on Mental Health	Gendered, racialized, and cultural encounters in STEM that influenced the onset or exacerbation of mental health concerns	There was at least one person in my cohort who jokingly said, essentially, that I only got into the program because I was a black woman… it was just like another stab at that confidence, like you don't actually belong here. You're only here to fill the quota. That…sucked. [Ashley]
	Academic Difficulties	STEM challenges related to academics and research	I felt as though it took me a long time to really get a hold of [the technique] because it's a technique that really occurs in real time… So, it's challenging to do because when you're a new person, there's so many different things you have to keep track of in real time. [Bethany]
Impact on wellbeing and STEM persistence	Impact on Mental Health	The ways in which STEM difficulties contributed or exacerbated mental health-related distress	I didn't expect it to hit me as hard as it did, but I ended up in a depression. [Ashley]
	Impact on STEM Persistence	The ways in which mental health concerns impacted academic progress	[Lab environment] became so uncomfortable and…I was dealing with all this stuff, and one day I just said, "I can't no more." [Sofia]
Contextual supports and coping	Interpersonal support in academic setting	Support from advisor, PIs, program staff, professors, lab mates, or colleagues in academic setting specifically related to mental health concern/distressing encounter	I didn't feel comfortable with all the personal aspects, talking about details, but I did go to [my advisor] and say, "Hey, here's just a brief outline of what's happening in my life. This is why I need some time." He was very understanding of that. [Emily]
	Acknowledgement of NOT discussing mental health concern in an academic setting	Data highlighting that a participant did *not* discuss mental health concerns with anyone within the STEM academic setting	I don't want you to tell them that I'm looking for help. Are you going to tell them that I'm getting psychiatric help?" I was so fearful that they will know that I couldn't deal with everything. [Sofia]
	Utilization of counseling services	Participant explicitly states that they utilized mental health counseling services during their doctoral studies, describes reasons for seeking counseling services, and/or discusses impact of counseling	The university health services has a really good counseling program. Amazing. I think I owe them, that place, just probably not to have gone to extremes through my depression. [Sofia]

code each transcript ensured that multiple perspectives and interpretations of the data were considered during the coding portion of the analysis.

Following the coding, the research team held weekly meetings where we shared our understandings and perspectives of the data, one code at a time, across team member identities. We engaged in critical reflections of our own coding and interpretative processes. This process of intentionally inviting multiple perspectives supported both the fairness of the research process and also the confirmability (Morrow, 2005) of the findings by reducing the likelihood that the biases or beliefs of a single researcher were guiding the interpretation more than the data provided by the participants. Finally, following our critical reflections/discussions, the team was intentional with the analyses to draw out and describe the variability in experiences across participants' racial/ethnic identities and STEM completion status.

Results

In the current study, we examined the types of challenges faced by a racially and ethnically diverse group of doctoral women in STEM, the psychological toll and related persistence decisions that stemmed from navigating these barriers, and the buffering effects of contextual supports. Embedded within this analysis was an intersectional examination of the experiences of graduate WOC and white women participants as well as a nuanced examination of the experiences of participants who chose to continue (CTC) their doctoral degrees and those who chose to discontinue (CTD) their doctoral pursuits prematurely. Our analysis identified three themes: 1) *institutional challenges as contextual barriers*, 2) *impact on wellbeing and STEM persistence*, and 3) *contextual supports and coping*. In the following sections, we delineate these three themes and provide corresponding excerpts from participant interviews.

Theme 1: Institutional Challenges as Contextual Barriers

Salient among participants' responses was the concomitant impact of the following contextual barriers: 1) lack of interpersonal support from within the STEM environment, 2) gendered, racialized, and cultural encounters, and 3) academic challenges. These contextual barriers are well researched in the extant literature (e.g., Charleston et al., 2014; McGee, 2020; McGee et al., 2019; Ong et al., 2011). Correspondingly, our analysis specifically drew out the impact these challenges had on graduate WOC, women who discontinued their doctoral programs, as well as the toll that these academic barriers levied on participants' mental health.

Lack of Interpersonal Support

12 participants expressed experiencing a lack of interpersonal support from their academic settings, though participants who chose to discontinue reported more instances of lack of support than did participants who chose to continue. Participant' narratives – across all participants – indicated that this lack of support manifested as dismissiveness, silence, and inaction from professors, advisors, peers, and/or colleagues.

Ashley (CTD/Black), Alejandra (CTD/Latinx), Emily (CTD/white), and Bethany (CTC/white) all noted experiences of unsupportiveness levied through dismissive faculty actions. For instance, when Bethany (CTC/white) informed her advisor that she experienced an anxiety attack, she felt as though he did not recognize the impact of this experience. She regarded her anxiety attack as a "terrifying ordeal" but went on to share that "the way he reacted didn't seem as though it was in proportion to what I had been feeling at the time." Alejandra (CTD/Latinx) reported a similar unsupportive and dismissive encounter when she reached out to her professor asking for support with course material. She stated, "I was trying to approach [him] and say, 'Hey, I'm having all

Table 3 Interrater Reliability Values

Theme	Subtheme	Krippendorff's alpha (α)	q[a]
Institutional challenges as contextual barriers	Lack of interpersonal support in academic setting	0.74	0.02
	Impact of Gendered, Racialized, & Cultural Encounters on Mental Health	0.87	0.00
	Academic Difficulties	0.85	0.00
Impact on wellbeing and STEM persistence	Impact on Mental Health	0.81	0.00
	Impact on STEM Persistence	0.82	0.00
Contextual supports and coping	Utilization of counseling services	0.96	0.00
	Acknowledgement of NOT discussing mental health concern in an academic setting	0.79	0.01
	Interpersonal support in academic setting	0.81	0.00

[a] q represents the probability of not achieving a value of at least 0.67 across 1000 bootstrapped samples (Hayes & Krippendorff, 2007)

these troubles. What do you suggest? Do you have maybe some book that can help me, or can I set up more time with your office hours?" Despite her attempts at reaching out and asking for help, Alejandra (CTD/Latinx) felt disappointed and exasperated by his response. She stated, "[After] I shared all these feelings and all those things, he just goes and tells me that he cannot help me." Even after an explicit attempt to request assistance, Alejandra (CTD/Latinx) was dismissed by her STEM faculty. In another instance, Alejandra (CTD/Latinx) described once again meeting with a different professor regarding difficulties with the course material and being dismissed. She shared with him her feelings of "overwhelm" and that her difficulties understanding the material were "causing [her] anxiety". Instead of offering clarity regarding the course content, Alejandra (CTD) was once again discounted by her professor's response. She stated,

> His answer was like, 'Well, have you [sought] help?' I was like, 'Yeah, I'm reaching out to you.' He was like, 'Well, I cannot help you.' So, he was more like 'I know about math... Emotions, overwhelm, anxiety, I cannot help you, but you should reach out to someone that can help you.' ~ Alejandra, Latina, CTD, Mathematics

Repeated unsupportive and dismissive faculty behaviors such as those encountered by Alejandra (CTD) and others, particularly those who chose to discontinue, contributed to a decreased sense of hope that other faculty members would respond any differently. Consequently, these participants were less likely to share their concerns with other faculty in the future. This was echoed by Ashley (CTD/Black) who decided that after a while "it wasn't worth talking to anyone else about [it]." Alejandra (CTD/Latinx) regarded these unsupportive encounters with her professors, as "pebbles" that "started weighing more and more on [her] back." This depiction speaks to the cumulative cost of navigating unsupportive STEM environments. Often, no single encounter is the catalyst for discontinuing one's doctoral pursuits; instead, it is the accumulation of these individual stressors.

Silence and inaction were additional ways in which faculty unsupportiveness manifested in participants' narratives. One such example was when Kathleen (CTC/Black Biracial) experienced repeated instances of inaction from her advisor and colleagues amidst disclosures of difficulty with her research in her weekly research labs. She stated, "*no one* ever really stepped in, [or said] 'Hey, set it up this way. Try it this way.' No one ever interjected." Kathleen's (CTC/Black Biracial) narrative highlighted the ways in which inaction on both her advisor and colleagues' part contributed to inadequate guidance on her experiments. Although research lab meetings are sites where students should be receiving peer and faculty support regarding ongoing experiments, Kathleen's (CTC/Black Biracial) recount of her experiences illustrated that she did not receive this type of instrumental support.

Silence and inaction on the part of the STEM program also served as an additional "pebble" that affected participants who decided to discontinue their STEM doctoral pursuits. This effect was particularly noteworthy when participants witnessed other women's negative STEM encounters and saw little to no action being taken by program faculty. For example, Emily (CTD/white) stated, "some of my fellow female students have encountered some issues that I feel reflect poorly on the program and have kind of made me lose a little bit of respect, a little bit of faith in what they're doing." Witnessing these unsupportive actions contributed to Emily (CTD/white) feeling as though she too would not be supported if she sought assistance from her program. She stated, "them (i.e., fellow female students) not being supported makes me feel like if I needed to go to [the program] for something, that I would not be supported either." Emily's (CTD/white) experiences illuminated how observing other women's negative encounters in STEM had just as significant of an impact as experiencing the negative encounter herself.

Evident from these participants' narratives are the ways in which they were met with a host of unsupportive behaviors and comments after multiple attempts of seeking help. With each unsupportive encounter, participants became increasingly demotivated to engage in additional help-seeking behaviors, leaving many to disengage and suffer in silence. This cycle was particularly noteworthy among participants who chose to discontinue their STEM doctoral pursuits.

Gendered, Racialized, and Cultural Encounters

All 12 participants endorsed experiencing gendered, racialized, and/or cultural encounters that negatively impacted their psychological wellbeing. Notably, Black women had to contend with faculty and peers' lack of awareness and avoidance of the toll of systemic racism. For instance, Ashley (CTD/Black) described the psychological cost of being bombarded with social media images of police brutality towards unarmed Black men and the subsequent feelings of lack of support from her colleagues in her lab. She explained,

> It was hard to go back to the lab when I'm in an environment where everyone else in the lab, whether they be international students or just people who aren't getting the same type of social media barrage with the same imagery when they log onto Facebook or when they log into Instagram or Twitter. I didn't feel like they empathized or could really understand what it felt like to feel so insignificant, even though we're both pursuing the same type of degree. That was a really hard time for me to recover from because I didn't feel like there was anyone... I felt there wasn't anyone. ~Ashley, Black, CTD, Engineering

Ashley (CTD/Black) not only had to contend with being the only Black woman in her program, but her experience of racial battle fatigue (i.e., the cumulative toll that stems from race-based stressors) was also rendered invisible by those in her STEM program. She noted that her colleagues had little to no understanding of the emotional cost of systemic racism and what she had to bring with her to the lab each day. Ashley (CTD/Black) further described the psychological impact that stemmed from these unsupportive encounters by stating, "the people who were in my immediate circle in my lab environment, couldn't understand what it was I had to bring with me emotionally every day. That was a really discouraging time." She further stated, "it hit me that it doesn't matter what degrees I have and what my credentials are. I felt like just because of what I looked like, I didn't matter." Although Ashley (CTD/Black) was referring to the spree of killings of unarmed Black men by the police in 2015, her experience remains relevant today when Black men and women (e.g., George Floyd, Breonna Taylor, and others) continue to be brutally murdered at the hands of the police. As is evident in Ashley's (CTD) narrative, white, hegemonic standards of professionalism (Gray, 2019) force Black students to leave their lived experiences "at the door", in turn, perpetuating their psychological fragmentation and disembodiment.

Racial battle fatigue among Black and Brown graduate students in STEM is a common experience (McGee, 2020). What is unique to WOC in STEM though is that they must contend with the toll of systemic racism in the broader society as well as the confluence of sexism and racism within STEM milieus. Six of the seven graduate WOC reported navigating subtle and overt forms of racism and sexism in their academic settings that included inappropriate and offensive jokes, feedback, and comments perpetrated by both peers and professors alike. For example, Felicia (CTC/Black) reported feeling uncomfortable around a classmate who regularly made inappropriate jokes about "women in the kitchen". Additionally, Fernanda (CTC/Latinx Biracial) reported that she was given gendered feedback by her advisor that the males in her group did not receive. She explained, "[My advisor] would always tell me that I was too nice and that I should speak up… He would never say [that] to my male lab mates." In several cases, participants described encounters where their colleagues attributed their success and admittance into the STEM doctoral program to their gender and race instead of their skillset and capabilities. For instance, Kathleen (CTC/Black Biracial) recounted an experience where a colleague asked her, "Why do you think you got here?". She shared, "I jokingly was like, 'Oh, it's because I'm a Black woman and they need us.' And he was like, 'You know, I know you're saying it jokingly, but it probably does have something to do with it.'" Along the same lines, participants described experiences of tokenism and the accompanying impact that that had on their wellbeing and persistence intentions. For instance, Monique (CTC) reported being concerned that her academic performance would reflect negatively upon her entire race. She explained,

> When I came in, I was the only person of color in the whole entire department, so that was difficult. And so, I kind of had this sense of, 'Oh, my gosh. If I don't do well, then they'll never let in any other person of color...' I feel like it's almost an unspoken rule. It's like you represent everybody else. How you perform is indicative of whether or not they're going to bring in more people like you. ~ Monique, Bi-racial (Black and Latina), CTC, Engineering

Monique's (CTC) narrative highlights the inordinate cost of being the only WOC, much less Student of Color, in STEM departments. She makes apparent the ways in which students are consumed with fear, worry, and concern that should they fail to succeed, STEM programs will, in essence, decline admission to other Students of Color. Balancing the weight of this worry, in addition to the rigors of a STEM doctoral program, can have a significant impact on WOC's mental health and STEM persistence intentions. This toll was notable in Ashley's (CTD) narrative who reported feeling pressured to represent her race and gender, even *after* she decided to discontinue her PhD in Engineering. She shared, "[leaving] was something that I was afraid [of] and like, 'Oh, I've let down the culture… I just, I can't do it [i.e., continue in STEM]… I'm so sorry guys.'" The emotional price to represent one's race and gender is an invisible, but salient, tax that detracts students' efforts away from their academics and levies a significant psychological cost.

The participants' reports shed light on the multifaceted marginalization that graduate women, especially WOC, experience in STEM environments. Racist, sexist, and demeaning encounters impacted their psychological wellbeing and diminished their comfort in seeking support. Enduring such oppressive acts while trying to persist in a doctoral program calls attention to how WOC shoulder experiences deemed invisible by the STEM environment.

Academic Difficulties

All 12 participants reported that they experienced academic difficulties during their STEM doctoral studies that either contributed to or exacerbated their psychological distress. These challenges spanned transitioning to graduate school to balancing programmatic milestones. For example, Alejandra (CTD/Latinx) reported feeling "overwhelmed" during her transition to graduate school, and Monique (CTC/Black-Latinx Biracial) described the added layer of stress that accompanied failing her first two comprehensive exams. Monique (CTC/Black-Latinx Biracial) described the psychological ramifications of this challenge by stating, "I think

I cried throughout my whole second semester." She then went on to note the escalating feelings of self-doubt when she stated, "Oh, my goodness. I don't know if I could do this." Evident in Monique's (CTC/Black-Latinx Biracial) narrative were the ways in which this experience negatively impacted her mental health, exacerbated her self-doubt, and contributed to her questioning her capabilities to persist in STEM. Like Monique (CTC/Black-Latinx Biracial), Alejandra (CTD/Latinx) explained that the combined effect of the academic challenges exacerbated the stress she was experiencing. She shared,

> We were having tests and homework, and we had all these other duties that we have to fulfill. We were having meetings and having all those things all together. It was hard sometimes for me. I wasn't sleeping enough. Homework with five problems will take me three days to finish. I mean, like three days, 72 hours, like *three days*. I was feeling like I was working [but it was] not enough time. I didn't have weekends. I wasn't even dreaming even about a whole weekend, maybe an afternoon. I didn't have that. So, all those little things caused ... stress. ~ Alejandra, Latina, CTD, Mathematics

Alejandra's (CTD) experience makes apparent the ways in which graduate students' physical and emotional wellbeing are stunted by the overwhelming number of competing academic demands. Balancing this immense volume of work leads to reduced sleep, which in turn increases stress.

In addition to diminishing acts of care for themselves (e.g., sleep), graduate women also noted the impact these academic difficulties levied on them emotionally. When asked about failing her comprehensive exams, Felicia (CTC/Black) replied, "I really felt embarrassed." In fact, shame and embarrassment were common emotional responses to experiencing academic difficulties. For example, Ashley (CTD/Black) reported feeling shame in response to difficulties in her research lab. She stated, "I was really ashamed…I [probably] slipped through the cracks." These feelings of shame then amplified participants' self-doubt. Ashley (CTD/Black) reported thoughts such as, "I don't really belong here, or I look good on paper, but that doesn't mean anything now that I'm being put to the test." Ashley's (CTD/Black) and Felicia's (CTC/Black) experiences illuminate the ways these academic challenges, and the ensuing feelings of shame and embarrassment, erode students' sense of belonging in STEM and their belief in the capability to succeed. For some participants, shame and embarrassment paralyzed their engagement in help-seeking behaviors. For example, Monique (CTC/Black-Latinx Biracial) explained, "I just kept it to myself… I didn't want to bring these struggles [to my advisor] because I was like, 'Oh, I'm going to disappoint him [and] I [didn't] want to disappoint him.'" For Monique (CTC/Black-Latinx Biracial), it was not until she was on academic probation that she talked with her advisor. She summarized her decision to delay talking with her advisor by saying, "I was just so embarrassed, and it was hard."

Of note, the cycle of shame and avoidance was more pronounced among graduate WOC (e.g., Ashley (CTD/Black), Monique (CTC/Black-Latinx Biracial), Alejandra (CTD/Latinx), and Felicia (CTC/Black)) and is likely tied to the subtheme 'Gendered, Racialized, and Cultural Encounters'. Specifically, graduate WOC's fears and concerns that STEM programs may be less likely to admit other WOC into the STEM program if they were unsuccessful could be contributing to heightened feelings of shame and powerlessness when they encounter a challenge. Asking for help may, as Monique (CTC/Black-Latinx Biracial) noted, could 'disappoint' their advisors, in turn jeopardizing future programmatic admissions for other Students of Color. Given this relation, unsupportive behaviors from STEM faculty can be especially damaging and demotivating when graduate WOC *do* request assistance and support from faculty.

To summarize, the findings around the lack of interpersonal support, experiences of sexism and gendered racism, and academic challenges highlight significant hurdles that the doctoral women in STEM had to navigate. They collectively demonstrate the presence of an institutional culture that negatively impacted all 12 participants' wellbeing and intentions to persist in STEM. These findings are underscored by the ways in which the STEM environment and faculty often failed to adequately support their students, which many women internalized, in turn leading to self-doubt, feelings of shame, and questioning their belonging in the STEM milieu.

Theme 2: Impact on Wellbeing and STEM Persistence

Unsurprisingly, the amalgamation of the institutional barriers and challenges exerted a considerable toll on graduate women's mental health and STEM persistence intentions. In the sections below, we detail the impact in these two areas specifically.

Impact on Mental Health

All 12 participants reported experiencing mental health concerns during their STEM doctoral programs, including depression, anxiety, obsessive compulsive disorder, and suicidal ideation. For many participants, the toll of their graduate school experience manifested as symptoms of depression. Kathleen (CTC/Black Biracial) described feeling unmotivated and lacking interest in activities that were previously interesting (clinically referred to as anhedonia). She shared, "yeah. I mean, I was depressed … I felt like I was dragging my bones to work [referring to her research lab].

I had no motivation, or energy, or enthusiasm, or desire to do this." These sentiments were echoed by Emma (CTC/white), who reported "I was having a hard time feeling motivated … I was starting to sort of verge on, acute depression." Bahar (CTD/white) shared similar struggles with being in her research lab. She stated, "After a while I was really having a hard time in the morning when I was waking up. It was really hard for me to go to the lab and I was not really having that motivation." Kathleen, Emma, and Bahar's recount of their experiences are all very consistent with the criteria used to diagnose depression. They described their lack of motivation, decreased desire to get out of bed, and little to no energy without any physical exertion. Furthermore, these narratives highlight the cyclical relationship between mental health concerns and academic functioning: mental health concerns interfered with their ability to fulfill academic obligations, which in turn magnified their mental health concerns. This bidirectionality makes explicit the ways in which psychological distress thwarts graduate students' success and academic productivity.

Participants explicitly described the STEM climate and related difficulties as key contributors to their psychological distress. For example, Emily (CTD/white) shared, "I realized the mental and emotional toll that grad school was heaping on the, honestly, unrealistic level of expectations, the multiple projects, the teaching, and still dealing with [my] personal life, and all while being thrown in the deep end." She went on to characterize the graduate school socialization process as a pervasive "sink or swim" culture whereby "no[one] actually guides you on how to do research, how to do a PhD." This ubiquitous culture, coupled with little faculty support, personified the old adage of 'working oneself into the ground.' These narratives make explicit how this type of STEM culture can be detrimental to students' physical, emotional, and mental health. Like Emily (CTD/white), Diane (CTD) shared,

> I was not able to go to the gym because I was working on the weekends. I was eating very poorly, so I was gaining weight. It was taking a toll on my relationships. I didn't go out on the weekends and I didn't have a social life. It took a toll on my mental health. I was very, very sad and my anxiety was through the roof. ~Diane, white, CTD, Physical Sciences

Diane's (CTD) experience illustrates the breadth of areas that are impacted by the stress and difficulties participants face in their STEM programs. She noted the negative impact these challenges had on her relationships, physical health, eating, ability to have a social life, and especially emphasized the consequences for her mental health. Quite fittingly, Monique (CTC/Black-Latinx Biracial) regarded the PhD process as one that "completely breaks you down," given the immense toll that is levied on students' bodies. Monique (CTC/Black-Latinx Biracial) further noted that the profession does a grave disservice to students because, "a lot of [advisors] are good at the breaking down bit but not [at] the building [back] up bit." A key example of such a failure is the perpetuation of a culture where STEM professors render taboo discussions around mental health and de-prioritize acts of self-care. Diane (CTD/white) summarized this "just-get-on-with-it" graduate school culture as a "rite of passage" which, in turn, equates the STEM graduate school experience with a form of hazing. It is no wonder, then, that Felicia (CTC/Black) reported, "really struggling with the program" and "dealing with crazy levels of anxiety."

Three participants harkened the emotional cost of the graduate school socialization process to psychological trauma, specifically post-traumatic stress disorder (PTSD). Monique (CTC/Black-Latinx Biracial), shared, "a lot of people that I've talked to who also went through the whole PhD process all say the same thing. They had to recover almost. It's like having PTSD through that whole experience." In line with PTSD, Sofia (CTD) recounted vivid nightmares and flashbacks.

> I would wake up screaming. And it was the worst thing, because when I think about it [i.e., grad school experience], it's not traumatic like being beaten or tortured. It was just different. [However] It messed with me. That confidence, [that] identity. I just burned little by little in it." ~ Sofia, Latina, CTD, Biological Sciences

Sofia's (CTD) recount of her psychological trauma, namely waking up at night screaming, was utterly painful. This was especially so, because as she said, it was not as though she was physically assaulted. It is evident though that Sofia (CTD/Latinx) was indeed emotionally and psychologically traumatized by her STEM graduate experience. In conjunction with PTSD symptoms, two participants reported that the severity of their mental health concerns escalated to the point of considering suicide. Sofia (CTD/Latinx) shared, "I wasn't sure if I wanted to leave the program, but I got to the point that if I had not left, I would have probably start[ed] considering suicide, just because it was [so] overwhelming." Kathleen (CTC/Black Biracial) also described considering suicide and reported, "I felt totally trapped. I started having a lot more suicide[al] ideation." For Sofia (CTD/Latinx), the decision to leave her program was, in essence, the ultimate act of self-care. It was choosing her health, her wellbeing, and her life.

The participants' responses revealed the grave extent to which negative STEM climates worsened students' mental health through unrealistic expectations and inadequate support.

Impact on STEM Persistence

The severity of the psychological distress described in the previous section contributed to students making the difficult decision to either postpone their academic milestones or discontinue their STEM doctoral pursuits altogether. All 12 participants expressed that they had considered discontinuing their STEM degrees at least once during the time that they were in their programs. Of these 12 participants, six ultimately chose to leave their doctoral programs. A significant theme across these six CTD (i.e., chose to discontinue) participants' narratives was that discontinuing their PhDs or postponing the attainment of programmatic milestones was a preventative act to prioritize their wellbeing. As it pertained to slowing degree progress, Emily (CTD) reported delaying her comprehensive exams in order to attend to her mental health. She shared,

> It was essentially the preparation for the exam on top of other things that I was dealing with. [It] was more than I could handle all at one time, so I needed to find a way to push one of them off. I can't push off my own mental and physical health, so my comprehensive exams got pushed off. ~Emily, white, CTD, Physical Sciences

For Emily (CTD), it was difficult navigating the cumulative toll of all her competing demands. So, something had to give. Of all the things that were a priority, Emily (CTD/white) decided that her mental and physical health were non-negotiables. In a STEM environment that epitomizes a keep-working-at-all-costs culture, Emily (CTD/white) was acutely aware of the risks of her decision to postpone her comprehensive exam, yet she proceeded anyway. This decision highlighted the extent to which protecting one's mental health was important for these graduate women.

In addition to delaying programmatic milestones, all six participants (three white women and three WOC) who discontinued their STEM doctoral pursuits spoke to the importance of choosing their mental health and stability over program completion. For example, Diane (CTD) assessed her quality of life and noticed the physical and psychological price of continuing in the PhD program. She shared,

> It was just realizing how unhappy I was, and it was just the realization that [of the] five years, I had three and a half years to go. [That] was a long time to be extremely unhappy. And it was taking a toll on my health. ~Diane, white, CTD, Physical Sciences

For Diane (CTD), the realization that she could be spending the next three and half years feeling the way she felt currently was enough to make her decide to discontinue her PhD. For her, actively choosing to engage in something that took such a negative toll on her wellbeing was not an option. Alejandra (CTD/Latinx) echoed a similar sentiment and described the psychological cost of her STEM experience by stating, "all these things [were] just lowering you down, mentally breaking you." These experiences led to her asking herself, "do I want to keep doing this? That was my main question, do I want to keep doing it?" In the end, Alejandra (CTD/Latinx) decided that she did not want to continue subjecting herself to these negative experiences. Bahar (CTD/white) also came to the realization that she just could not do it anymore. She shared, "I was really concerned about my mental health. I was not finding much happiness… I was so tired and exhausted as well." So, she too decided "I can't really do it anymore." Sofia (CTD/Latinx) chose to take a leave of absence given the increasing severity of her psychological distress. She shared, "I'm choosing myself at this point. I don't want to have these negative thoughts about myself [i.e., suicide]. I don't want to feel this way about myself anymore". Ashley (CTD/Black) shared a similar experience, stating "This will kill me if I keep going this way, and I don't want to die over this, so we're just going to make a safe choice and walk away." For all six graduate women, discontinuing their PhD was the ultimate act of self-preservation.

Among the six participants who chose to discontinue, three (two white women and one WOC) reported having to work through their feelings of failure. Participants noted that these feelings exacerbated the stressfulness of discontinuing their programs. Emily (CTD) reported,

> The most difficult part of that decision was really the feeling of failure, feeling like even though I was making an active cost-benefit decision [that] the PhD was not worth the emotional [and] mental cost… [yet] it still felt like a failure to switch from a PhD to a master's. ~Emily, white, CTD, Physical Sciences

Although Emily (CTD) made the decision to discontinue her program for the betterment of her health, she acknowledged feeling like a failure for not pushing through. Of all the parts of leaving that were difficult, Emily (CTD/white), labeled the feelings of failure as the worst. Like Emily (CTD/white), Diane (CTD/white) also struggled with feeling like a failure for making the decision to switch labs. She shared, "I thought of it as quitting, even though I was just going to switch labs. To me that was a failure all of its own…just not sticking through it." The decision to switch labs, coupled with the feelings of failure it conjured up, weighed on her decision-making capacity. She noted, "it was a mixture of my own insecurities not letting me leave." In the end though, she decided leaving was for the best.

These experiences of feeling like a failure were especially nuanced for Ashley (CTD), a WOC, as is shown in the quote below.

> It was drilled into us how important it is to have this minority PhD pipeline, and how gruesome the statistics are on Black representation, that was a motivator for me not to go. Because we need women, like Black women PhDs, like we need those. They need to be around. They need to be present. They need to be visible. That was something that I was afraid [of] and… that affected the decision process…I recognized that the decision I was making was about me personally and it's not bringing down the whole race or the whole gender. ~Ashley, Black, CTD, Engineering

Given the underrepresentation and repeated messages about the need for Black women in the STEM pipeline, Ashley deciding to discontinue her STEM PhD program, even if it was for her mental health, was an almost unthinkable act. In fact, deciding to leave her doctoral program not only felt like she was letting herself down, but that she was also failing her entire race and gender. The enormity of this burden paralyzed Ashley (CTD/Black) from leaving her PhD program for several years. When most students depart STEM PhD programs in their first or second year (Joseph, 2012), Ashley (CTD/Black) left at the end of her fourth year. Ashley's (CTD) experience highlights the ways in which the fear of disappointing oneself and others can stymie WOC's decisions to discontinue and therefore lengthening the time in which they are suffering debilitating psychological distress. In the end, Ashley (CTD/Black) was propelled into action by the recognition that her decision to leave was about her, and not her entire race or gender.

Notably, three of the four WOC who decided to continue in their STEM PhD programs despite the toll on their mental health (i.e., Monique, Kathleen, and Fernanda) indicated doing so because of external pressures. For example, Kathleen (CTC) described feeling "trapped" in her program. She stated,

> I felt totally trapped [and] I started having a lot more suicide ideation. I felt like, how embarrassing, I left [former] University and I felt like when I left people were kind of like "Oh, how disloyal."…So, I felt like all these people maybe were a little bit bitter about me leaving. Then I get here…take this big risk…I could never have been like, "Let me just leave this now." ~Kathleen, Black Biracial, CTC, Biological Sciences

So, like many of the participants who decided to discontinue their STEM PhDs, Kathleen (CTC/Black Biracial) encountered significant mental health challenges. Nonetheless, she felt as though she could not leave her program. She had already made the decision to transfer institutions and was riddled with the guilt and embarrassment for leaving the first institution. She felt she was in the impossible situation where she could not leave her second institution. However, this feeling of being 'trapped' certainly amplified her distress as is evident by the increase in her suicidal ideation. So, although Kathleen (CTC/Black Biracial) and others decided to stay, these decisions also had significant ramifications for their mental health.

In summary, the results of these two sub-themes highlight the prevalence of having thoughts about discontinuing a STEM doctoral program and shed light on the salient role of psychological distress in deciding to leave the program. Of importance are the nuanced ways in which these experiences differed for graduate WOC in STEM. In the subsequent sections we discuss the factors that were supportive of graduate women's STEM persistence.

Theme 3: Institutional Support and Coping

Participants described coping with institutional challenges and the associated psychological ramifications in a variety of ways, including receiving interpersonal support from peers, advisors, and university staff members. Participants also described actively choosing *not* to share their mental health concerns in their academic settings as a form of coping. Lastly, participants described seeking counseling services as an external, unbiased source of support for their distress.

Interpersonal Support

After discussing their mental health concerns with important others within their academic settings, all 12 participants described receiving instrumental and/or psychosocial support from their peers, advisors, and university staff members. Psychosocial support came in the form of encouragement, affirmation, validation, empathy, and safety for open expression. Instrumental support took the form of direct, active, material, and operational assistance in academic, career, or personal domains.

Support from peers consisted of friends and colleagues from both inside and outside of participants' doctoral programs. Although peers provided instrumental support in the form of goal setting, they primarily offered psychosocial support through validation of shared experiences and difficulties. For example, Fernanda (CTC/Latinx Biracial) described experiencing invaluable support from her roommate, a fellow graduate student in a different department, when she was experiencing significant emotional distress. She stated, "she heard me crying so many times. She was the most supportive person from my entire PhD." Fernanda went on to describe the actions she found most supportive by stating, "it was just very reassuring having someone telling me that it was gonna be okay and you know, that I could handle that, I could find ways to cope with the feedback and change what I had to change." For Fernanda (CTC/Latinx Biracial), her roommate's support, particularly her

reassurance, encouragement, and her unwavering belief in Fernanda's capabilities was extremely impactful. This support was often much needed and came at moments of significant distress.

In addition to peers, there was a notable theme of participants receiving interpersonal support from university staff members, who served as critical counterspaces where graduate women, particularly WOC, were able to be their full and authentic selves and receive validation. For example, Sofia (CTD/Latinx) described being able to emote with a staff member turned mentor who also identified as a WOC. She shared, "She and I became kind of close, mentor–mentee, in a way friends…she was another person who probably heard me cry and just share the struggles. And she would share her struggles. We cried together too. She was really good." These results extend the past research on counterspaces (e.g., Ong et al., 2018) and uniquely highlight the nuanced ways in which counterspaces served as a supportive space to mitigate the psychological toll that accompanies structural barriers in STEM. Similar to its benefits in supporting graduate WOC's mental health, university staff counterspaces also supported graduate WOC persistence intentions. Monique (CTC/Black-Latinx Biracial) recalled the support she received from a staff member affiliated with an on-campus counterspace designed for Students of Color, she shared her appreciation for specific actions such as offering words of encouragement "Oh, we've got to come up with a plan, you can do it," or taking the time to listen by scheduling time for "one on one lunches." Monique (CTC/Black-Latinx Biracial) noted that her "super supportive" behaviors counteracted any thoughts that "this whole PhD program is not for you" and "basically made it so you could not quit." It is important to note that these university staff member counterspaces were uniquely beneficial to WOC (i.e., Ashley, Sofia, and Monique). Often these staff members shared similar gender and racialized identities and were outside of participants' laboratories and departments. These characteristics may have contributed to participants' increased comfort with sharing more openly and vulnerably.

In addition to university staff counterspaces and peers, five participants described the importance of receiving interpersonal support from their advisors. However, only Emily (CTD/white) noted the importance of advisor support as it related to her mental health. She noted that her advisor advocated for her to get an extension for her comprehensive exams after hearing her struggles with mental health concerns. Although the instrumental support (i.e., extension) was important, Emily (CTD/white) emphasized that it was his holistic psychosocial support that truly impacted her. She teared up while sharing, "I think really knowing that he [i.e., advisor] cared about my personal and mental wellbeing as well as my academic performance was probably the most powerful part of that support". It was apparent that for Emily (CTD/white), having her advisor's support of her mental health was very impactful – so much so, that she became teary-eyed as she recalled the memory of their conversation. Having her mental and personal challenges acknowledged likely signaled to her that he was committed to supporting her as a whole person, not just as a student.

These results highlight the salience of interpersonal support from peers, advisors, and university staff members in supporting students' mental health and STEM persistence. Notably, only one participant described the supportive actions of her advisor as it related to her mental health. Others discussed seeking support from peers and university staff outside of their departments. These findings build on the extant literature by highlighting the importance of shared identity spaces, such as peers and university staff members, as critical supports for graduate women, specifically WOC's, mental health.

Did Not Discuss Mental Health Concerns in STEM Settings

While some participants described seeking interpersonal support from outside of their academic settings, others described coping by *not* discussing their mental health concerns with those inside their academic spaces. In our analysis, participants were coded each time they decided against discussing mental health concerns with their advisors, program staff, professors, lab mates, or colleagues. All 12 of the participants described deliberately holding back at some point throughout their graduate tenure. Analysis of the participants' responses indicated concerns about being negatively perceived by others if they discussed difficulties related to their mental health. Impression management was especially salient when deciding against discussing mental health concerns with their advisors. Monique described her process as follows,

> I didn't want to bring these struggles because I was like, "Oh, I'm going to disappoint him [advisor]. I don't want to disappoint him." I just kept it to myself almost and after I was on academic probation, I was just so embarrassed, and it was hard. ~Monique, Bi-racial (Black and Latina), CTC, Engineering

For Monique (CTC/Black-Latinx Biracial), her concern for how her advisor would perceive her if he found out about her mental health concerns prevented her from sharing these concerns with him. This hesitation started off as a way to ward off disappointing her advisor, but it then morphed into embarrassment and shame after the mental health concerns began affecting Monique's academics. Similarly, Felicia (CTC/Black) was concerned that she would be perceived as incapable if she talked to her advisor about her mental health concerns. She stated, "[I] just thought it was a sign that I wasn't capable, so I didn't see how talking to my advisor

would help me." For both Monique (CTC/Black-Latinx Biracial) and Felicia (CTC/Black), they worried that their advisors would think of them differently if they found out about their mental health concerns. Although the participants' advisors did not explicitly deter conversations about mental health, their behaviors certainly implied that these conversations were discouraged. For instance, Felicia (CTC/Black) cited her advisor's "boundary driven" personality and his efforts to "separate personal from work" as among the reasons she chose not to discuss her concerns with him. She stated, "I think that's probably why I wouldn't really come to him, with emotional problems, more like specifically work-related problems". These types of behaviors by STEM advisors socialized students to compartmentalize and leave personal and emotional concerns outside of the work environment. Further, these behaviors perpetuated a culture of 'professionalism' that was based on white, masculine, and western standards (Gray, 2019).

Not only were participants reticent about how their advisors would think of them if they found out about their mental health concerns, but they also worried about how their STEM colleagues would perceive them. For instance, Sofia (CTD) described being consumed with fear that her conversations in therapy would be shared with her department. She stated,

> Most of the time [my therapist would say], "Know this [in regard to seeking counseling]. No they can't. This is medical stuff." But I always had this fear that they [would] know. I didn't tell anybody that I was going through the counseling services, not even my PI knew, 'cause I thought that I had to show being strong. ~Sofia, Latina, CTD, Biological Sciences

For Sofia (CTD), the worry of being found out by those in her STEM department, including her PI, was an all-consuming experience. This anxiety led to her frequently inquiring about the confidentiality of her therapy sessions. Like Sofia (CTD/Latinx), Ashley (CTD/Black) voiced concerns about her lab mates viewing her attempts to seek therapy negatively. She stated, "I wouldn't want someone in [my lab] to know, because they would see me as less." As WOC in STEM, Ashley (CTD/Black) and Sofia (CTD/Latinx) were likely doubly concerned about their actions reinforcing others pejorative beliefs that they did not have what it took to succeed in STEM. So, rather than reinforce these assumptions of inferiority, they simply chose not to disclose the challenges they were experiencing.

A final phenomenon was participants expressing uncertainty about their advisors' ability to offer emotional safety and helpfulness. This uncertainty hindered students' willingness to discuss their mental health concerns in their academic environments. Bahar (CTD/white) reported discontinuing communications about her mental health concerns because she found others' responses to be unhelpful. Alejandra (CTD/Latinx) emulated a similar reasoning and stated, "Well, I just simply tried to avoid share[ing] any problems [with] the professors from whom I was taking classes, because I tried once, and it didn't go well." Diane (CTD/white) noted concerns about feeling unsafe to share with those in the academic milieu due to the possibility of information being shared with others. She stated, "I didn't feel safe talk[ing] to any other faculty because I was like, they're all friends, they're going to talk to each other." Diane (CTD/white) also worried about the repercussions of discussing her concerns by stating, "I felt unsafe to talk to another faculty because I was like, it's going to go back to Advisor #2, it's going to make things so much worse for me." Of importance is that these three participants all discontinued their STEM doctoral pursuits, suggesting that a culture that stifles and stigmatizes open discussion about mental health, and the challenges that exacerbate mental health, may deter students' help-seeking behaviors, in turn, impeding pathways to STEM persistence.

It is important to note that although there were times when the participants intentionally chose not to discuss their mental health concerns, all 12 participants did in fact discuss their mental health concerns with someone in the academic milieu (e.g., advisor, university staff) at some point. Analysis of participants' narratives revealed that participants often discussed their concerns as a last resort, or as an unplanned event. Ashley (CTD/Black) reported, "I got to a breaking point, where ultimately I had to open up and share". Similarly, Diane (CTD/white) expressed feeling as though she had reached her limit and needed to discuss her concerns. She stated, "I was so mad at [that] point that [I] either was going to scream at him or I was going to burst out in[to] tears and cry. And it ended up that I burst out in tears and cried." Bahar (CTD/white) also described being at her wits end when she stated "I can't really handle this situation anymore," which resulted in her telling her program that she was discontinuing her doctoral pursuits. Of importance is that the pattern of discussing concerns as a last resort was more common among women who discontinued their PhD. Although several factors could explain this phenomenon, one possibility is that students felt unsupported throughout their program and their "breaking point" came at a time when their challenges became insurmountable resulting in their decisions to discontinue their programs.

In summary, the excerpts provided here shed light on the reasons women in STEM are reticent to discuss their mental health concerns in the STEM milieu. Those concerns included fears of being viewed as less than or incapable, and a lack of psychological safety from their advisors to be vulnerable and transparent. Ultimately the decision not to share one's mental health concern was a form of coping, a way to protect the participants from the stigmatizing STEM

culture. Pertinent to these findings are that with a more supportive STEM environment, and with advisors who are able to provide safety for sharing concerns and see help-seeking as a strength, concerns could be addressed sooner and before the participants reached their breaking points.

Comparative Analysis of the Results

The current undertaking is noteworthy because it comparatively examined the experiences of both WOC and white women as well as women who "Chose to Complete" (CTC) and "Chose to Discontinue" (CTD) their doctoral STEM programs. In this section of the results, we highlight some differences and similarities along these dimensions. It would be remiss of us to not note here that the experiences of both WOC and white women can stand alone; a comparison is not needed to justify either of these group's experiences. Instead, with this nuanced examination, we hope to resist the often used one-size-fits-all (white) approach to supporting persistence among women in STEM. In so doing, we offer some insight into the ways in which future researchers and practitioners can tailor programmatic efforts to more equitably serve and support degree completion among women in STEM from diverse racial/ethnic backgrounds. This nuanced overview will draw from Table 4 which shows the frequency of coding for each sub-theme by race/ethnicity (white or WOC) and completion status (CTC or CTD).

As aforementioned, three subthemes related to contextual barriers were identified: 1) perceived lack of support, 2) gendered and racialized encounters, and 3) academic challenges; all 12 participants reported experiencing each of them, albeit in varying degrees. As it pertains to perceived lack of support, women who chose to discontinue reported experiencing more than two times more instances of lack of interpersonal support in their academic setting compared to women who chose to continue. Among all participants who chose to discontinue, lack of support manifested as repeated dismissiveness from faculty from whom they sought support. Among WOC, participants who chose to discontinue endorsed experiencing lack of support more than twice as frequently (46 excerpts) as WOC participants who chose to continue (19 excerpts). Similarly, white women who chose to discontinue were coded for lack of support more than three times (42 excerpts) as frequently as white women who chose to continue (12 excerpts). These results suggest that a lack of interpersonal support in the STEM academic setting likely contributed to both WOC and white women discontinuing their STEM academic pursuits.

As it relates to the second subtheme, the impact of gendered, racialized, and cultural encounters on Mental Health, both WOC and white women noted that gendered/sexist experiences negatively affected their wellbeing. Given the interlocking systems of oppression that affect the lives of WOC (i.e., racism and sexism), they also reported navigating racialized experiences in STEM. Consequently, WOC participants endorsed this subtheme more than two times as frequently as white women participants (42 excerpts vs. 18 excerpts). Salient in the experiences of the WOC participants was racial battle fatigue; Black women specifically reported having to carry the burden of existing in a STEM space where most of their white colleagues did not understand, were not aware of, and did not have to navigate experiences of systemic racism. It is in this way that the intersecting experiences of marginalization negatively impacted WOC's mental health.

Table 4 shows that the contextual barriers related to academic challenges was coded 1.5 times more frequently among women who chose to discontinue (53 excerpts) than women who chose to continue (34 excerpts). Furthermore, WOC endorsed academic challenges more than two times as frequently (61 excerpts) than their white counterparts (26 excerpts). The qualitative narratives from WOC offer unique insight into the disproportional endorsement of academic challenges. Participants' narratives indicated a bidirectionality with mental health concerns such that elevated mental health concerns interfered with participants' ability to fulfill their academic obligations and failing to do so then magnified their mental health concerns. As illustrated in Table 4. WOC endorsed both mental health concerns (88 excerpts) and academic challenges (61 excerpts) more frequently than their white counterparts. Not only was this bidirectionality evident in participants' narratives, WOC who chose to discontinue their STEM pursuits disproportionately endorsed experiencing a lack of support in response to the academic challenges they encountered. The degree to which this occurred for WOC differed for white women. It is possible that with greater support with these academic challenges, WOC may have chosen to continue in STEM.

With regards to Theme 2 (i.e., impact on wellbeing and STEM persistence) all 12 participants reported that they considered discontinuing their doctoral degrees and that they experienced mental health challenges (e.g., depression and anxiety) during their doctoral program. Table 4 shows that, across all the participants, mental health challenges were coded 130 times. Notably, this represents the most highly endorsed subtheme. Of these 130 instances, 76 were among women who chose to discontinue their degree programs, and 88 were among WOC, whereas only 42 excerpts were coded for white women. Among the instances of mental health challenges coded for WOC, 45 were from WOC who chose to discontinue their degree program, and 43 were among WOC who chose to continue. These results are telling, in that, WOC who chose to continue are doing so while simultaneously navigating substantial psychological distress. White women who decided to discontinue more frequently endorsed mental health challenges (31 excerpts) compared to white women who chose to continue (11 excerpts).

Table 4 Participants' Frequency of Endorsement of Each Subtheme

Themes	Subthemes	WOC CTC	WOC CTD	White CTC	White CTD	WOC Total	White Total	CTC Total	CTD Total	Total
Institutional challenges as contextual barriers	Lack of interpersonal support in academic setting	19	46	12	42	65	54	31	88	119
	Impact of Gendered, Racialized, & Cultural Encounters on Mental Health	20	22	8	10	42	18	28	32	60
	Academic Difficulties	26	35	8	18	61	26	34	53	87
Impact on wellbeing and STEM persistence	Impact on Mental Health	43	45	11	31	88	42	54	76	130
	Impact on STEM Persistence	23	36	9	30	59	39	32	66	98
Contextual supports and coping	Interpersonal support in academic setting	22	38	13	33	60	46	35	71	106
	Acknowledgement of NOT discussing mental health concern in an academic setting	12	17	7	7	29	14	19	24	43
	Utilization of counseling services	24	11	3	13	35	16	27	24	51

Of the 98 excerpts related to STEM persistence, 66 were among participants who chose to discontinue their degree programs, and 59 were among WOC, whereas only 39 excerpts were coded for white women. Results showed that participants who chose to discontinue their degrees prematurely chose to do so as an act necessary to preserve or reclaim their wellbeing. Three WOC participants who ultimately did complete their degrees expressed that they chose to do so because they felt external pressures to do so, despite acknowledging that they too were simultaneously experiencing significant mental health challenges. White women participants did not endorse similar external pressures.

As it related to Theme 3, contextual supports and coping, participants described receiving interpersonal support from peers, advisors, university staff members, and university counseling centers. Across all participants, interpersonal support was coded 106 times, which we note to be fewer than the number of times that mental health challenges were coded. Table 4 also shows that this interpersonal support was endorsed twice as frequently among women who chose to discontinue (71 excerpts) than among those who chose to continue (35 excerpts). As mentioned in the discussion of this subtheme above, the support for women who chose to discontinue came largely in response to their decision to leave their programs. This trend is notable among both WOC (38 excerpts) and white women who chose to discontinue (33 excerpts). We had expected to see that women who chose to continue were endorsing more experiences of support than women who chose to discontinue, as this would suggest that the support is a contributing factor to their persistence. However, the coding frequency data does not support this expectation.

Additionally, all participants described choosing not to discuss mental health concerns in their STEM setting as a coping method. Of the 43 times participants reported instances of this behavior, 24 were among participants who chose to discontinue their degree programs, and 29 were among WOC, whereas only 14 excerpts were coded for white women. These results suggest that although WOC and participants who chose to discontinue, and more specifically WOC who chose to discontinue, were experiencing mental health concerns, they did not feel comfortable discussing their concerns in the STEM academic setting.

Finally, Table 4 shows that the utilization of counseling services was slightly higher for women who chose to continue (27 excerpts) compared to those who chose to discontinue (24 excerpts). Along the same lines, WOC who chose to continue endorsed using counseling services more frequently (24 excerpts) than WOC who chose to discontinue (11 excerpts). Additionally, WOC participants were coded for using counseling more than twice as frequently (35 excerpts) as white women (16 excerpts). These results

suggest that although WOC were not discussing their mental health concerns in the STEM academic setting, they were inclined to seek counseling services, and this may have been an avenue of support that contributed to their continued persistence.

Taken collectively, the results demonstrate that navigating contextual barriers (which Table 4 shows were reported more frequently by WOC and by women who chose to discontinue) in graduate STEM environments exerted a considerable negative impact on women's mental health. The subsequent psychological toll, reported more frequently among WOC than white women and more frequently among women who chose to discontinue than those who chose to complete their degrees, were influential factors in graduate women's ultimate persistence decisions. Contextual supports such as advisors, peers, and university staff, including therapists at UCCs, were influential in buffering the toll of contextual barriers on graduate women's mental health and STEM persistence.

Discussion

The study presented here has three particularly noteworthy contributions. First, we employed a two-fold comparative focus whereby we: 1) applied an intersectional approach to understanding the differential experiences of women from diverse racial/ethnic backgrounds, and 2) examined the ways in which participants' experiences differed for those who chose to depart from STEM versus continue their STEM doctoral programs. Second, this endeavor contributes to answering the clarion call to address the 'mental health crisis' that is plaguing STEM graduate education (Evans et al., 2018; Nagy et al., 2019). Third, this study highlights how decreased mental health thwarts efforts to broaden participation in STEM, particularly among WOC and white women pursuing doctoral degrees in STEM. In the subsequent paragraphs we discuss these findings in the context of SCCT's contextual barriers and supports.

Chilly STEM Climate and Distress as Barriers to STEM Persistence

Our study illuminated the role of the chilly STEM climate in increasing WOC's psychological distress. These results align with extant research in psychology that links marginalizing encounters to a myriad of negative mental health outcomes, including anxiety and depression (Bernard et al., 2017; Hwang & Goto, 2009; Torres et al., 2010). In our findings, the chilly STEM climate was characterized by the following: 1) a pervasive lack of interpersonal support from key STEM stakeholders (e.g., professors, mentors, advisors, and peers), and 2) repeated encounters with subtle and overt forms of racism and sexism. Of importance, lack of interpersonal support manifested as a form of dismissiveness. Specifically, STEM faculty were dismissive of participants' attempts at seeking help whether for academic-related concerns or for mental health related concerns. Such dismissiveness may have rendered students' concerns invisible.

Consistent with findings from O'Brien et al. (2016) and McGee et al. (2019), our findings showed that structural racism, such as the inequitable representation of WOC in STEM, also had clear psychological ramifications for WOC. WOC participants in our study worried not only about their own academic success, but also about endangering the chances of future Students of Color entering STEM should they disclose their academic difficulties. This worry is a byproduct of being tokenized and, implicitly or explicitly, having to serve as a representative of one's gender and race.

Unique among this study's findings is the linkage between negative STEM climates, increased psychological distress, and intentions to persist in STEM. All 12 participants endorsed increased psychological distress and attributed this increase, in whole or in part, to their unsupportive and marginalizing STEM environments. Key among these unsupportive encounters was the negative STEM socialization process which many characterized as "rite of passage" or a hazing experience of sorts. The psychological costs included elevated symptoms of depression, anxiety, and PTSD. These results are consistent with Evans et al. (2018) who found that graduate students in STEM were six times more likely to report depressive symptomatology than the general population. In addition to depression and anxiety, two participants noted how the cumulative toll of their negative STEM encounters contributed to suicidal ideation, which is consistent with extant findings showing that 7.3 – 9.9% of graduate students have endorsed thoughts of suicide during their studies (Garcia-Williams et al., 2014; Louden & Skeem, 2008).

Participants' narratives also shed light on the reciprocal association between mental health and academic functioning. Results indicated that mental health concerns interfered with participants' ability to fulfill their academic obligations, and failing to do so then magnified their mental health concerns. This bidirectionality makes explicit the ways in which psychological distress thwarts graduate students' success and academic productivity (Nagy et al., 2019). Notably, increased psychological distress also played a salient role in graduate women deciding to leave their STEM PhD programs. In fact, all six participants who chose to depart STEM prematurely regarded their decisions to leave as a preventative act to prioritize and protect their mental health. Strikingly, even the act of departing STEM was impacted by structural racism. WOC described being riddled with guilt and feelings of failure about their decisions to discontinue because, as the token Black or Brown student, they needed to be a representative for their race and succeed in STEM.

The marginalizing STEM environments, then, heightened students' psychological distress, which in turn contributed to WOC deciding to leave; and, upon making the difficult decision to leave, the same environments, rife with structural racism, also heightened students' psychological distress amidst their departure because of the worry of 'letting down' their communities.

Another notable finding was that all 12 participants chose *not* to disclose the state of their mental health to advisors or other key STEM stakeholders at some point throughout their doctoral programs. This is consistent with past work by Mousavi et al. (2018) who found that only 16% of participants discussed their psychological distress with their advisors. For graduate women in the current study, particularly WOC, such a disclosure, especially in an environment where such topics are rendered taboo, was particularly worrisome because their competency and capability in STEM would be further questioned and doubted (Wilkins-Yel et al., 2019b). Consequently, many participants only chose to disclose their mental health concerns after their difficulties worsened. This eventual disclosure was more common among graduate women who departed STEM and was usually to communicate that they had decided to discontinue their doctoral pursuits. The marginalizing STEM climate levied a considerable psychological toll on women, and it also stifled their ability to discuss this toll early on, in turn prolonging and exacerbating distress.

Within the context of the SCCT framework (Lent et al., 1994), these results offer new insight into how the toll that ensues from navigating negative STEM encounters can be a mechanism through which contextual barriers thwart women's success and persistence in STEM, particularly at the graduate level. To date, this toll has not been examined in the context of academic persistence within the SCCT framework. However, including the debilitating ramifications that stem from marginalizing STEM environments as a contextual barrier legitimizes this toll and, in turn, highlights new pathways for interventions and affecting change. Furthermore, there is a dearth of research that examines the SCCT framework within a graduate (versus undergraduate context), especially as it relates to STEM persistence (Lent & Brown, 2019). Consequently, the findings of the current study contribute to our understanding of the applicability of SCCT to understanding STEM persistence among graduate women in STEM.

Critical Counterspaces as Contextual Supports

Results of the current study also indicated that graduate women often sought refuge in critical counterspaces as contextual supports located outside of their departments. Case and Hunter (2012) regarded the creation and use of counterspaces as a form of adaptive responding: a way to cope, counteract, mitigate, and/or resist the psychological consequences of marginalization and oppression. Given the barrage of institutional and interpersonal slights that WOC navigate repeatedly, Ong et al. (2018) noted the importance of counterspaces for WOC specifically. In the current sample, counterspaces took the form of shared-identity university staff members and university counseling centers (UCCs). University staff members were often located outside of STEM departments and in offices that served Students of Color broadly or Students of Color in STEM specifically. These staff members were key outlets for graduate WOC to unmask, authentically share their concerns, and receive validation and support. WOC noted greater comfort with these staff members because of their shared gender- and racial-identity, which many felt increased the likelihood that these staff members understood their experiences. In so doing, shared-identity staff members provided WOC with social support to counter marginalization and, in conjunction with WOC, collectively challenged pejorative notions of their minoritized identities and doubts in their capabilities.

In addition to university staff members, UCCs also served as key counterspaces for graduate women. Participants described engaging in therapy when they felt that they were at their 'wits end' or after their internal resources to cope with challenges felt depleted. Among other benefits, counseling facilitated skill building (e.g., mindfulness stress reduction techniques), which in turn bolstered graduate women's resources to withstand the toll of the negative encounters in STEM. Participants' narratives also emphasized the benefit of having an outside perspective and a confidential space where they were able to openly vent and emote. This confidential space was especially important because many participants worried that if others knew about their distress or that they were seeking therapy, their credibility and capability to succeed in STEM would be questioned. Notably, counseling provided an avenue for graduate women to process and cope with the feelings of failure that accompanied their decisions to discontinue their STEM doctoral pursuits.

Limitations and Future Directions

This study also has several limitations. First, while we made an effort to capture diversity in the voices of Black/African American, White, Latinx, and Bi/Multiracial women in STEM doctoral programs, our results are limited to the current sample and cannot be generalized to all women doctoral students from racially and ethnically minoritized communities in STEM (e.g., Indigenous or Asian women). While all WOC share common experiences of gender-racial oppression, there are unique socio-political histories that contribute to each group's experiences of oppression and discrimination in the U.S. educational system (Andersen & Collins, 2001). The choice of including the specific groups of Black/African

American and Latinx was to facilitate greater in-depth analysis of those group's experiences and not at all to erase or diminish the experiences of non-Black and non-Latinx WOC. However, this choice means that we have left out the experiences of some WOC, particularly Indigenous and Asian/Asian American women, which we consider and acknowledge as a limitation in the study. Additionally, the interviews we conducted were retrospective and so relied on participants' memories which could be less accurate and suffer from recall bias. Finally, though we posited the impact of the STEM climate on mental health and persistence decisions, causal relations cannot be claimed. A follow-up longitudinal quantitative study would be required to formalize such associations.

There are two key directions for future work that build on the findings here. First, future investigations should extend the current intersectional examination to not only understand the experiences of Black/African American and Latinx students, but also Indigenous and Asian/Asian American graduate women as well. Second, future work could build on the current qualitative findings to generate quantitative survey instruments that can be administered to much larger samples than were included in this study. Such an analysis will provide important, more generalizable data about the impact of climate, culture, and support on the mental health and persistence intentions among WOC doctoral students in STEM. Finally, future work could include deeper qualitative investigations of graduate WOC who have discontinued their STEM doctoral programs to understand the ways in which increased psychological distress, by way of the marginalizing STEM environments, contributed to their decisions to discontinue. The current study offered initial evidence of this phenomenon, but a larger sample size of graduate WOC who have departed STEM prematurely, would likely offer a more nuanced understanding.

Practice Implications

The growing body of evidence about the mental health crisis in graduate education (Evans et al., 2018; Okahana, 2015), underscored by the experiences of graduate women in STEM interviewed in this study, point to a critical need for change within the STEM doctoral education ecosystem. The findings presented in this paper stress the need for prompt and localized actions within the STEM higher education environment. In accordance, we suggest three related and actionable strategies that faculty, staff, and administrators within STEM higher education should prioritize the following: 1) acknowledge and address the racism and sexism that remains rife within STEM higher education environments, 2) advocate for a whole-person approach to student mentorship, and 3) train faculty, staff, and administrators to both recognize the signs of psychological distress and refer students to related supports.

All participants in this study reported multiple instances of racism and sexism amplified by negative interactions with faculty and peers that, together, were described as producing psychological distress in graduate women and weakening their intentions to persist to degree completion. Departments must act to counter these marginalizing encounters through actions such as mandatory anti-racism and anti-oppressive faculty training and being culturally sensitive to students whose identities may differ from their own and take swift action to address these oppressive encounters when they do occur. Faculty can also be trained on how to provide encouragement. Expressions of confidence in the abilities of WOC and white women in STEM are associated with greater self-efficacy, hope, increased motivation, heightened sense of belonging, more engagement with the university, and persistence (Constantine & Sue, 2006; Fisher et al., 2019; Zeldin & Pajares, 2000). Of note is that such trainings must be carefully designed to avoid unintended negative consequences, such as the activation of social identity threat as was found in an investigation of a validated gender bias intervention (Pietri, et al., 2019). Finally, our findings reinforce the importance of having faculty, staff, and administrators support students in identifying mentors and counterspaces with shared-identity peers and affinity-based groups (Garcia, 2021; Ong et al., 2018). In the current study, these identity-based groups were especially salient to graduate WOC.

Administrators and faculty within STEM departments can and should also be advocating for faculty to learn and adopt a whole-person approach to mentorship. Part of this approach includes raising awareness of and responsiveness to the effects of socio-political challenges in students' lives. For Students of Color, as echoed by some of the participants in this study, systemic stressors such as racism and police brutality levy a considerable toll on students' mental health (McGee, 2020; Turner & Richardson, 2016). Faculty advisors need to be aware of how these social issues negatively impact students and move toward advising relationships that embody care for the whole person – including listening with empathy, providing emotional safety, and fostering emotional wellbeing along with academic success. These human-centered efforts will decrease the likelihood of students needing to compartmentalize the challenges occurring outside and inside their STEM environment.

Finally STEM faculty, staff, and administrators should learn to recognize signs of psychological distress. In this study, participants used words and expressions such as "crazy level of anxiety," anxiety attack, sink or swim culture, overwhelmed, embarrassed, discouraged, stressed out, depressed, guilty, terrifying ordeal, and worried about failure. While most students at times use terms like these, it is important for faculty to recognize them as potential red flags when they are combined with academic difficulties, lack of

productivity, absence, unusual fatigue, and health problems. By recognizing both verbal and non-verbal signs of distress early on, advisors can play a key role in preventing the detrimental toll on students' mental health. University mental health personnel can provide training for faculty in recognizing the signs of depression and anxiety. Additionally, although many students worry that admitting to counseling will diminish their stature with their advisor (Mousavi, et al., 2018), the common utilization of mental health care can be reframed as a powerful resource for caring for oneself in the pursuit of wellness. It is imperative that faculty, advisors, and staff within STEM departments advocate for the proactive use of mental health. For example, advisors can have on hand a list of support services available on campus, including counterspaces for Students of Color or a list of apps such as Liberate Meditate. Preventative strategies at the departmental level can include posting messages on department bulletin boards about attending to personal wellbeing; disseminating information about mindfulness and meditation groups over listservs, wellness resources on campus, local, and national affinity groups; and sponsoring invited talks by local counselors or psychologists on strategies for maintaining wellbeing.

Taken together, addressing systemic oppression in STEM and attending to the psychological sequelae of these marginalizing encounters have direct implications on graduate women's scholarly productivity and ability to thrive in STEM. In essence, students need to *be* well, in order to *do* well.

Conclusion

The present endeavor comes at a time when many have sounded the alarm that a 'mental health crisis' is plaguing STEM graduate education (Evans et al., 2018; Nagy et al., 2019), and this alarm comes amidst the inequitable representation of women, particularly WOC, across doctoral programs in STEM nationwide. Yet, there is a dearth in our understanding of how negative STEM climates differentially impact the mental health and STEM persistence of both WOC and white women in STEM doctoral programs. There is also an erasure of the unique ways in which institutional supports – particularly faculty advisors and administration – mitigate the psychological toll levied by the negative STEM climate. This research sheds new light on how psychological distress, an invisible but salient byproduct of chilly STEM climates, undercuts graduate women's persistence in STEM.

The narratives of graduate women in this study indicated that their decision to depart STEM prematurely was a preventative act to protect their mental health. These findings suggest that this toll has grave implications for efforts to broaden participation in STEM, particularly among graduate WOC. In addition to highlighting the deterrents to mental health and STEM persistence, this study also identified the sources of departmental and institutional support that graduate women found useful in buffering the impact of these negative experiences. Key contextual supports included advisors, peers, and shared gender- and racial-identity counterspaces (e.g., university staff members and UCCs). Taken together, this study supports the need for increased efforts to address the psychological ramifications of navigating STEM milieus imbued with structural racism and marginalizing encounters.

Authors' Contributions All authors contributed to the study conception and design. Data collection and analysis were performed by Kerrie Wilkins-Yel, Amanda Arnold, Jennifer Bekki Madison Natarajan, and Bianca Bernstein. The manuscript was collaboratively written by all authors of the manuscript. All authors read and approved the final manuscript.

Funding This work is supported by a collaborative National Science Foundation grant that was awarded to Drs. Bekki, Wilkins-Yel, Bernstein, and Randall (# 1761278 and # 2019533).

Availability of Data and Material The authors will adhere to all data transparency requirements.

Compliance with Ethical Standards

Ethics Approval This study received IRB approval from both Arizona State University (#00008323) and the University of Massachusetts Boston (# 2020082).

Consent to Participate The study involved research with human participants (adult women aged 18+). All women participated in informed consent and agreed to participate in the study.

Consent for Publication This manuscript has not been previously published nor is it under review at any other journal.

Conflicts of Interest/Competing Interests The authors declare that they have no conflict of interest.

References

Abrams, J. A., Hill, A., & Maxwell, M. (2019). Underneath the mask of the strong Black woman schema: Disentangling influences of strength and self-silencing on depressive symptoms among U.S. Black women. *Sex Roles*, *80*(9–10), 517–526.

Alexander, Q. R., & Hermann, M. A. (2016). African American women's experiences in graduate science, technology, engineering, and mathematics education at a predominantly white university: A qualitative investigation. *Journal of Diversity in Higher Education, 9*(4), 307–322. https://doi.org/10.1037/a0039705

Andersen, M. L., & Collins, P. H. (2001). Race, Class, and Gender: An Anthology (4th ed.). Belmont, California.: Wadsworth.

Arnold, A. C., Wilkins-Yel, K. G., Bekki, J. M., Bernstein, B. L., Natarajan, M., Randall, A. K., & Okwu, C. W. (2020a, January). Examining the effects of STEM climate on the mental health of graduate women from diverse racial/ethnic backgrounds.

In *Proceedings of the Annual Meeting of the Amerian Society of Engineering Education*.
Arnold, A. C., Wilkins-Yel, K. G., Bekki, J. M., Bernstein, B. L., Natarajan, M., Randall, A. K., & Owku, E. C. (2020b, January). Examining the Effects of STEM Climate on the Mental Health of Graduate Women from Diverse Racial/Ethnic Backgrounds. In *Proceedings of the 2020 American Society for Engineering Education Conference*.
Barthelemy, R. S., Mccormick, M., & Henderson, C. (2016). Gender discrimination in physics and astronomy: Graduate student experiences of sexism and gender microaggressions. *Physical Review Physics Education Research*, *12*(2).
Bernard, D. L., Lige, Q. M., Willis, H. A., Sosoo, E. E., & Neblett, E. W. (2017). Impostor phenomenon and mental health: The influence of racial discrimination and gender. *Journal of Counseling Psychology, 64*(2), 155–166. https://doi.org/10.1037/cou0000197
Bernstein, B. L. (2011). Managing barriers and building supports in science and engineering doctoral programs: Conceptual underpinnings for a new online training program for women. *Journal of Women and Minorities in Science and Engineering, 17*(1), 29–50.
Bernstein, B. L., Jacobson, R., & Russo, N. F. (2010). Mentoring woman in science, technology, engineering, and mathematics fields. In C. A. Rayburn, F. L. Denmark, M. E. Reuder, & A. M. Austria (Eds.), *A Handbook for Women Mentors: Transcending Barriers of Stereotype, Race, and Ethnicity* (pp. 43–64). Praeger.
Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa
Brown, B. A., Henderson, J. B., Gray, S., Donovan, B., Sullivan, S., Patterson, A., & Waggstaff, W. (2015). From description to explanation: An empirical exploration of the African American pipeline problem in STEM. *Journal of Research in Science Teaching, 53*(1), 146–177. https://doi.org/10.1002/tea.21249
Byars-Winston, A., Estrada, Y., Howard, C., Davis, D., & Zalapa, J. (2010). Influence of social cognitive and ethnic variables on academic goals of underrepresented students in science and engineering: a multiple-groups analysis. *Journal of Counseling Psychology, 57*(2), 205.
Camacho, M. M., & Lord, S. M. (2011). " Microaggressions" in engineering education: Climate for Asian, Latina and White women. In *2011 Frontiers in Education Conference (FIE)* (pp. S3H-1). IEEE.
Casad, B. J., Petzel, Z. W., & Ingalls, E. A. (2018). A model of threatening academic environments predicts women STEM majors' self-esteem and engagement in STEM. *Sex Roles, 80*(7–8), 469–488. https://doi.org/10.1007/s11199-018-0942-4
Case, A. D., & Hunter, C. D. (2012). Counterspaces: A unit of analysis for understanding the role of settings in marginalized individuals' adaptive responses to oppression. *American Journal of Community Psychology, 50*(1–2), 257–270. https://doi.org/10.1007/s10464-012-9497-7
Castro, A. R., & Collins, C. S. (2021). Asian American women in STEM in the lab with "White Men Named John." *Science Education, 105*(1), 33–61.
Charleston, L. J., George, P. L., Jackson, J. F., Berhanu, J., & Amechi, M. H. (2014). Navigating underrepresented STEM spaces: Experiences of Black women in US computing science higher education programs who actualize success. *Journal of Diversity in Higher Education, 7*(3), 166.
Council of Graduate Schools. (2019). *New Initiative to Support Graduate Student Mental Health and Wellness.* https://cgsnet.org/new-initiative-support-graduate-student-mental-health-and-wellness
Collective, C. R. (1977). *A Black Feminist Statement* (pp. 210–218). The Combahee River Collective Statement.
Collins, P. H. (1990). Black feminist thought in the matrix of domination. *Black Feminist Thought: Knowledge, Consciousness, and the Politics of Empowerment, 138,* 221–238.
Collins, P. H. (2000). Gender, black feminism, and black political economy. *The Annals of the American Academy of Political and Social Science, 568*(1), 41–53.
Collins, P. H. (2002). *Black feminist thought: Knowledge, consciousness, and the politics of empowerment*. Routledge.
Collins, P. H., & Bilge, S. (2016). *Intersectionality*. John Wiley & Sons.
Constantine, M. G., & Sue, D. W. (2006). Factors contributing to optimal human functioning in people of Color in the United States. *The Counseling Psychologist, 34*(2), 228–244.
Crenshaw, K. (1990). Mapping the margins: Intersectionality, identity politics, and violence against women of color. *Stanford Law Review, 43,* 1241.
Crenshaw, K. (1991). Mapping the margins: Identity politics, intersectionality, and violence against women. *Stanford Law Review, 43*(6), 1241–1299.
Cutrona, C. E., & Russell, D. W. (1987). The provisions of social relationships and adaptation to stress. *Advances in Personal Relationships, 1*(1), 37–67.
Dawson, A., Bernstein, B., & Bekki, J. (2015). Providing the psychosocial benefits of mentoring to women in STEM: CareerWISE as an online solution. *New Directions for Higher Education, 171*, 53–62. https://doi.org/10.1002/he.20142
DeBerard, M. S., Spielmans, G. I., & Julka, D. L. (2004). Predictors of academic achievement and retention among college freshmen: A longitudinal study. *College Student Journal, 38*(1), 66–81.
Deziel, M., Olawo, D., Truchon, L., & Golab, L. (2013). Analyzing the mental health of engineering students using classification and regression. In *Educational Data Mining 2013*.
Donovan, R. A., & West, L. M. (2015). Stress and mental health: Moderating role of the strong Black woman stereotype. *Journal of Black Psychology, 41*(4), 384–396. https://doi.org/10.1177/0095798417732414
Dutt, K. (2020). Race and racism in the geosciences. *Nature Geoscience, 13*(1), 2–3.
Edge, L. (2020). Science has a racism problem. *Cell, 181*, 1443–1444.
Evans, T. M., Bira, L., Gastelum, J. B., Weiss, L. T., & Vanderford, N. L. (2018). Evidence for a mental health crisis in graduate education. *Nature Biotechnology, 36*(3), 282–284.
Fisher, A. J., Mendoza-Denton, R., Patt, C., Young, I., Eppig, A., Garrell, R. L., & Richards, M. A. (2019). Structure and belonging: Pathways to success for underrepresented minority and women PhD students in STEM fields. *Plos One*, *14*(1).
Glaser, B. G. (1965). The constant comparative method of qualitative analysis. *Social Problems, 12*(4), 436–445. https://doi.org/10.1525/sp.1965.12.4.03a00070
Garcia, C. B. (2021). *Experiences Negotiating Racial and Ethnic Microaggressions as Underrepresented College Students Pursuing STEM* [Unpublished doctoral dissertation]. Fordham University.
Garcia-Williams, A. G., Moffitt, L., & Kaslow, N. J. (2014). Mental health and suicidal behavior among graduate students. *Academic Psychiatry, 38*(5), 554–560.
Golde, C. M. (2005). The role of the department and discipline in doctoral student attrition: Lessons from four departments. *The Journal of Higher Education, 76*(6), 669–700.
González, J. C. (2007). Surviving the doctorate and thriving as faculty: Latina junior faculty reflecting on their doctoral studies experiences. *Equity & Excellence in Education, 40*(4), 291–300.
Grandy, J. (1998). Persistence in science of high-ability minority students: Results of a longitudinal study. *The Journal of Higher Education, 69*(6), 589.

Gray, A. (2019). The Bias of 'Professionalism' Standards. *Stanford Social Innovation Review*. Retrieved from https://ssir.org/articles/entry/the_bias_of_professionalism_standards

Hayes, A. F., & Krippendorff, K. (2007). Answering the call for a standard reliability measure for coding data. *Communication Methods and Measures, 1*(1), 77–89.

Hoyle, R. H., & Crawford, A. M. (1994). Use of individual-level data to investigate group phenomena: Issues and strategies. *Small Group Research, 25*(4), 464–485.

Hurtado, S., & Figueroa, T. (2013). Women of color faculty in science technology engineering and mathematics (STEM): Experiences in academia. *Proceedings of the National Academy of Sciences: Seeking Solutions: Maximizing American Talent by Advancing Women of Color in Academia, June 2012, Washington, DC*.

Hwang, W.C., & Goto, S. (2009). The impact of perceived racial discrimination on the mental health of Asian American and Latino college students. *Asian American Journal of Psychology, S*(1), 15–28. https://doi.org/10.1037/1948-1985.S.1.15

Hyun, J., Quinn, B., Madon, T., & Lustig, S. (2007). Mental health need, awareness, and use of counseling services among international graduate students. *Journal of American College Health, 56*(2), 109–118. https://doi.org/10.3200/JACH.56.2.109-118

Hyun, J. K., Quinn, B. C., Madon, T., & Lustig, S. (2006). Graduate student mental health: Needs assessment and utilization of counseling services. *Journal of College Student Development, 47*(3), 247–266.

Inzlicht, M., Aronson, J., & Mendoza-Denton, R. (2009). On being the target of prejudice: Educational implications. *Coping with minority status: Responses to exclusion and inclusion*, 13-37. https://doi.org/10.1017/cbo9780511804465.002

Joseph, J. (2012). From one culture to another: Years one and two of graduate school for African American women in the STEM fields. *International Journal of Doctoral Studies, 7*(1), 125–142.

Kram, K. E. (1983). Phases of the mentor relationship. *Academy of Management Journal, 26*(4), 608–625. https://doi.org/10.5465/255910

Krippendorff, K. (2004). *Content analysis: An introduction to its methodology*. SAGE Publications.

Lee, H. S., Flores, L. Y., Navarro, R. L., & Kanagui-Muñoz, M. (2015). A longitudinal test of social cognitive career theory's academic persistence model among Latino/a and White men and women engineering students. *Journal of Vocational Behavior, 88,* 95–103.

Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice, and performance. *Journal of Vocational Behavior, 45*(1), 79–122. https://doi.org/10.1006/jvbe.1994.1027

Lent, R., Singley, D., Sheu, H., Schmidt, J., & Schmidt, L. (2007). Relation of social-cognitive factors to academic satisfaction in engineering students. *Journal of Career Assessment, 15*(1), 87–97. https://doi.org/10.1177/1069072706294518

Lent, R. W., & Brown, S. D. (2019). Social cognitive career theory at 25: Empirical status of the interest, choice, and performance models. *Journal of Vocational Behavior*, *115*, 103316.

Levecque, K., Anseel, F., Beuckelaer, A. D., Heyden, J. V. D., & Gisle, L. (2017). Work organization and mental health problems in PhD students. *Research Policy, 46*(4), 868–879. https://doi.org/10.1016/j.respol.2017.02.008

Louden, J. E., & Skeem, J. (2008) Results of UC Irvine survey of graduate students' mental health [PDF file]. https://www.grad.uci.edu/forms/current-student/SurveyResultsJS.pdf

Lovitts, B. (2001). *Leaving the ivory tower: The causes and consequences of departure from doctoral study*. Rowman & Littlefield Publishers.

Mallinckrodt, B., & Leong, F. T. L. (1992). Social support in academic programs and family environments: Sex differences and role conflicts for graduate students. *Journal of Counseling & Development, 70*(6), 716–723.

McGee, E. O. (2020). Interrogating structural racism in STEM higher education. *Educational Researcher, 49*(9), 633–644.

McGee, E. O. (2021). *Black, brown, bruised: How racialized STEM education stifles innovation*. Harvard Education Press.

McGee, E. O., Griffith, D. M., & Houston, S. (2019). "I know I have to work twice as hard and hope that makes me good enough": Exploring the stress and strain of Black doctoral students in engineering and computing. *Teachers College Record., 121*(4), 1–38.

Miner, K. N., January, S. C., Dray, K. K., & Carter-Sowell, A. R. (2019). Is it always this cold? Chilly interpersonal climates as a barrier to the well-being of early-career women faculty in STEM. *Equality, Diversity and Inclusion: An International Journal, 38*(2), 226–245.

Mojtabai, R. (2007). Americans' attitudes toward mental health treatment seeking: 1990–2003. *Psychiatric Services, 58*(5), 642–651. https://doi.org/10.1176/ps.2007.58.5.642

Morrow, S. (2005). Quality and trustworthiness in qualitative research in counseling psychology. *Journal of Counseling Psychology, 52*(2), 250–260.

Mousavi, M. P. S., Sohrabpour, Z., Anderson, E. L., Stemig-Vindedahl, A., Golden, D., Christenson, G., & Bühlmann, P. (2018). Stress and mental health in graduate school: How student empowerment creates lasting change. *Journal of Chemical Education, 95*(11), 1939–1946. https://doi.org/10.1021/acs.jchemed.8b00188

Nagy, G. A., Fang, C. M., Hish, A. J., Kelly, L., Nicchitta, C. V., Dzirasa, K., & Rosenthal, M. Z. (2019). Burnout and mental health problems in biomedical doctoral students. *CBE—Life Sciences Education*, *18*(2). https://doi.org/10.1187/cbe.18-09-0198

National Academies of Sciences, Engineering, and Medicine. (2018). *Graduate STEM education for the 21st century*. National Academies Press.

Nature. (2019). The mental health of PhD researchers demands urgent attention. 575, 257–258. https://doi.org/10.1038/d41586-019-03489-1

Navarro, R. L., Flores, L. Y., Lee, H. S., & Gonzalez, R. (2014). Testing a longitudinal social cognitive model of intended persistence with engineering students across gender and race/ethnicity. *Journal of Vocational Behavior, 85*(1), 146–155.

Nicpon, M., Huser, L., Blanks, E., Sollenberger, S., Befort, C., & Kurpius, S. (2006). The relationship of loneliness and social support with college freshmen's academic performance and persistence. *Journal of College Student Retention, 8*(3), 345–358. https://doi.org/10.2190/A465-356M-7652-783R

O'Brien, K. R., McAbee, S. T., Hebl, M. R., & Rodgers, J. R. (2016). The impact of interpersonal discrimination and stress on health and performance for early career STEM academicians. *Frontiers in Psychology, 7*, 615. https://doi.org/10.3389/fpsyg.2016.00615

Okahana, H. (2015). Pressing Issue: Mental Wellness of Graduate Students. *Council of Graduate Schools*, Washington, D.C. Retrieved from https://cgsnet.org/pressing-issue-mental-wellness-graduate-students-0#_ftn1

Oliver, M., Pearson, N., Coe, N., Gunnell, D., & Oliver, M. (2005). Help-seeking behaviour in men and women with common mental health problems: Cross-sectional study. *The British Journal of Psychiatry: the Journal of Mental Science*, 186, 297–301. Retrieved from http://search.proquest.com/docview/67569050/

Ong, M., Smith, J., & Ko, L. (2018). Counterspaces for women of color in STEM higher education: Marginal and central spaces for persistence and success. *Journal of Research in Science Teaching*, 55(2), 206–245. https://doi-org.proxyiub.uits.iu.edu/10.1002/tea.21417

Ong, M., Wright, C., Espinosa, L., & Orfield, G. (2011). Inside the double bind: A synthesis of empirical research on undergraduate and graduate women of color in Science, Technology, Engineering,

and Mathematics. *Harvard Educational Review*, *81*(2), 172–209. https://doi.org/10.17763/haer.81.2.t022245n7x4752v2

Pietri, E. S., Hennes, E. P., Dovidio, J. F., Brescoll, V. L., Bailey, A. H., Moss-Racusin, C. A., & Handelsman, J. (2019). Addressing unintended consequences of gender diversity interventions on women's sense of belonging in STEM. *Sex Roles, 80*(9), 527–547.

Posselt, J. (2018). Normalizing struggle: Dimensions of faculty support for doctoral students and implications for persistence and well-being. *The Journal of Higher Education, 89*(6), 988–1013.

Posselt, J. R. (2020). Supporting Graduate Student Mental Health and Wellbeing Consultant Paper. *Council of Graduate Schools*. Retrieved from https://www.cgsnet.org/ckfinder/userfiles/files/Consultant%20Paper%20Posselt%20Final.pdf

Primé, D. R., Bernstein, B. L., Wilkins, K. G., & Bekki, J. M. (2015). Measuring the advising alliance for female graduate students in science and engineering: An emerging structure. *Journal of Career Assessment, 23*(1), 64–78.

Razon, N. A., & Ross, K. (2012). Negotiating fluid identities: Alliance-building in qualitative interviews. *Qualitative Inquiry, 18*(6), 494–503.

Rosenthal, L., London, B., Levy, S., & Lobel, M. (2011). The roles of perceived identity compatibility and social support for women in a single-sex STEM program at a co-educational university. *Sex Roles, 65*(9–10), 725–736. https://doi.org/10.1007/s11199-011-9945-0

Saldaña, J. (2015). *The coding manual for qualitative researchers*. SAGE Publications.

Saravanan, C., & Wilks, R. (2014). Medical students' experience of and reaction to stress: The role of depression and anxiety. *The Scientific World Journal, 2014*, 1–8.

Sheehy, B. N. (2019). Support received from the dissertation advisor and the graduate student success of doctoral students majoring in the sciences. *Graduate Theses and Dissertations*. https://scholarcommons.usf.edu/etd/7937

Settles, I. H. (2004). When multiple identities interfere: The role of identity centrality. *Personality and Social Psychology Bulletin, 30*(4), 487–500.

Settles, I. H., Jellison, W. A., & Pratt-Hyatt, J. S. (2009). Identification with multiple social groups: The moderating role of identity change over time among women-scientists. *Journal of Research in Personality, 43*(5), 856–867.

Solórzano, D. G. (1998). Critical race theory, race and gender microaggressions, and the experience of Chicana and Chicano scholars. *International Journal of Qualitative Studies in Education, 11*(1), 121–136.

Sowell, R., Allum, J., & Okahana, H. (2015). *Doctoral initiative on minority attrition and completion (DIMAC Report)*. Council of Graduate Schools.

Stanton, A. G., Jerald, M. C., Ward, L. M., & Avery, L. R. (2017). Social Media Contributions to Strong Black Woman Ideal Endorsement and Black Women's Mental Health. *Psychology of Women Quarterly, 41*(4), 465–478. https://doi.org/10.1177/0361684317732330

Thompson, V. L. S., Bazile, A., & Akbar, M. (2004). African Americans' perceptions of psychotherapy and psychotherapists. *Professional Psychology: Research and Practice, 35*(1), 19–26. https://doi.org/10.1037/0735-7028.35.1.19

Tillman, L. C. (2002). Culturally Sensitive Research Approaches: An African American Perspective. *Educational Researcher, 31*(9), 3–12.

Torres, L., Driscoll, M. W., & Burrow, A. L. (2010). Racial microaggressions and psychological functioning among highly achieving African Americans: A mixed-methods approach. *Journal of Social and Clinical Psychology, 29*(10), 1074–1099.

Turner, E. A., & Richardson, J. (2016). Racial trauma is real: The impact of police shootings on African Americans. *Psychology Benefits Society, 14*.

UC Berkeley Graduate Assembly. (2014). *Graduate student happiness and well-being report* [PDF file]. http://ga.berkeley.edu/wellbeingreport/

Uebelacker, L., Eaton, C., Weisberg, R., Sands, M., Williams, C., Calhoun, D., Manson, J., Denburg, N., & Taylor, T. (2013). Social support and physical activity as moderators of life stress in predicting baseline depression and change in depression over time in the Women's Health Initiative. *Social Psychiatry and Psychiatric Epidemiology, 48*(12), 1971–1982. https://doi.org/10.1007/s00127-013-0693-z

Van der Doef, M., & Maes, S. (1999). The job demand-control (-support) model and psychological well-being: A review of 20 years of empirical research. *Work & Stress, 13*(2), 87–114. https://doi.org/10.1080/026783799296084

Varma, R., Prasad, A., & Kapur, D. (2006). Confronting the "socialization" barrier: Cross ethnic differences in undergraduate women's preference for IT education. In J. M. Cohoon & W. Aspray (Eds.), *Women and information technology: Research on underrepresentation* (pp. 301–322). MIT Press.

Watson, N., & Hunter, C. (2016a). "I had to be strong": Tensions in the strong Black woman schema. *Journal of Black Psychology, 42*, 424–452. https://doi.org/10.1177/0095798415597093

Watson, N. N., & Hunter, C. D. (2016b). "I had to be strong" tensions in the strong Black woman schema. *Journal of Black Psychology, 42*(5), 424–452.

Wilkins-Yel, K., Bekki, J.M., Bernstein, B.L., & Reed, A. (2019). Intersectional perspectives: Interpersonal contributors to moments of doubt for graduate WOC in STEM. In *Proceedings of the 2019 CoNECD (The Collaborative Network for Engineering and Computing Diversity) Conference*.

Wilkins-Yel, K. G., Hyman, J., & Zounlome, N. O. (2019b). Linking intersectional invisibility and hypervisibility to experiences of microaggressions among graduate women of color in STEM. *Journal of Vocational Behavior, 113*, 51–61.

Wilkins-Yel, K. G., Simpson, A., & Sparks, P. D. (2019c). Persisting despite the odds: Resilience and coping among women in engineering. *Journal of Women and Minorities in Science and Engineering, 25*(4), 353–368.

Zeldin, A. L., & Pajares, F. (2000). Against the odds: Self-efficacy beliefs of women in mathematical, scientific, and technological careers. *American Educational Research Journal, 37*(1), 215–246.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.