Supporting Women of Color in STEM Doctoral Programs: The Association Between

Academic Challenges and Symptoms of Distress and Possible Moderating Effects of

Academic Resilience and Perceived Social Support

by

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ABSTRACT

Despite an increasing number of women completing doctoral programs each year, there remains a deficit in the representation of women in the fields of science, technology, engineering, and mathematics (STEM). Moreover, Women of Color (WoC) in STEM doctoral programs face unique stressors and barriers that their male colleagues may not, such as microaggressions, racism, and sexism due to their marginalized identities. Although there is a growing body of research focusing on how WoC in STEM successfully navigate academic challenges and symptoms of distress present in rigorous doctoral training, there is limited research examining intrapersonal (i.e., academic resilience) and interpersonal (i.e., perceived social support) factors that may mitigate the negative associations of these experiences. To address these gaps in the literature, the present study gathered data from 174 WoC during December 2021 and January 2022. Results supported the hypothesis that academic challenges would be positively associated with symptoms of distress. Furthermore, based on research showing positive associations between both academic resilience and social support and psychological well-being, the study also examined whether academic resilience and perceived social support from friends and romantic partners. While academic resilience was not found to moderate the association between academic challenges and symptoms of distress, perceived social support was found to have moderating effects, such that low and high levels of perceived social support increased the strength of the positive association between academic challenges and symptoms of distress. Results of the present study have implications for doctoral programs and mental health practitioners working at university college centers

and support for need for the enhancement of the structure and process of the doctoral

program experience for WoC in STEM.

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CHAPTER 1

INTRODUCTION

The COVID-19 pandemic has exacerbated mental health concerns among graduate students, further increasing the need for accessible mental health resources on college campuses (Bukko & Dessi, 2021). Indeed, there is a growing mental health crisis among graduate students compared to ever before (Woolston, 2021). In December 2020, the American Council on Education (ACE) reported that mental health was identified by 68% of university presidents as one of their most pressing issues, yet efforts by universities to address and prevent mental health concerns among students are lacking. Particularly, graduate students are at an elevated risk for psychological disorders, such as anxiety and depression, given to the intense stress that graduate programs entail (Liu et al., 2022).

Even prior to the COVID-19 pandemic, upwards trends regarding the prevalence of psychological disorders, with anxiety and depression at the forefront, were identified among graduate students (e.g., Oswalt et al., 2020). According to a survey with graduate students, 41% scored in the moderate to severe range for anxiety and 39% scored in the moderate to severe range for depression (Evans et al., 2018). Moreover, in a sample of PhD students in science and engineering, approximately half the students indicated that they were depressed (Bernstein, 2015). Researchers have called upon universities and educators to pay attention to the needs of their graduate students, including investing in mental health and student support resources, especially for students who may be traditionally underrepresented in their degree fields.

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While more women are enrolling in doctoral programs in the United States (U.S.) each year, there continues to be a significant gap in their representation in the fields of science, technology, engineering, and mathematics (STEM) (National Science Foundation, 2021). Moreover, the pursuit of a PhD is an intensely stressful endeavor comprised of new challenges and rigorous training. In addition to academic challenges, women report facing gender specific barriers, such as overt sexism and forms of exclusion, which are associated with symptoms of distress, as they navigate STEM disciplines that have historically been led by men (Arnold et al., 2022; Cabay et al., 2018; De Welde & Larsen, 2011). These challenges may be particularly pronounced for Women of Color (WoC) in STEM, given their intersecting identities as a woman and as a person of Color, specifically their experiences of both gendered and racialized discrimination (Ong et al., 2011). Indeed, WoC continue to leave STEM doctoral programs at a higher rate than men likely because of their day-to-day experiences of microaggressions, racism, and sexism (Bekki et al., 2013; Bernstein & Russo, 2008; Sowell et al., 2015; Wilkins-Yel et al., 2019).

The high rate of attrition among WoC in STEM doctoral programs may also be rooted in the quality and structure of the graduate program (Holmes et al., 2019). For example, this can include the development and maintenance of supportive resources and environments, such as peer group interactions, mentoring, and facilitating diversity and inclusion (Lovitts, 2000). Specifically, Ong et al. (2017) identified the first year of doctoral studies for WoC in STEM to be crucial in determining their persistence in the program, with students attributing dropping out of their programs to finances, lack of support, and program structure. Moreover, Cabay et al. (2018) found that WoC attributed

dropping out of engineering to discouraging academic climates rather than academic difficulties. It is likely that these "chilly climates" negatively impact female doctoral student's ability to navigate academic challenges (Crawford & MacLeod, 1990). Beyond the academic structure, it is important to consider both individual or *intrapersonal* and relational or *interpersonal* factors that may influence the experiences of WoC in STEM, and in particular experiences of academic resilience.

Academic resilience is defined as a student's capacity to overcome adversity, or stressors, that may be a threat to their educational development (Martin & Marsh, 2009). Prior research with 160 Latino high school students has found academic resilience to be positively associated with academic achievement (Fallon, 2010), suggesting that interventions fostering increased resilience within academic programs could be extremely beneficial for student persistence. Additionally, having a supportive environment may position WoC in STEM to experience lower symptoms of distress, which may contribute to their persistence in completing their degree program.

Taken together, the present study examined the association between academic challenges and symptoms of distress for WoC in STEM doctoral programs. While the positive association between perceived academic challenges and symptoms of distress are robustly present in the literature (Cabay et al., 2018; De Welde & Larsen, 2011; Gunter & Stambach, 2005), the question remains: where do WoC in STEM doctoral programs find support? Thus, the present study also examined academic resilience and social support received from friends and romantic partners as potential moderators between the positive association between academic challenges and symptoms of distress.

Academic Challenges and Symptoms of Distress

Perceived academic challenges refer to the challenges unique to the student experience, such as challenges with transitioning to graduate school, balancing program demands with personal life, lack of support, competition, and feelings of inadequacy within the graduate program (Lovitts, 2000). These challenges tend to increase from undergraduate to doctoral programs (Myers & Pavel, 2011), and manifest as doctoral students work to excel in challenging courses, conducting research, teaching in the classroom, and rigorous doctoral training. Specifically, those in STEM programs may experience an intense pressure to achieve that can be accompanied by a severely competitive environment (Bernstein & Russo, 2008). Furthermore, prior research with STEM doctoral students has indicated that this competitive environment can be especially unwelcoming and problematic for women, and WoC in particular (De Welde & Larsen, 2011).

Women in STEM face a unique array of academic challenges as they progress toward degree completion in a field that lacks female representation and role models (Good et al., 2012; Smyth & Nosek, 2015). Specifically, they may experience feelings of pressure to conform to masculine norms, while also learning to navigate gender specific barriers (Cabay et al., 2018; Fabert et al., 2011; Gunter & Stambach, 2005). Women in STEM have also voiced feeling less satisfied with the advising and career preparation received in their doctoral programs in comparison to their male colleagues (Ruud et al., 2016). Furthermore, prior research has shown that women indicate feeling marginalized, invisible, isolated, and alone in their STEM doctoral programs, considering that they must navigate both race and gender-based disadvantages (Ong et al., 2011). As such, these academic challenges and accumulated disadvantages are often associated with

WoC's experiences of psychological distress (Mcgee & Bentley, 2017; Ong et al, 2017, Wilkins-Yel et al., 2021). Therefore, it is important to identify protective factors, such as academic resilience and perceived social support, that may reduce the negative effect of such experiences and lend themselves to positive outcomes (Bekki et al., 2013; Caplan, 1981; Fallon, 2010; Mallinckrodt & Leong, 1992; Martin, 2013). To address this, the present study examined both *intrapersonal* (i.e., academic resilience) and *interpersonal* (i.e., perceived social support) factors as possible moderators for the hypothesized positive association between academic challenges and symptoms of distress.

Possible Moderating Effects of Academic Resilience and Social Support

Resilience is a broadly researched psychological construct that accounts for an individual's experience of, or potential for, positive adaptation in the presence of challenging circumstances (Riley & Masten, 2005). Akin to the term resilience, *academic resilience* refers to educational success despite adversity within an academic context (Martin & Marsh, 2009). Academic resilience involves the interaction of protective and risk factors as well as adaptation and coping strategies (Fergus & Zimmerman, 2005). In addition to intrapersonal factors, such as academic resilience, it is important to consider interpersonal factors, such as social support, that may buffer the hypothesized association between academic challenges and symptoms of distress. *Perceived social support* can be defined as an individuals' perceived availability and accessibility of help or empathy from others when needed (Sarason & Sarason, 1985), such as friends and romantic partners (Zimet et al., 1988). Previous research with graduate students has deemed social support to be positively associated with well-being (Byers et al., 2014; Goplerud, 1980; Haynes et

al., 2012). Specifically, social support has been indicated to be an invaluable resource in student achievement and stress management (Caplan, 1991; Stratton et al., 2006).

For WoC in STEM, support from close others has been found to be critical factors in long-term student success (Chang et al., 2011; Espinosa, 2011; Ong et al., 2011). Additionally, academic resilience has been deemed to be important for graduate student persistence and achievement, and further research with WoC in STEM doctoral programs is needed (Bekki et al., 2013). Therefore, the proposed study examined how WoC in STEM doctoral programs report navigating the challenges and stressors of graduate school, and whether associations depend partly on their level of academic resilience and perceived social support.

Present Study

Black/African American, Hispanic/Latino, and American Indian women accounted for 3.31% of all individuals earning engineering doctorate degrees in 2017 (National Science Foundation, 2019). Considering the disproportion of WoC participating in and completing STEM doctoral degrees as compared to men and White women (Carlone & Johnson, 2007; Ong et al., 2011), there remains a gap in the research examining protective factors in the persistence of WoC in these programs. More specifically, WoC in STEM have distinguished academic difficulties, self-doubt, lack of interpersonal support, and difficult interpersonal interactions as notable academic challenges (Arnold et al., 2020). In addition, previous research with female doctoral student samples have highlighted the intense stress that women indicate experiencing throughout their doctoral endeavors (Oswalt & Riddock, 2007; Wao et al., 2010);

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however, social support has been found to buffer against the negative effects of stress (Cohen & Wills, 1985; Lovitts, 2005; Munir & Jackson, 1997).

The present study aimed to collect cross-sectional self-report data from WoC enrolled in STEM doctoral programs in the U.S. to examine the association between perceived academic challenges and symptoms of distress. Based on literature that highlights a (positive) association between academic challenges and symptoms of distress (Arnold et al., 2020; Byers et al., 2014; Offstein et al., 2004), it was hypothesized that academic challenges will be positively associated with symptoms of distress (Hypothesis 1).

This study also examined both intrapersonal and interpersonal factors that may moderate the hypothesized (positive) association between academic challenges and symptoms of psychological distress. First, based on literature to suggest a positive association between academic resilience and student persistence and achievement (Bekki et al., 2013; Fallon, 2010; Martin, 2013), it was hypothesized that academic resilience would buffer the (positive) association between academic challenges and symptoms of distress (Hypothesis 2), such that WoC who report higher levels of academic resilience will report lower levels of symptoms of distress. Second, based on literature suggesting a positive association between social support and psychological functioning (Cohen & Wills 1985; Stratton et al., 2006), it was hypothesized that perceived social support would buffer the (positive) association between academic challenges and symptoms of distress (Hypothesis 3), such that WoC who perceive higher levels of support will report lower levels of symptoms of distress. Lastly, a 2-way interaction between academic resilience and social support was examined. Specifically, it was hypothesized that those who report

high levels of academic resilience and social support will report lower levels of symptoms of distress, compared to those who report low levels of academic resilience and support (Hypothesis 4).

CHAPTER 2

METHOD

Author Positionality

I have taken into consideration my positionality as a White, cisgender woman and second-year master's student in the development, implementation, and dissemination of this study's findings. My master's program in counseling is grounded in multiculturalism, which gives me unique perspectives on the aspects of my identity that give me significant power and privilege. I also recognize the responsibility I have as a White woman engaged in social justice research to continue to unlearn and stop the ways in which I, and the systems in which I belong, perpetuate racism and systemic injustices (Davis & Linder, 2017).

Recruitment and Participants

Participants were recruited by sending the project flyer to STEM departments with doctoral programs at universities across the U.S (see Appendix E). Snowball sampling techniques were also implemented. Participants needed to meet the following criteria to participate: 1) be over the age of 18, 2) identify as a Woman of Color (WoC), and 3) be enrolled in a STEM PhD program. One hundred ninety-seven WoC expressed interest in the current study. Eight were excluded because they did not meet the eligibility criteria (i.e., did not identify as a WoC and were not enrolled in a STEM doctoral program), and 15 were excluded due to missing data (i.e., completed less than 80% of the survey). The final sample included 174 WoC.

Participants ranged in age from 21 to 46 years ($M = 26.47$, $SD = 4.23$). Of those who completed the survey, 56.9% ($n = 99$) identified as Asian American, 25.9% ($n = 45$)

as Black or African American, 16.7% ($n = 29$) as Hispanic or Latino, 1.7% ($n = 3$) as American Indian or Alaska Native, 1.1% ($n = 2$) as Native Hawaiian or Pacific Islander, and 13.8% ($n = 24$) as Other (e.g., Middle Eastern). Participants reported their sexual orientation as heterosexual ($n = 113$), bisexual ($n = 27$), queer ($n = 14$), lesbian ($n = 4$), gay ($n = 1$), and other ($n = 7$).

Regarding relationship status, 42% ($n = 73$) participants reported that they were single, 26.4% ($n = 46$) were in a committed relationship and not living with their partner, 10.3% ($n = 18$) were in a committed relationship and living with their partner, 15.5% ($n = 27$) were married to their partner, and 5.7% ($n = 10$) were engaged to their partner.

Overall, the sample included a wide range of STEM doctoral program fields, with 11.2% ($n = 19$) of participants studying Chemistry or Biochemistry, 10.6% ($n = 18$) Biology or Microbiology, 9.4% ($n = 16$) Biomedical Engineering or Informatics, 8.8% ($n = 15$) Chemical Engineering, 7.6% ($n = 13$) Computer Science, 6.5% ($n = 11$) Environmental Life Sciences, 6.5% ($n = 11$) Mathematics or Applied Mathematics, 4.7% ($n = 8$) Electrical, Industrial, or Mechanical Engineering, 4.7% ($n = 8$) Molecular and Cell Biology, 4.1% ($n = 7$) Physics, 4.1% ($n = 7$) Materials Science and Engineering, 3.5% ($n = 6$) Neuroscience, 2.9% ($n = 5$) Civic, Environmental, and Sustainable Engineering, 2.9% ($n = 5$) Evolutionary Biology, 2.4% ($n = 4$) Aerospace Engineering, 2.4% ($n = 4$) Astrophysics, 1.8% ($n = 3$) Computer Engineering, 1.8% ($n = 3$) Geological Sciences, 1.2% ($n = 2$) Statistics, and 2.9% ($n = 5$) 'Other.'

Lastly, 36.2% ($n = 63$) of participants reported being an international student.

Procedure

Emails were sent to the department heads and administrative assistants of STEM doctoral programs across the U.S. asking them to send the study flyer to their student listservs (see Appendix E). Interested participants were provided a link and QR code to the screening survey to determine eligibility. Participants were also able to access the screening survey link directly from social media posts.

Once participants accessed the survey, they were first presented with the informed consent and questions related to eligibility. Eligible participants were automatically directed to the research survey (see Appendix C). Total participation took approximately 30 minutes. At the end of the survey, participants could choose to opt into a raffle for the opportunity to be compensated for their participation. Two hundred five participants opted into the raffle and 30 participants were randomly selected to receive a $25 Amazon gift card.

Measures

Screening

Interested participants took an initial screening questionnaire to determine their eligibility (See Appendix A).

Demographics

Participants were asked to provide standard demographic information, in addition to information regarding their degree program (See Appendix B).

Perceived Academic Challenges

Perceived academic challenges were measured using a list of 14 commonly identified challenges that many women in STEM graduate programs report (Randall et al., 2020; See Appendix C). Participants were asked to identify academic challenges they

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have experienced from the list of 14 challenges. Sample items of the academic challenges assessed include: "challenges transitioning to graduate school," "challenges related to comprehensive exams," and "interpersonal issues with academic peers or colleagues (e.g., conflict, competitiveness, exclusion, lack of support, etc.)." There are also items pertaining to feelings of burnout and research challenges.

For each acknowledged challenge, participants are asked to report how much each challenge interfered with their academic work/progress to degree completion on a 5-point rating scale ranging from 1 = *not at all* to 5 = *a lot.* For scoring purposes, scores were summed, such that high scores reflected greater academic challenges. The scale reliability was Cronbach's α = .82 for the study sample.

Symptoms of Distress

Symptoms of distress were measured using the Depression, Anxiety, and Stress Scale-21 (DASS-21; Lovibond & Lovibond, 1995; see Appendix C). The DASS-21 contains three 7-item subscales: Depression, Anxiety, and Distress; however, for the purpose of this study the full scale was utilized (i.e., total scores of psychological distress). A sample statement from the Depression subscale is, "I couldn't seem to experience any positive feeling at all." A sample statement from the Anxiety subscale is, "I felt I was close to panic." A sample statement from the Stress subscale is, "I tended to over-react to situations." The DASS-21 items ask participants to rate how much each statement applied to them over the past week on a 4-point rating scale ranging from 0 = *did not apply to me at all* to 3 = *applied to me very much or most of the time*. A higher score on each individual subscale indicates higher levels of that subscale. Total score was computed by summing scale items such that a higher total score indicates higher levels of

overall symptoms of distress. The scale reliability was Cronbach's $\alpha = .94$ for the study sample.

Academic Resilience

Academic resilience was measured using the Academic Resilience Scale (ARS-30; Cassidy, 2016; See Appendix C). The ARS-30 is a 30 item self-report scale designed to assess the psychological construct of resilience, or success despite adversity, within an academic context. Scale items consist of positive and negatively phrased cognitive-affective and behavioral responses to adversity informed by prior research. For the purpose of this study, the ARS-30 was adapted to reflect academic resilience within the context of a STEM doctoral program. Participants were asked to read the following paragraph before responding to the scale items:

> You have received feedback from reviewers for a recent journal article submission, and the journal has chosen to 'reject' your paper. The feedback from the reviewers is quite critical, including reference to 'lack of appropriate experimental design' and 'poor writing and expression,' and it also includes concrete suggestions for how the work could be improved. The peer reviews for two other recent conference papers you submitted were also less favorable than you would want; similar comments were made by reviewers of these conference papers as those made for your journal article.

A sample statement from the ARS-30 is, "I would use the feedback to improve my work." Another sample item is, "I would use my past successes to help motivate myself." Participants were then to rate how much each statement applied to them on a 5-point Likert scale ranging from 1 = *likely* to 5 = *unlikely*. Total score was computed by

summing responses to the 30 individual items, with a possible total score ranging from 30–150. Positive items were reversed during scoring, wherein a higher ARS score indicated greater academic resistance. The subscale reliability was Cronbach's α = .89 for the study sample.

Perceived Social Support

Perceived social support was measured using the Multidimensional Scale of Perceived Social Support (MSPSS; Zimet et al., 1988; See Appendix C). The MSPSS is a 12-item measure designed to assess perceptions of social support adequacy from three specific sources: family, friends, and significant other. For the purpose of this study, the entire scale was used to assess for perceived social support. A sample statement from the MSPSS family subscale is, "my family really tries to help me when I am in need." A sample statement from the friends subscale is, "I can talk about my problems with my friends." A sample statement from the significant other subscale is, "there is a special person who is around when I am in need." Each of these groups (source of support) consists of four items that ask participants to rate each statement on a 7-point rating scale ranging from 1 = *very strongly disagree* (1) to 7 = *very strongly agree*. The total score is computed by calculating the mean score of the MSPSS 12 items. A higher score on the MSPSS indicated higher levels of perceived social support, and a higher score on each subscale indicated higher levels of support from that specific source. The scale reliability was Cronbach's α = .91 for the study sample.

Control Variables

Gender-Racial Microaggressions

Gender-racial microaggressions were measured using the18-item STEM Gender-Racial Microaggression Scale (Wilkins-Yel et al., 2021). The Gender-Racial Microaggressions Scale is designed to assess gender and racial microaggressions within three 6-item subscales: (1) *unwelcomed*, *ignored*, and *excluded*, (2) *exoticization* and *sexual objectification*, and (3) *delegitimization of credibility*. Participants were asked to indicate the frequency with which each event listed has occurred to them within their STEM department. A sample item from the unwelcomed, ignored, and excluded subscale includes, "my colleagues have made me feel unwelcomed in my STEM program." A sample item from the exoticization and sexual objectification subscale includes, "I have been told that I am "exotic" because of my race and gender." A sample item from the delegitimization of credibility subscale includes, "a colleague expressed surprise that I, as a Women of Color, was knowledgeable about a topic related to my field." For scoring purposes, scores were summed, such that high scores for each subscale reflected greater levels of gender-racial pertaining to that category, and high total scores reflected greater levels of gender-racial microaggressions. The scale reliability was Cronbach's $\alpha = .93$ for the study sample.

Data Analysis

Prior to hypothesis testing, data was checked for skewness and kurtosis. Skewness and kurtosis fell within the acceptable range for all variables except the control variable. The skewness of gender and racial microaggressions (Wilkins-Yel et al., 2021) was found to be 1.3, indicating that the distribution was right-skewed. Mean centering of gender-racial microaggressions, academic challenges, academic resilience and perceived social support was used to reduce the risk of multicollinearity between variables and to promote

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clearer interpretations (Shieh, 2011). Next, a hierarchical multiple regression analysis was conducted using SPSS 27 (IBM Corp., 2020) to test for the possible main effect of academic challenges on symptoms of distress (H1), and the interaction between academic resilience (H2) and perceived social support (H3) on symptoms of distress. Lastly, the 2-way interaction between academic resilience and perceived social support on the association between academic challenges and symptoms of distress was examined (H4).

To test H1, gender-racial microaggressions and academic challenges were entered into Model 1 to examine possible main effects on symptoms of distress. To test H2, academic resilience and the interaction term (academic challenges X academic resilience) was entered into Model 2. To test H3, perceived social support and the interaction term (academic challenges X perceived social support) was entered into model 3. To test H4, the interaction term (academic resilience X perceived social support) was entered into model 4.

CHAPTER 3

RESULTS

Descriptives

Descriptive statistics for the study variables can be found in Table 1. Results

showed significant positive correlations between academic challenges and symptoms of

distress ($r = .59$, $p < .001$), such that higher scores in academic challenges were

associated with higher symptoms of distress. Based on the list of 14 academic challenges,

participants reported an average of 6.90 academic challenges experienced within the past

year ($SD = 3.20$). Gender and racial microaggressions were positively correlated with

academic challenges ($r = .55$, $p < .001$) and symptoms of distress ($r = .49$, $p < .001$),

indicating that higher levels of microaggressions were associated with higher academic

challenges and symptoms of distress.

Additionally, academic resilience was negatively correlated with academic

challenges ($r = -.31$, $p < .001$) and symptoms of distress ($r = -.26$, $p < .001$), such that

higher scores in academic resilience were associated with lower academic challenges and

symptoms of distress. Perceived social support was also negatively correlated with

academic challenges ($r = -.19$, $p < .05$) and symptoms of distress ($r = -.19$, $p < .05$), such

that higher scores in perceived social support were associated with lower academic

challenges and symptoms of distress.

H1: Association Between Academic Challenges and Symptoms of Distress

It was hypothesized that academic challenges would be positively associated with

symptoms of distress, such that higher academic challenges would predict higher

symptoms of distress, controlling for gender-racial microaggressions. Model 1 was

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significant, $R = .63$, adjust $R^2 = .38$, $F(2, 163) = 52.46$, p < .001. Results showed that there was a significant main effect of academic challenges on symptoms of distress, $\beta = .94$ $p < .001$. As such, H1 was supported.

H2: Moderating Effects of Academic Resilience

It was hypothesized that academic resilience would moderate the (positive) association between academic challenges and symptoms of distress, such that academic resilience would buffer the association between academic challenges and symptoms of distress, controlling for gender-racial microaggressions.

In model 2, the R^2-change of .004 was not significant, adjusted $R^2 = .38$, $F(2, 161) = .52$, $p = .60$. Results showed that academic resilience did not moderate the association between academic challenges and symptoms of distress, $\beta = -.00$, $p = .62$. As such, H2 was not supported.

H3: Moderating Effects of Social Support

It was hypothesized that perceived social support would moderate the association between academic challenges and symptoms of distress, such that perceived social support would influence the strength of the possible association between academic challenges and symptoms of distress, controlling for gender-racial microaggressions.

In model 3, the R^2-change of .42 was not significant, adjusted $R^2 = .39$, $F(2, 159) = .52$, $p = .08$. However, results showed that there was a significant interaction between academic challenges and perceived social support on symptoms of distress ($\beta = .21$, $p = .03$), indicating that perceived social support moderated the association between academic challenges and symptoms of distress.

PROCESS (Hayes, 2013) was used to decompose the interaction. At low levels (-1 SD), perceived social support significantly strengthened the association between academic challenges on symptoms of distress ($\beta = .69$, 95% CI [.32, 1.1]). Similarly, at high levels (+ 1 SD) perceived social support strengthened the association between academic challenges on symptoms of distress ($\beta = 1.2$, 95% CI [.81, 1.6]). As shown in Figure 1, academic challenges predicted higher levels of symptoms of distress, and this effect was stronger for those who reported higher social support. As such, H3 was not supported.

H4: Interaction of Academic Resilience and Social Support

It was hypothesized that there would be a 2-way interaction between academic resilience and perceived social support on the association between academic challenges and symptoms of distress, such that the interaction of academic resilience and social support would influence the strength of the possible association between academic challenges and symptoms of distress, controlling for gender-racial microaggressions.

In model 4, the R^2-change of .41 was not significant, adjusted $R^2 = .39$, $F(2, 157) = .10$, $p = .91$. Results showed that there was not a significant 2-way interaction between academic resilience and perceived social support on the association between academic challenges and symptoms of distress ($\beta = .001$ $p = .82$). As such, H4 was not supported.

CHAPTER 4

DISCUSSION

The mental-health crisis among graduate students continues to gain the attention

of researchers and educators, yet universities are still limited in how they are addressing

student mental health issues, especially among traditionally marginalized groups (Evans,

2018; Oswalt et al., 2020; Woolston, 2021). Further, WoC remain underrepresented in

the fields of science, technology, engineering, and mathematics (STEM), despite the

growth and expansion these fields have seen in recent years (National Science

Foundation, 2021). Researchers have attributed the underrepresentation of WoC in

STEM, in part, to their daily experience of racism, sexism, microaggressions, and

tokenism (Bekki et al., 2013; Sowell et al., 2015; Wilkins-Yel et al., 2019). In addition to

the academic challenges and distress that comprise intensive doctoral programs, previous

research has called attention to "double bind" standards involving the gender and racial

discrimination that WoC in STEM doctoral programs face (e.g., Ong et al., 2011).

Using data collected from 174 participants between December 2021 and January

2022, results from the present study supported the hypothesis that WoC in STEM

experience discrimination related to their marginalized identities, as participants reported

experiencing both gender and racial microaggressions within their doctoral programs.

Given these negative experiences, which have also been documented previously in the

literature (Johnson et al., 2017; Ong et al., 2018; Wilkins-Yel et al., 2017), there is a need

for understanding potential protective factors for doctoral student persistence and

psychological well-being.

Prior research with graduate students has identified considerable mental health concerns related to the graduate student experience (Offstein et al., 2004; Oswalt & Riddock, 2007; Wao et al., 2010). These concerns have been found to be especially salient for doctoral students holding marginalized identities (Arnold et al., 2020; Saravanan & Wilks, 2014), however there is still a gap in the literature examining intrapersonal (e.g., academic resilience) and interpersonal (e.g., social support) factors that may mitigate symptoms of distress for WoC in STEM doctoral programs. While a growing body of literature has focused on the support that women seek within their STEM doctoral programs, highlighting the importance of the advisor-advisee relationship (Prime et al., 2014; Wilkins-Yel et al., 2022), additional research is warranted that is geared towards understanding where WoC find support outside of their academic program. The present study addressed this gap by considering both academic resilience (intrapersonal) and social support (interpersonal) as potential moderators for the association between academic challenges and symptoms of distress.

Academic Challenges and Symptoms of Distress

Doctoral students must navigate rigorous training, while simultaneously attempting to maintain, on some level, personal relationships, interests, and their overall health and psychological well-being (Haynes et al., 2011). The academic challenge reported most frequently in the current sample was a lack of confidence or feelings of inadequacy/imposter syndrome, followed by challenges transitioning to graduate school, research challenges, time management challenges, cultural challenges, and feelings of burnout. These results suggest that a variety of academic challenges exist for doctoral

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students as they navigate deadlines and work towards degree completion, which compliments prior literature (Arnold et al., 2020).

Academic challenges have been deemed to be a major contributor to psychological distress for doctoral students (Cabay et al., 2018; De Welde & Larsen, 2011). As such, the present study examined the association between academic challenges and symptoms of distress for WoC in STEM. As predicted, results from the present study supported the positive association between academic challenges and symptoms of distress for WoC in STEM doctoral programs.

Moderating Effect of Academic Resilience

Academic resilience refers to a student's capacity to overcome academically related adversity or stressors (Martin & Marsh, 2009). Based on the literature suggesting a positive association between resilience and student persistence and achievement for women in STEM (Bekki et al., 2013; Wilkins-Yel et al., 2021), it was hypothesized that academic resilience would moderate the (positive) association between academic challenges and symptoms of distress. Contrary to the hypothesis, academic resilience did not significantly moderate the association between academic challenges and symptoms of distress.

One of the factors that may have contributed to this result is the present study's modification of the academic resilience measure vignette to include a scenario related to academic resilience in a STEM doctoral program context (Cassidy, 2016). The scenario mirrored receiving feedback regarding the rejection of a recent journal article submission. While many doctoral students may be familiar with the processes for journal article and conference paper submissions and feedback, it is possible that some are not. Interestingly,

although the moderating effects of academic resilience were not supported, results showed that academic resilience was negatively associated with academic challenges and symptoms of distress. These results suggests that despite facing adversity, WoC in STEM develop resilience as a coping mechanism to manage and adapt to stressful situations (Windle et al., 2011).

Research on academic resilience within the context of higher education has identified additional personal characteristics that contribute to academic resilience, such as trust, autonomy, initiative, hard work, and identity (Morales, 2008). Academic resilience develops from a sense of purpose and community alongside students' identity and orientation to the future (Morales, 2010; Oyserman & Destin, 2010). Therefore, it is difficult to achieve an overall understanding of one's academic resilience without also taking their environment into account. For example, an individual's seemingly low academic resilience may be the product of an environment that inhibits rather than empowers them (e.g., WoC in STEM environments). These are factors that would be important to examine in future research.

Furthermore, influential people in the lives of WoC in STEM, such as advisors, have been found to play a role in student confidence and ability to succeed despite setbacks (Wilkins-Yel et al., 2021). Although predictions related to academic resilience were not supported in the present study, academic resilience was significantly associated with each of the study variables in the anticipated direction. In line with previous research, academic resilience was also positively associated with social support (Fergus & Zimmerman, 2005). These findings speak to the value in cultivating a psychologically

and emotionally supportive environment where students have a sense of belonging and can authentically express themselves.

Moderating Effect of Social Support

The psychological benefits of social support are well-documented (Cohen & Wills, 1985; Lovitts, 2005; Munir & Jackson, 1997). Additionally, support from close others has been found to be instrumental for psychological well-being as women cope with challenges within STEM environments (London et al., 2011; Prime et al., 2015). While studies have focused on support within the context of one's doctoral program, including the advisor-advisee relationship (Wilkins-Yel et al., 2022), the present study is unique in its investigation of perceived social support outside of the doctoral program.

This study hypothesized that perceived social support from family, friends, and significant others would buffer the positive association between academic challenges and symptoms of distress. Results from the present study did not support this hypothesis. Contrary to predictions, perceived social support strengthened the positive association between academic challenges and symptoms of distress. Academic challenges predicted higher levels of symptoms of distress, and this effect was stronger for people who reported higher social support. Notably, those who reported lower social support tended to report higher levels of distress, regardless of academic challenges, however, higher levels of social support did not buffer the effect of academic challenges on symptoms of distress.

These results could be related to inconsistencies regarding conceptualizing social support. Seeking support from others can be a healthy coping mechanism when challenges and distress arise (Offstein et al., 2004). Therefore, some participants

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experiencing increased levels of academic challenges and symptoms of distress may be more reliant on support from friends and family. Additionally, the present study accounts for sources of support, however it is unclear as to the amount of support participants are perceiving in their lives. It is one thing to be aware of the availability of support if needed and another to seek out support when one needs it. Thus, someone could have a high score for social support based on their perception of support in their life, yet not be actively engaging in behaviors related to maintaining supportive relationships, such as spending quality time with close others.

Students may be more likely to seek support from their advisor and peers within their program who can relate to the academic challenges that they may be experiencing, thus fostering a sense of community and belonging (Fisher et al., 2019; Good et al., 2012). Moreover, on account of social support being measured by participants' perceptions of support from their friends, family, and significant others, lower scores may be influenced by one's relationship status. As such, it is possible that single participants reported lower scores on the significant other subscale despite potentially having high levels of overall social support in their lives.

Lastly, it is important to consider the context to which the data were collected. The ongoing COVID-19 pandemic has undoubtably impacted human connection. For many, the last two years have been characterized by change and uncertainty (Horesh & Brown, 2020). Many students have been tasked with adjusting to a doctoral program while simultaneously navigating online learning, social distancing, and distress related to COVID-19 (Dubey et al., 2020). Interestingly, in a study seeking to understanding the impact of COVID-19 on doctoral students, Bukko and Dessi (2021) found relationships

with program faculty and peers to be integral to student persistence during the COVID-19 pandemic. Although the present study did not account for relationships within participants' doctoral programs, findings add to the literature by examining WoC's support outside of their doctoral programs.

Limitations

The present study is notwithstanding limitations. First, the study utilized a self-report methodology that relied on participant recall and was retrospective in nature. Limitations to self-report measures include the potential for dishonesty, social-desirability bias, and response-shift bias (Rosenman et al., 2011). Second, given the study design, participants were able to complete the survey in multiple sittings Additionally, some participants completed the survey in December 2021 and January 2022, which is a time that most U.S. universities hold their winter breaks; a time in which graduate school stressors are likely low.

Further, limitations related to the study measures may exist. While internal validity for the present study was strong, Cassidy's (2016) *Academic Resilience Scale* has not been previously validated to measure academic resilience for WoC and has not been previously validated with the vignette that was adapted for the present study. Similarly, Randall et al.'s (2022) *Perceived Academic Challenges Scale* and Wilkins-Yel et al.'s (2021) *Gender-Racial Microaggressions Scale* showed good internal validity ($\alpha = .82$ and $\alpha = .93$, respectively), however these have not been previously validated. Given these measures are not yet validated, threats to validity must be taken into consideration. Finally, in regard to the significant other subscale of Zimet et al.'s (1988) *Multidimensional Scale of Perceived Social Support*, it may be difficult to assess who

participants are conceptualizing 'significant person' as, and it is possible that this could include a romantic partner, mentor, or best friend.

It is also important to consider limitations that may exist due to the present study being conducted within the context of the COVID-19 pandemic. The COVID-19 pandemic exacerbated the mental health crisis (Breslau et al., 2021) and continues to have lasting implications for and beyond individual's doctoral program experience, stress, relationships, and resilience. In addition to academic challenges, students were also presented with new challenges related to the health and economic burden of the pandemic (Eigege & Kennedy, 2021). The present study did not assess for influences of the pandemic, a potentially significant contributor to participants' symptoms of distress.

Implications for Mental Health Professionals

Results from this study appeal to the need for multicultural competency training for mental health professionals, particularly those in University Counseling Centers. In particular for clinicians who see graduate student clients, and in particular clients of Color, presenting concerns may include experiences of discrimination and feelings of inadequacy, doubt, and lowered confidence in their abilities during their doctoral endeavors (Meyer, 2013; Wilkins-Yel, 2019). As such, mental health professionals can be crucial sources of support for WoC seeking mental health services by fostering and empowering growth and resilience in clients experiencing the adverse effects of their marginalized identities. Specifically, mental health professionals have a duty to advocate on behalf of their clients to influence change (ACA, 2014). Advocating for clients involves identifying systemic factors that may be acting as barriers to their clients' development (Lewis et al., 2022), such as unwelcoming and discriminatory STEM

settings. Mental health professionals can become allies and strive to change systems of oppression by working to rebuild communities and systems that operate in non-oppressive ways, including those that exist in university settings.

Given mental health professionals ethics associated with advocacy (ACA, 2014, Section A.7.a), they along with others (e.g., faculty and administrators), could work together to create a supportive academic environment. For example, faculty and staff working could work with mental health professionals to create programming to increase a sense of community for students. Programs could involve mental health professionals in the development of diversity and inclusion trainings, mental health resources, and positive mentoring strategies. Lastly, mental health professionals can play a role in educating faculty about the gender and racial barriers for WoC in STEM, including microaggressions and inherent power and privilege dynamics between faculty and students. While it may be inevitable that WoC navigate stress due to the demands of an intensive STEM doctoral program, there are ways that graduate programs can be more diligent in their efforts to support WoC.

Furthermore, the present study speaks to the importance of counselors engaging in continued reflective practice while acknowledging their potential biases and assumptions that may be influencing their work with students of Color. In a review of reflective practice, Taylor (2020) shares that "counselors need to know themselves to ensure cultural competencies, ethics of practice, appropriate analysis of power and oppression, for personal and professional development, and to use reflective practice as a supportive tool" (para. 23). For example, at my internship at ASU Counseling Services, my focus is to understand and validate the holistic experience of my clients, while propelling them in

the direction of tangible positive outcomes both professionally and personally. Therefore, it is critical for me to recognize the ways in which my identities, both visible and invisible, inform my research and practice. I address these intentionally by engaging clients in conversations about our shared and unshared identities, with consideration given to the inherent power and privilege within our working relationship.

Future Directions

While the findings of this study provide a glimpse into the lived experiences of WoC in STEM doctoral programs, they are unable to provide a comprehensive exploration of perspectives. As such, researchers are encouraged to consider qualitative methods of data collection that would allow for an in-depth investigation of the academic challenges, symptoms of distress, perceived social support, and academic resilience for WoC in STEM (as an example see Bekki et al., 2013). Future research could take this a step further by diving deeper into the academic challenges that WoC in STEM report. One of the ways in which future research could address this is with the use of qualitative data collection methods. The use of such methods allows for greater depth when it comes to people's attitudes and experiences (Griffin, 2004). Teasing apart academic challenges further could help highlight the specific components of academic challenges that have implications for symptoms of distress. For example, future research could explore academic challenges items such as "challenging department or lab changes" and "time management challenges" more closely to gain insight into the meaning participants might be making of these categories. It would also be helpful to further examine academic challenges by degree program and university.

Research is warranted to examine the distinct components of academic resilience that may be beneficial for student success and well-being, particularly for WoC in STEM. A longitudinal approach could be utilized to account for differences in responses based on time and progress in the doctoral program. For example, future directions might include a longitudinal investigation of the implementation of programming for STEM doctoral programs aimed towards fostering an environment of inclusion and a sense of belonging among WoC students. Researchers may also seek to investigate constructs similar to academic resilience, such as general resilience and perceived self-efficacy, as they relate to student persistence and psychological well-being. Moreover, studies could incorporate sources of support within (e.g., advising relationship, students in their cohort, and mental health resources) and outside of one's doctoral program (e.g., family, friends, and significant others) for a more comprehensive investigation of social support. In addition to sources of support, other factors (e.g., time spent socializing, physical proximity to loved ones, etc.) could give insight into the intricacies of social support as it relates to overall functioning and well-being for WoC in STEM fields.

Finally, researchers could work directly with faculty, staff, and other students to foster environments that promote student resilience. Researchers and clinicians can work alongside educators as they navigate the implementation of diversity and inclusion trainings, mentoring training, as such opportunities have been found to enhance student persistence and success (Fisher et al., 2019). Thus, future research is encouraged to identify protective factors within STEM programs, such as professional development training and mental health resources for WoC graduate students. It is possible that illuminating specific aspects of programs that are oriented toward increasing the well-

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being of the students enrolled in their programs could cultivate an environment that promotes student resilience, rather than merely expecting student resilience, could have positive implications for student retention, success, and overall doctoral experience.

Conclusion

Results of the present study provide implications for those holding positions of power at universities, namely STEM faculty and mental health professionals serving these communities. The present study examined the hypothesized positive association between academic challenges and symptoms of distress and moderating effects of academic resilience and perceived social support. Results from the present study suggest that the maintenance of supportive relationships outside of WoC's STEM doctoral programs can be beneficial for managing academic challenges and symptoms of distress. The study also demonstrated that greater gender and racial barriers were associated with greater academic challenges and symptoms of distress for WoC.

Implications of this work include identifying supportive networks for WoC in STEM who find themselves in traditionally White and male STEM environments. Additionally, it is important that those working with graduate students (e.g., staff and faculty) consider the barriers, discrimination, and negative mental health outcomes that individuals with marginalized identities experience. In doing so, individuals can empower students of Color by lifting them up and advocating for systemic change in academic circles to aid in feelings of belonging, which may ultimately increase rates of retention.

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APPENDIX A

TABLES AND FIGURES

Table 1

Descriptive Statistics for Study Variables

	M	SD	Range
Age	26.47	4.23	25
Gender-Racial Microaggressions	36.54	16.15	78
Academic Challenges	26.11	14.46	62
Symptoms of Distress	48.15	29.96	126
Academic Resilience	107.84	16.17	81
Perceived Social Support	5.33	1.18	5.50

Note. Age is presented in years.

Table 2

Correlations among Study Variables

	1.	2.	3.	4.	5.
1. Gender-Racial Microaggressions	-				
2. Academic Challenges	.59**	-			
3. Symptoms of Distress	.49**	.59**	-		
4. Academic Resilience	-.25**	-.31**	-.26**	.18*	-
5. Perceived Social Support	-.12	-.19*	-.19*		-

Note. * = *p* < .05; ** = *p* < .01; *** = *p* < .001.

Table 3
Academic Challenges, Academic Resilience, and Social Support on Symptoms of Distress

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
Intercept	48.4	1.83	-	47.88	<.001
Control					
Microaggressions	.45	.14	-.24	-2.70	.00
Main Effect					
Academic challenges	.94	.15	.46	1.47	<.001
Interaction					
Academic challenges x Academic resilience	-.00	.01	-.01	-.16	.87
Interaction	.21	.10	.13	2.1	.04
Academic challenges x Social support					
Interaction	.00	.01	.02	.23	.82
Academic challenges x Academic resilience x Social support					

*Note.* Microaggressions were measured with the Gender-Racial Microaggressions Scale (Wilkins-Yel et al., 2021).

Table 4

Regression Model Summaries Predicting Academic Challenges

	Model Significance	Adjusted R^2	F Change	df1	df2	Significant F Change
Model 1	<.001	.38	52.46	2	163	<.001
Model 2	<.001	.38	.00	2	161	.60
Model 3	<.001	.39	.02	2	159	.08
Model 4	<.001	.39	.00	2	157	.91

Note. Model 1: microaggressions (control), academic challenges (IV); Model 2: microaggressions (control), academic challenges (IV), academic resilience (MOD), academic challenges X academic resilience (MOD); Model 3: microaggressions (control), academic challenges (IV), social support (MOD), academic challenges X social support; Model 4: microaggressions (control), academic challenges (IV), academic resilience, academic challenges X academic resilience (MOD), social support (MOD), academic challenges X social support, academic resilience X social support, academic challenges X academic resilience X social support.

Figure 1. Social Support Moderates the Positive Association between Academic
Challenges and Symptoms of Distress
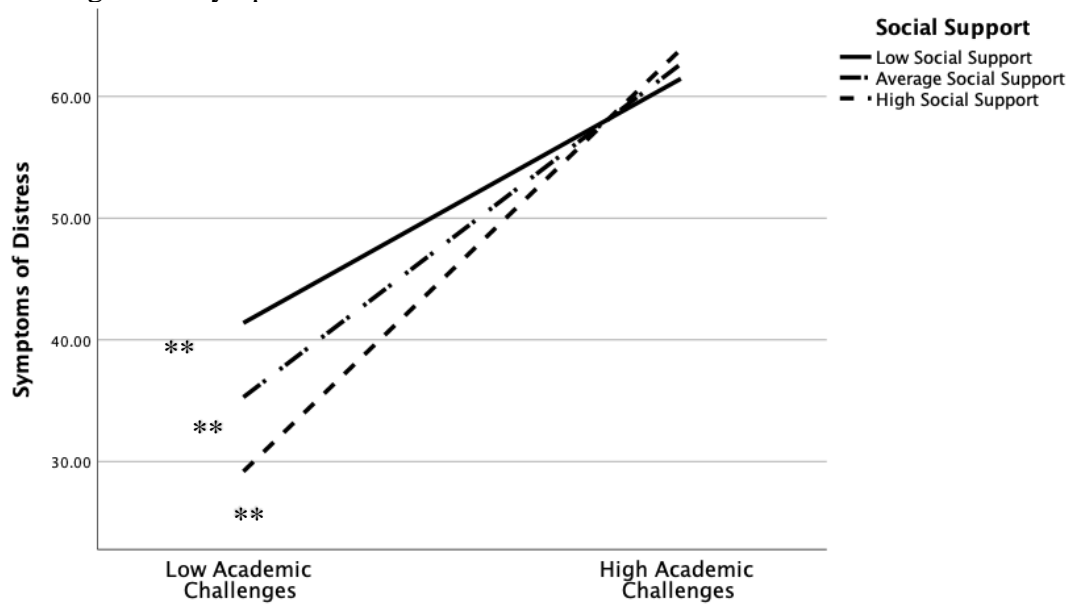
Note. Low Social Support = -1 SD; High Social Support = +1 SD; ** = significant slope

APPENDIX B

SCREENING QUESTIONS

1. Which of the following best describes your gender identity?
   - ○ Man   1
   - ○ Woman   2
   - ○ Other (please specify): _____   3
   - ○ Prefer not to report   4

2. Do you identify as a Woman of Color?
   - ○ Yes   1
   - ○ No   2

3. Are you currently enrolled in a science, technology, engineering, or mathematics (STEM) doctoral program?
   - ○ Yes   1
   - ○ No   2

APPENDIX C

DEMOGRAPHICS

1. What is your country of birth? _____ (dropdown)
2. *If "Other" is selected:*
   If other, please specify: _____

3. What is your current age?
   Years: _____
   Months: _____
4. Are you Hispanic or Latino?
   - ○ No, I am not Hispanic or Latino   1
   - ○ Yes, I am Cuban   2
   - ○ Yes, I am Mexican or Chicano   3
   - ○ Yes, I am Puerto Rican   4
   - ○ Yes, I am Other Hispanic or Latino (please specify): _____   5
   - ○ Prefer not to report   6

5. With which race(s) do you identify? (choose all that apply):
   - ○ American Indian or Alaska Native   1
   - ○ Asian   2
   - ○ Black or African American   3
   - ○ European American or White   4
   - ○ Native Hawaiian or Pacific Islander   5
   - ○ Other (please specify): _____   6

6. How strongly do you identify as a woman of Color?
   - ○ Not at all   0
   - ○ A little   1
   - ○ Moderate amount   2
   - ○ A lot   3

7. Are you an international student?
   - ○ Yes   1
   - ○ No   2

8. What is your primary language? _____

9. Please indicate your sexual orientation
   - a. Heterosexual   1
   - b. Bisexual   2
   - c. Lesbian   3
   - d. Gay   4
   - e. Queer   5
   - f. Other (please specify): _____   6
   - g. Prefer not to answer   7

10. What best describes your relationship status?
- ○ Single/Never married — 1
- ○ Single (separated, divorced, widowed) — 2
- ○ In a committed relationship, not living with my partner — 3
- ○ In a committed relationship, living with my partner — 4
- ○ Engaged to my partner — 5
- ○ Married to my partner — 6

11. What is your parenting status? (select all that apply)
- ○ I have one or more dependent children — 1
- ○ I have adult and/or non-dependent children — 2
- ○ I do not plan to have children in the future — 3
- ○ I plan to have children in the future — 4

12. Which of the following corresponds with your <u>highest</u> academic degree? (dropdown)
- ○ BS — 1
- ○ MA — 2
- ○ MS — 3
- ○ MBA — 4
- ○ PhD — 5
- ○ EdD — 6
- ○ DSc — 7
- ○ JD — 8
- ○ MD — 9
- ○ Other — 10

13. *If "Other" is selected:* If other, please specify: _____

14. Please select the field that most closely relates to your highest academic degree: (dropdown)
- ○ Aerospace, aeronautical, and astronautical engineering — 1
- ○ Agricultural sciences and natural resources — 2
- ○ Bioengineering and biomedical engineering — 3
- ○ Biological and biomedical sciences — 4
- ○ Chemical engineering — 5
- ○ Chemistry — 6
- ○ Civil engineering — 7
- ○ Computer and information sciences — 8
- ○ Electrical, electronics, and communications engineering — 9
- ○ Geosciences, atmospheric, and ocean sciences — 10
- ○ Health sciences — 11
- ○ Industrial and manufacturing engineering — 12
- ○ Materials science and engineering — 13
- ○ Mathematics and statistics — 14

○	Mechanical engineering	15
○	Physics and astronomy	16
○	Other	17

15. *If "Other" is selected:*
    If other, please specify: _____

16. Please select the field that most closely relates to your current academic program:
    (dropdown)

○	Aerospace Engineering	1
○	Applied Mathematics	2
○	Applied Mathematics for the Life & Social Sciences	3
○	Astrophysics	4
○	Biochemistry	5
○	Biological Design	6
○	Biology	7
○	Biomedical Engineering	8
○	Biomedical Informatics	9
○	Chemical Engineering	10
○	Chemistry	11
○	Civil, Environmental, & Sustainable Engineering	12
○	Computer Engineering	13
○	Computer Science	14
○	Electrical Engineering	15
○	Environmental Life Sciences	16
○	Evolutionary Biology	17
○	Exploration Systems Design	18
○	Geological Sciences	19
○	Industrial Engineering	20
○	Materials Science & Engineering	21
○	Mathematics	22
○	Mechanical Engineering	23
○	Microbiology	24
○	Molecular & Cellular Biology	25
○	Neuroscience	26
○	Physics	27
○	Statistics	28
○	Other	29

17. *If "Other" is selected:*
    If other, please specify: _____

18. In what calendar year did you begin graduate school?

19. In what calendar year did you begin your doctoral program?

20. What is your anticipated date of graduation?

21. Have you completed your Comprehensive Examination Requirements?
- ○ Yes   1
- ○ No   2

22. What percentage of your professional time is devoted to research?

APPENDIX D

RESEARCH SURVEY

STEM Gender-Racial Microaggression Scale (Wilkins-Yel et al., 2021)

The following items ask about your experiences as a Woman of Color in your STEM department. Please read each item and indicate the frequency with which each event has occurred to you in your STEM department.

Never	Less than once in a year	A few times in a year	About once a month	A few times a Month	Once a week or more
1	2	3	4	5	6

Subscale - Unwelcomed, ignored, and excluded
1.   I am excluded from social activities by my white colleagues.
2.   A peer has made me feel like I am the "odd one out."
3.   My colleagues have made me feel unwelcomed in my STEM program.
4.   I have been excluded from conversations by my white female colleagues.
5.   I have felt excluded from a project that required teamwork.
6.   My STEM program was not designed for people who look like me.

Subscale - Exoticization & Sexual objectification
7.   I have been told that I am "exotic" because of my race and gender.
8.   A male peer has made a lewd or inappropriate comment about my body.
9.   A colleague implied that I was only admitted to the STEM graduate program because of my race and gender identities.
10.   I have experienced unwanted attention from my male colleagues when I wear articles of clothing such as skirts and dresses.
11.   People have made inappropriate comments about my body.
12.   I have felt sexually objectified by men in my STEM department.

Subscale - Delegitimization of credibility
13.   A colleague expressed surprise that I, as a Woman of Color, was knowledgeable about a topic related to my field.
14.   Someone assumed that I needed help/support without asking me.
15.   Someone in authority ignored a point I made but later supported this same point when it was raised by a male colleague.
16.   My opinions have gone unacknowledged in discussions.
17.   Someone in authority expressed their assumption that I was not competent on a specific subject matter.
18.   People have underestimated my academic abilities.

SCORING: Scores will be summed, such that high scores for each subscale will reflect greater levels of gender-racial microaggressions pertaining to that category, and high total scores will reflect greater levels of gender-racial microaggressions.

Academic Challenges (Randall et al., 2020)

This form contains a list of challenges that many women in STEM graduate programs report experiencing. Please indicate which of the following challenges you have experienced **within the past year**. Mark as many that may apply.

Have experienced 1	Have NOT experienced 0

Academic Challenges:

1. Challenges transitioning to graduate school
2. Challenges related to comprehensive exams
3. Research challenges (e.g., lack of progress, unpublishable results, inadequacy of equipment or supplies, etc.)
4. Academic experiences related to intersectional identities (e.g., gender, race/ethnicity, religion, etc.)
5. Challenging department or lab changes
6. Interpersonal issues with academic peers or colleagues (e.g., conflict, competitiveness, exclusion, lack of support, etc.)
7. Interpersonal issues with faculty members or staff (e.g., disagreements, criticism, lack of support, lack of guidance, etc.)
8. Interpersonal issues with advisor (e.g., disagreements, negative feedback, lack of mentoring or support, etc.)
9. Pressures to stay in academic program
10. Concerns about financing graduate study
11. Time management challenges
12. Cultural challenges (e.g., adjustment to new country, microaggressions, language barriers, etc.)
13. Academically-related lack of confidence or feelings of inadequacy/imposter syndrome
14. Feelings of burnout

Please indicate how much each stressor has interfered with your academic work/progress to degree completion: *(each challenge will display only if "Have Experienced" is selected on* Challenge_Exp*)*

Not at all 1	A little 2	Some 3	Moderately 4	A lot 5

Please indicate how much stress YOU have experienced as a result of each challenge:
(each challenge will display only if "Have Experienced" is selected on Challenge_Exp*)*

No stress 1	A little stress 2	Some stress 3	Moderate stress 4	High stress 5

Please rank the following challenges from most stressful (1) to least stressful according to how much stress YOU have experienced as a result. For example, if a challenge caused you to feel a great deal of stress, you would rank it towards the top. If a challenge caused you to feel a little stress, you would rank it towards the bottom. *(each challenge will display only if "Have Experienced" is selected) (each challenge will display only if "Have Experienced" is selected on* Challenge_Exp*)*

SCORING: Scores will be summed, such that high scores will reflect greater academic challenges

Depression Anxiety Stress Scale-21 (DASS-21; Lovibond & Lovibond, 1995)

Please read each statement and select a number 0, 1, 2 or 3 which indicates how much the statement applied to you over the past week. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:

Did not apply to me at all 0	Applied to me to some degree, or some of the time 1	Applied to me to a considerable degree or a good part of time 2	Applied to me very much or most of the time 3

1. I found it hard to wind down.
2. I was aware of dryness of my mouth.
3. I couldn't seem to experience any positive feeling at all.
4. I experienced breathing difficulty (e.g. excessively rapid breathing, breathlessness in the absence of physical exertion)
5. I found it difficult to work up the initiative to do things.
6. I tended to over-react to situations.
7. I experienced trembling (e.g., in the hands).
8. I felt that I was using a lot of nervous energy.
9. I was worried about situations in which I might panic and make a fool of myself.
10. I felt that I had nothing to look forward to.
11. I found myself getting agitated.
12. I found it difficult to relax.
13. I felt down-hearted and blue.
14. I was intolerant of anything that kept me from getting on with what I was doing.
15. I felt I was close to panic.
16. I was unable to become enthusiastic about anything.
17. I felt that I wasn't worth much as a person.
18. I felt I was rather touchy.
19. I was aware of the action of my heart in the absence of physical exertion (e.g. sense of heart rate increase, heart missing a beat).
20. I felt scared without any good reason.
21. I felt that life was meaningless.

SCORING: Sum subscale scores to calculate the final score. Recommended cut-off scores for conventional severity labels (normal, moderate, severe) are as follows:

	Depression	Anxiety	Stress
Normal	0-9	0-7	0-14

Mild	10-13	8-9	15-18
Moderate	14-20	10-14	19-25
Severe	21-27	15-19	26-33
Extremely Severe	28+	20+	34+

Multidimensional Scale of Perceived Social Support (MSPSS; Zimet et al., 1988)

We are interested in how you feel about the following statements. Read each statement carefully and indicate how you feel. Please reflect on your experiences <u>outside your doctoral program.</u>

Very strongly disagree 1	Strongly disagree 2	Mildly disagree 3	Neutral 4	Mildly agree 5	Strongly agree 6	Very strongly agree 7

1. There is a special person who is around when I am in need.
2. There is a special person with whom I can share my joys and sorrows.
3. My family really tries to help me.
4. I get the emotional help and support I need from my family.
5. I have a special person who is a real source of comfort to me.
6. My friends really try to help me.
7. I can count on my friends when things go wrong.
8. I can talk about my problems with my family.
9. I have friends with whom I can share my joys and sorrows.
10. There is a special person in my life who cares about my feelings.
11. My family is willing to help me to make decisions.
12. I can talk about my problems with my friends.

SCORING:
MSPSSmean = Mean score on MSPSS (12 items) [Sum MSPSS1 – 12, then divide by 12]
MSPSSsother = Significant Other Subscale mean score (4 items) [Sum MSPSS1, 2, 5, and 10, then divide by 4]
MSPSSfamily = Family Subscale mean score (4 items) [Sum MSPSS3, 4, 8, and 11, then divide by 4]
MSPSSfriends = Friends Subscale mean score (4 items) [Sum MSPSS6, 7, 9, 12, divided by 4]

Academic Resilience Scale (ARS-30; Cassidy, 2016)

Participants are asked to imagine themselves as the student characterized in the vignette and thus experiencing academic adversity and to answer the following items.
You have received feedback from reviewers for a recent journal article submission, and the journal has chosen to 'reject' your paper. The feedback from the reviewers is quite critical, including reference to 'lack of appropriate experimental design' and 'poor writing and expression,' and it also includes concrete suggestions for how the work could be improved. The peer reviews for two other recent conference papers you submitted were also less favorable than you would want; similar comments were made by reviewers of these conference papers as those made for your journal article.

Likely 1	Somewhat Likely 2	Neutral 3	Somewhat Unlikely 4	Unlikely 5

1. I would not accept the reviewers' feedback
2. I would use the feedback to improve my work
3. I would just give up
4. I would use the situation to motivate myself
5. I would change my career plans
6. I would probably get annoyed
7. I would begin to think my chances of success in my doctoral program were poor
8. I would see the situation as a challenge
9. I would do my best to stop thinking negative thoughts
10. I would see the situation as temporary
11. I would work harder
12. I would probably get depressed
13. I would try to think of new solutions
14. I would be very disappointed
15. I would blame the reviewers
16. I would keep trying
17. I would not change my long-term goals and ambitions
18. I would use my past successes to help motivate myself
19. I would begin to think my chances of getting the job I want were poor
20. I would start to monitor and evaluate my achievements and effort
21. I would seek help from my advisor
22. I would give myself encouragement
23. I would stop myself from panicking
24. I would try different ways to study
25. I would set my own goals for achievement
26. I would seek encouragement from my family and friends
27. I would try to think more about my strengths and weaknesses to help me work better

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28. I would feel like everything was ruined and was going wrong

29. I would start to self-impose rewards and punishments depending on my performance

30. I would look forward to showing that I can improve my professional skills

SCORING: Total score is computed by summing responses to the 30 individual items, with a possible total score ranging from 30–150. Positive items are reversed during scoring, and a higher ARS score indicates greater academic resistance.

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APPENDIX E

IRB APPROVAL

ASU Knowledge Enterprise Development

EXEMPTION GRANTED

Ashley Randall
CISA: Counseling and Counseling Psychology
480/727-5312
Ashley.K.Randall@asu.edu

Dear Ashley Randall:

On 11/19/2021 the ASU IRB reviewed the following protocol:

Type of Review:	Modification / Update
Title:	Supporting Women of Color in STEM Doctoral Programs: The Association Between Academic Challenges and Symptoms of Distress and Possible Moderating Effects of Academic Resilience and Perceived Social Support
Investigator:	Ashley Randall
IRB ID:	STUDY00014680
Funding:	Name: Arizona State University (ASU), Funding Source ID: Graduate Professional and Student Association (GPSA)
Grant Title:	None
Grant ID:	None
Documents Reviewed:	• Consent Form, Category: Consent Form; • GPSA Funding Award Email, Category: Sponsor Attachment; • IRB Protocol, Category: IRB Protocol; • Modification Changes Tracked, Category: Other; • Recruitment Flyer, Category: Recruitment Materials;

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (2) Tests, surveys, interviews, or observation on 11/17/2021.

APPENDIX F

STUDY FLYER

Research Opportunity!

Are you enrolled in a PhD program in a STEM field? Do you identify as a Woman of Color? Are you 18 years old or older?

If you answered yes to these questions, you may be eligible to participate in the research study below

Survey Link

Chance to win one of thirty $25 Amazon gift cards!

Please email jhopki11@asu.edu with any questions