

Faculty Experiences of the Impostor Phenomenon in STEM Fields

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ABSTRACT

Successful people experiencing impostor phenomenon consider themselves less competent and less worthy of their positions or achievements. They attribute their success to luck, deceit, fraudulence, and others being kind to them instead of their own competence. Prior research has focused primarily on students in higher education; faculty experiences of impostor phenomenon in science, technology, engineering, and mathematics (STEM) fields are not well understood. The research question guiding this inquiry was: “What kind of academic events or activities could contribute to faculty experiences of impostor phenomenon in STEM?” Using a qualitative analysis of 56 interviews, this U.S.-based study examined occurrences and experiences among faculty who self-identified as experiencing impostor phenomenon. A prior survey from the same participants revealed that they were predominantly White and female, experiencing moderate, high, or intense impostor phenomenon. Thematic interview analysis revealed that impostor phenomenon could be related to the following: 1) peer comparison, 2) faculty evaluation, 3) public recognition, 4) the anticipatory fear of not knowing, and 5) a perceived lack of competency. A comparison with findings from the larger study revealed that there are commonalities among faculty, PhD student, and postdoctorate experiences of impostor phenomenon in STEM. This necessitates professional development opportunities that could address self-limiting beliefs across the academic pipeline.

INTRODUCTION

The President's Council of Advisors on Science and Technology noted an urgent need to address the shortage of nearly one million students in science, technology, engineering, and mathematics (STEM) disciplines through improved student training and retention, especially from the underrepresented backgrounds based on sex, race/ethnicity, and first-generation/lower socioeconomic status (PCAST, 2012). This necessitates strengthening the university faculty workforce. However, challenges to faculty development in STEM are manifold, including the recruitment, retention, and training of a diverse faculty body based on demographic characteristics and life experiences in combination with strong research and teaching identity (Whittaker and Montgomery, 2014).

Challenges to Gender-Based Equity among Faculty

The STEM community faces several challenges to attaining gender-based equity. Women have historically been underrepresented in all academic positions in STEM, especially in senior leadership roles. This is due to several factors, such as gender bias in selection, evaluation, promotion, and career advancement; masculinized workspaces; lack of support for women in caregiving roles; and lack of access to professional networking (Howe-Walsh and Turnbull, 2016; Laursen and Austin, 2020). Faculty women of color or those marginalized due to their intersecting minority identities based on race/ethnicity, class, and family education status are even more vulnerable to experiencing barriers to their advancement (Laursen and Austin, 2020). Even

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academic recruitment and promotion at the associate and full professor levels are not always meritocratic, and there may be subtle gender discrimination in terms of the opportunities that women get to build their networks and show their potential (Nielsen, 2016a,b).

Observed gendered differences in leadership styles (transformational vs. transactional leadership) have also been discussed in relation to the poor representation of women in STEM in various countries, including Australia, Germany, and the United Kingdom (Read and Kehm, 2016; Nash *et al.*, 2017). Interviews with several vice-chancellors of universities in Germany and the United Kingdom reveal notions of ideal leadership styles that are culturally viewed as masculinized (assertive, directive, showing top-down authority) as opposed to their own leadership styles, which are culturally viewed as feminized (collegial, collaborative); the same masculinized qualities that are revered in men make women leaders feel less accepted and more harshly scrutinized (Read and Kehm, 2016). Female leaders often feel othered on account of deviation from the cultural conceptualization of “the embodied male leader” as being ideal, dominant, or the norm (Read and Kehm, 2016).

Female faculty in science and technology from universities in the United Kingdom report several barriers to their career advancement into leadership roles (Howe-Walsh and Turnbull, 2016). Some of these barriers include the gendered nature of the field; short-term or temporary contracts with lack of job security; experiences of bullying and harassment; male-centric networks; lack of female mentors in senior positions; direct and indirect gender-based discrimination; lack of recognition; and gendered exclusion. As a result, women feel marginalized and experience a loss of confidence, worrying that there is little support for their own advancement to senior positions owing to lack of other women in senior positions (Howe-Walsh and Turnbull, 2016). Female PhD holders in astronomy and astrophysics report negative experiences that make them consider leaving the field: impostor phenomenon, their poor relationship with graduate advisors or mentors, and the two-body problem (Ivie *et al.*, 2016). In one Danish study with a sample size of 3293 researchers, the author found that female researchers are less likely to have international collaborations; they tend to publish more solo-authored papers, and they choose slightly lower-impact journals for publishing compared with male colleagues (Nielsen, 2016a). In South Africa, one study found that women at a research-focused institution produced less research and showed lower self-esteem compared with men, constrained by family responsibilities and lack of access to networking capital (Obers, 2015). Both research productivity and self-esteem could be improved through mentorship from department heads, although lack of enough female department heads also constrains the quality and quantity of mentorship women faculty receive (Obers, 2015).

In the life sciences, fewer than 15% PhDs transition to faculty positions across all genders after long doctoral and postdoctoral training spanning more than 10 years (Stephan, 2012). More women than men have a PhD in life sciences (>52%), yet their numbers dwindle in comparison to men as faculty at research institutions (Gibbs *et al.*, 2014; Sheltzer and Smith, 2014). Other challenges for junior faculty in STEM include less exposure to grant-writing workshops, mentored training in research, pedagogical training, and professional development workshops to

enhance research and teaching profiles (Baker *et al.*, 2014; Stains *et al.*, 2015). While increasing the number of women in the academic pipeline is considered to be one way of addressing gender disparities, data show that, despite an increased number of women as PhD students, postdoctorates, and junior faculty, women continue to be underrepresented in senior leadership positions and face gendered discrimination in salary, promotions, and career advancement (Monroe and Chiu, 2010).

Impostor Phenomenon among Faculty

Impostor phenomenon (popularly called “impostor syndrome”) occurs when competent, successful individuals doubt their success. They believe that they are less competent or less worthy of their positions or achievements (Clance and Imes, 1978). Instead of believing in their abilities, they attribute their success to luck, deceit, fraudulence, others’ kindness, and external factors not related to their own competence. Having self-deprecating beliefs or perceptions about one’s ability could impact one’s physical and mental health, self-presentation, sense of belonging, and socializing or networking experiences for integration and success in the academy.

Impostor phenomenon was first studied among successful, mostly White, female professionals in the United States (Clance and Imes, 1978). Although the term “impostor syndrome” or “imposter syndrome” is more popularly used in media, the term “impostor phenomenon” is more appropriate to describe the process of feeling like a fraud compared with “syndrome,” which could be associated with a stigmatic condition that needs medical intervention (email communication with one of the proponents of the term “impostor phenomenon,” Dr. Pauline Rose Clance in 2017, cited in Chakraverty, 2019, 2020b). Hence, the term “impostor phenomenon” is used throughout this paper in consultation with Dr. Clance.

The positioning of impostor phenomenon as an individual or internal trait has received criticism, because the onus of overcoming or managing rests on the individual. Recent research has focused on the environmental contributors such as workplace harassment (Chakraverty and Rishi, 2022); racial discrimination (Bernard *et al.*, 2018; Chakraverty, 2020a, 2022a,b,c); hypercompetitive learning environments (Canning *et al.*, 2020); and the underrepresentation of women, first-generation learners, and scholars of color in academia (Pulliam and Gonzalez, 2018; Stone *et al.*, 2018; Vaughn *et al.*, 2019; Canning *et al.*, 2020; Chakraverty, 2022a,b,c).

Impostor phenomenon can impede the development of a sense of belonging in a field or domain, contributing to eventual departure from the academy (Chakraverty, 2022a). The phenomenon has been examined among different demographics in STEM, such as women (Vaughn *et al.*, 2019), racial and/or ethnic minorities (Stone *et al.*, 2018; Chakraverty, 2020a, 2022a,b), first-generation learners (Pulliam and Gonzalez, 2018; Canning *et al.*, 2020), undergraduate students (Aycock *et al.*, 2019; Peteet *et al.*, 2015), and graduate students (Posselt, 2018; Chakraverty, 2020c; Cisco, 2020). Yet research examining impostor phenomenon among higher education faculty (especially in STEM) is sparse. Few studies have included faculty as a subsample (e.g., Vaughn *et al.*, 2019; Lee *et al.*, 2020), resulting in generic rather than faculty-specific findings. Overall, nine studies have specifically focused on faculty experiences of impostor phenomenon (Table 1), varying in their sample size

TABLE 1. Summary of literature for impostor phenomenon among faculty

Author(s)	Sample and data collection	Country of study	Key findings
Topping, 1983	Surveys from 285 university faculty (128 men/157 women)	United States	Impostor phenomenon was higher in men than in women; negatively related to: success attribution to ability (men), faculty rank, self-esteem, and success attribution to effort (men and women); positively related to trait anxiety and self-monitoring behaviors (men and women).
Brems <i>et al.</i> , 1994	Surveys from 112 faculty (86 tenured/26 untenured) at one university (46 women/66 men)	United States	Impostor phenomenon was related to mentorship and role modeling, teaching evaluations, and advising relationships.
Knights and Clarke, 2014	Interviews from 52 faculty (lecturers, readers, and professors) from eight business schools (60% male)	United Kingdom	Impostor phenomenon was related to academic insecurity and fragility.
Hutchins, 2015	Surveys from 61 tenure-track, tenured, and non-tenured faculty (61% women) from social sciences and STEM	United States	Moderate or more impostor phenomenon detected among faculty; untenured faculty had the highest impostor phenomenon; impostor phenomenon was related to emotional exhaustion and adaptive coping skills.
Hutchins and Rainbolt, 2017	Interviews from 16 faculty from a large, public research university and a medical teaching university (nine from STEM and seven from social and behavioral sciences)	United States	Impostor phenomenon was triggered by: 1) questioning expertise, 2) experiencing success, 3) comparisons with peers/colleagues, and 4) scholarly productivity. Coping mechanisms involved: 1) seeking social support, 2) correcting cognitive distortions, 3) engaging in maladaptive behaviors, and 4) positive affirmation/self-talk.
Robinson, 2018	Interviews from 23 tenured/tenure-track instructional faculty at California community colleges (all Black women)	United States	Impostor phenomenon was related to contentment, job satisfaction, on-campus relationships with colleagues and students, and microaggressions related to appearance.
Sims and Cassidy, 2019	Surveys from 54 early-career music education faculty (22 men/32 women) from across the country	United States	Moderate/high/intense impostor phenomenon detected among faculty; impostor phenomenon was related more to research and less to teaching.
Fields and Cunningham-Williams, 2021	Nine interviews with Black female faculty at research-intensive schools of social work	United States	Experiencing impostor phenomenon affected their professional lives, geared them toward overproductivity, challenged their integration into a predominantly White academic culture, and hindered them from presenting themselves authentically in front of colleagues.
Deshmukh <i>et al.</i> , 2022	Surveys from 30 clinical radiology faculty from one medical institution	United States	Of 30 faculty members, 83% experienced impostor phenomenon professionally that correlated with burnout.

(nine to 285 participants), data-collection instruments (both surveys and interviews), fields (STEM, music, social science, social work, radiology, and business), and other characteristics. A summary of relevant studies is presented here and in Table 1.

Impostor phenomenon among university faculty was documented as early as 1983, correlating positively with lower self-esteem, fear, self-doubt, and anxiety (Topping, 1983). Surveys from 112 faculty members at one U.S. institution also showed that impostor phenomenon was related to the teaching evaluation scores they received, advising relationships, discomfort considering themselves as mentors or role models, and mentoring a lower number of student advisees (Brems *et al.*, 1994). Interviews with 52 UK-based business school faculty experiencing impostor phenomenon revealed that participants may be prone to insecurity, self-doubt, and thinking of academic failures as due to their professional incompetence or

inadequacy; this could hamper identity development as successful academics based on their fit in a stressful, competitive environment (Knights and Clarke, 2014).

Surveys from 61 faculty members further showed that impostor phenomenon is related to lower research output, poor ability to secure extramural funding, poor performance of teaching and administrative duties, emotional exhaustion, and fears related to one's tenure status (Hutchins, 2015). Interviews with 16 faculty members in STEM and non-STEM fields revealed specific antecedents of impostor phenomenon, including being questioned about one's expertise, experiencing success, concerns about scholarly productivity, unfavorable comparisons with colleagues, receiving negative feedback on scholarship (e.g., academic writing and submitting research proposals), experiencing rejections, and difficulty with internalizing success (Hutchins and Rainbolt, 2017).

Impostor phenomenon has specifically been examined among early-career faculty pursuing research and teaching who experienced moderate to intense impostor phenomenon, especially in relation to research more than teaching (Sims and Cassidy, 2019). It has been examined among Black female faculty (e.g., Robinson, 2018; Fields and Cunningham-Williams, 2021), especially in relation to their job satisfaction, professional relationships, experiences of race-based microaggressions (Robinson, 2018), inauthentic self-presentation, and difficulties integrating in the predominantly White culture in academia (Fields and Cunningham-Williams, 2021). More recent research among radiology faculty at a medical center correlated impostor phenomenon with burnout (Deshmukh *et al.*, 2022).

Overall, multiple survey studies have demonstrated faculty experiencing moderate, high, or intense impostor phenomenon in self-selected samples (Hutchins, 2015; Sims and Cassidy, 2019; Vaughn *et al.*, 2019). While one study using 285 surveys reported higher impostor phenomenon among male university faculty (Topping, 1983), gender-based findings from other studies are inconclusive. Interestingly, among 1326 female academics (of whom 638 were tenure-track, tenured, non-tenure track, or part-time/contingent faculty), Vaughn and colleagues (2019) found that, at a mean of 62.5 out of 100 (moderate impostor phenomenon), 198 faculty members (all tenured) scored statistically significantly lower on the impostor phenomenon scale compared with master's and PhD students.

The current study aims to address gaps in the understanding of impostor phenomenon at the faculty level, such as the lack of focus in STEM disciplines. While quantitative studies have found associations between impostor phenomenon and factors such as faculty rank, self-esteem, anxiety, teaching and advising, emotional exhaustion, and burnout, among others (Topping, 1983; Brems *et al.*, 1994; Hutchins, 2015; Sims and Cassidy, 2019; Deshmukh *et al.*, 2022), critical events or activities related to impostor phenomenon are underexplored. The research question that guided this inquiry was: "What kind of academic events or activities could contribute to faculty experiences of impostor phenomenon in STEM?"

Professional Identity Development

This study uses a framework of professional identity development among faculty members. Professional identity refers to social interactions in the academy whereby the actors (people holding certain identities) strive to distinguish themselves with their skills and competencies to align with certain professional values and practices (Adams *et al.*, 2006). Professional identity development is an evolving, psychological process involving developing competencies and socializing in certain professional roles (Jarvis-Selinger *et al.*, 2012). Socialization is the key to identity development wherein one learns to adapt to the expected norms and values of the profession (Cruess *et al.*, 2014).

Doctoral training and experiences should ideally prepare individuals for their future paths to the professoriate through exposure to the skills and expectations required of a faculty job (Austin, 2002; Reybold, 2003). Many start preparing and training themselves for future faculty roles and learn how the professoriate works during doctoral training while closely working with faculty members during their dissertations (Austin, 2002; Reybold, 2003). Developing a faculty identity entails not just

how to do research, but an understanding of departmental, institutional, and academic norms and development of scholarly and teaching identities (Reybold, 2003).

Professional identity construction occurs due to the interplay between "doing" and "being" (Pratt *et al.*, 2006). Progressing from being a novice to an expert (from early faculty identity formation and acting the role of a faculty member to being a faculty member) involves self-determination, self-presentation, and internal validation based on academic experiences and competency development (Jarvis-Selinger *et al.*, 2012). While producing new knowledge through research output and/or engaging in quality teaching remain the primary functions for many, the need to stay competitive globally and attract more students have forced many institutions to reshape faculty roles and responsibilities to include undertaking administrative services and procuring external research funding (Billot, 2010). The tensions between teaching and professional identity as a scientist may pose barriers to faculty pedagogical change due to the hierarchical signaling of research being prioritized over teaching, with faculty consequently developing primarily research (and not teaching) identities (Brownell and Tanner, 2012).

Impostor phenomenon could be closely tied to identity development (Clance and Imes, 1978; Bernard *et al.*, 2018; Chakraverty, 2019; Chakraverty *et al.*, 2022) and how faculty conduct themselves in their careers (Hutchins and Rainbolt, 2017). Research and teaching (along with professional outreach and administrative services) typically comprise the core of faculty work (Cadez *et al.*, 2017). Transitioning from a PhD student to a faculty member (independent researcher) is a critical event involving significant role change; facing skepticism from colleagues, receiving negative reviews about one's research (during grant and journal paper writing), and being questioned by students could make faculty members question their credibility and feel like impostors (Hutchins and Rainbolt, 2017). Additionally, impostor experiences could hamper faculty identity development in the face of stress, competition, and constant self-doubts about one's worth and contribution to the academy (Knights and Clarke, 2014). Early-career (pre-tenure) faculty members in particular may question themselves and experience psychological distress (Dancy and Brown, 2011), lower productivity (Seritan and Mehta, 2016), and lower satisfaction (Neureiter and Traut-Mattausch, 2016).

Although Vaughn *et al.* (2019) had a mixed sample of 1326 women across all academic ranks (638, or 48%, of whom were faculty from different ranks), speculations about impostor phenomenon in relation to implications for faculty identity development are particularly interesting. Mean impostor sum scores of 66.8/100 indicated frequent impostor experiences, although with a large SD of 15.3 (including female faculty participants across all ranks). Higher impostor scores also correlated with lower perceived autonomy; lower relatedness; lower sense of competence; lower motivation to thrive; and the attribution of success to luck, a fluke, ease, or an advisor's kindness rather than one's own effort, ability, and family support. These factors, in addition to increased stress, multiple challenges to balancing work and family life, lower pay, gendered discrimination, and harassment, disproportionately pose more challenges to thriving in academia for women compared with men. This could affect the way women perceive and navigate academic roles,

socializing and seeking support within their networks depending on whom they attribute their success or failure to.

Those experiencing impostor phenomenon have a distorted sense of their ability, competence, and achievement potential, often attributing success to unintentional fraudulence, getting lucky, receiving help from others, and factors extraneous to their capabilities (Chakraverty, 2019). They might be prone to insecurity, self-doubt, and attributing academic failures to their professional incompetence or inadequacy (Knights and Clarke, 2014). This could impact research output, ability to secure extramural funding, teaching, performing administrative duties (Hutchins, 2015), and identity development as a successful academic based on their fit in a stressful, competitive environment (Knights and Clarke, 2014). Impostor phenomenon is deeply tied to one's cultural identity, personal identity, and science identity; many Native American scientists struggle to synergize all these identities (Chakraverty, 2022a). Because impostor phenomenon is deeply tied with different identities people hold salient, it is important to understand the manifestations of impostor phenomenon among higher education faculty, examining particular situations that could make them vulnerable to experiencing it.

METHODS

This study is a part of a larger, U.S.-based research study examining impostor phenomenon among several populations in STEM. In the larger study, data were collected twice using online surveys and one-on-one phone interviews from 2017 to 2018. The current study follows the same methodology. The study was approved by the Institutional Review Board at Washington State University, a large, R1, public university in Pullman, WA.

Methodological Rationale of the Current Study

In the review of literature presented in Table 1, four out of the nine studies conducted interviews (sample size: nine to 52 faculty participants). The current study adopted a primarily qualitative approach through interviews in addition to some initial survey data collection to allow for an in-depth examination of the phenomenon. Overall, 68 participants from various STEM fields experiencing impostor phenomenon self-selected themselves to complete a survey; 56 of these participants also completed an interview (the rest either declined or did not respond to the interview invitation). Thus, a final sample of 56 surveys and corresponding interviews were used for data analysis. This methodology helped in answering the research question through an in-depth exploration of academic events or activities contributing to faculty experiences of impostor phenomenon in STEM. Survey data were used as a gatekeeping mechanism to ensure that only those who self-reported as experiencing impostor feelings participated in the interviews.

Participants and Data Collection

In 2018, the author used convenience sampling (Sadler *et al.*, 2010) to identify and contact STEM faculty members of all ranks and demographic characteristics across the United States, requesting those who had experienced impostor phenomenon to complete an online survey. The survey link was hosted on the author's university webpage along with information about the study and an operational definition of impostor phenomenon,

that is, some individuals have difficulty owning their achievements and instead, fear being exposed as an impostor or fraud (Clance and Imes, 1978). An email with the study link and the author's information was shared in email Listservs of professional societies (e.g., 500 Women Scientists and Society for the Advancement of Biology Education Research), social media (e.g., LinkedIn), conferences (e.g., 2018 Annual Understanding Interventions that Broaden Participation in Science Careers conference), and the author's professional contacts at various universities. All U.S.-based faculty members in STEM who have experienced impostor phenomenon were eligible to participate irrespective of their sex, race and/or ethnicity, age, current rank, or other demographic characteristics. Data were collected sequentially.

Online Survey. Interested participants self-selected themselves to complete a onetime, online survey (5–7 minutes) with questions about their demographic backgrounds, 20 items from the validated Clance Impostor Phenomenon Scale (CIPS; Clance, 1985)¹ that were compulsory, and an open-ended question asking them about a recent experience of impostor phenomenon (no word limit). The open-ended question was asked to ensure that participants could articulate a personal experience based on their understanding of impostor phenomenon. The CIPS consisted of Likert-scale items with the following anchors: 1 = not at all, 2 = rarely, 3 = sometimes, 4 = often, and 5 = very true; a total maximum score of 100 was possible. In the larger study, CIPS scores from 959 participants across fields and positions were analyzed to examine the psychometric properties of the scale (Lee *et al.*, 2020).

Phone Interview. In the last survey question, participants were asked if they would participate in a follow-up, one-on-one, optional telephone interview (~30–40 minutes) to elaborate on their impostor experiences. Those interested voluntarily provided an email address at the end of the survey. The author promptly contacted them to schedule a semistructured interview. Interview questions were not related to their CIPS scores in the online survey (the CIPS scores were computed later). Those who mentioned in the survey that they did not feel like impostors were not contacted, even if they consented to be interviewed.

In the larger study, the author contacted three participants who had consented to be interviewed but had indicated in the survey that they did not feel like impostors. The interviews lasted only a few minutes, because none of the three participants were able to articulate experiences of impostor phenomenon. They shared participating in the study either because they wanted to learn more about the topic or because they wanted to support the author's research, as it had been their experience that it was difficult to find study participants. None of these reasons were sufficient for participation in the study. After that, the author did not contact anyone who stated in the survey that they did not feel like an impostor.

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TABLE 2. Interview questions

Where did you hear about this study? Why did you decide to participate in it?
Please share briefly about what is your academic background and what do you currently do.
Have you ever experienced impostor phenomenon? What does/did it feel like?
Do you remember specific personal and professional events (including workplace interactions as a faculty member) when you feel/felt like an impostor? Could you describe them in detail?
As a faculty member, are there specific activities that make you feel like an impostor? Could you describe those activities?
How does impostor phenomenon occur in everyday life? Does it contribute in any way to you achieving (or not achieving) your professional goals?
Do you share your impostor feelings with others? Who is your support system?
Do you think one can overcome impostor feelings? How?
Is there anything else you'd like to share about impostor experiences?
Can I answer any question you may have? Thank you for your time.

The author developed interview questions based on her understanding of the literature gaps examining impostor phenomenon among faculty (Table 2; see also Chakraverty, 2022a, Table 1, for interview questions from another part of the larger study). Follow-up questions were asked as required. Two of the core aspects of faculty professional identity development guided the interview questions: 1) professional socialization and workplace interactions in relation to impostor experiences and support systems available (or not) for managing such experiences; and 2) specific activities faculty undertook such as research, teaching, administrative work, mentoring students, or others that could contribute to impostor experiences, and how. These aspects of faculty identity development have not been previously addressed in relation to impostor phenomenon. The interviews delved deeper into past situations when faculty felt like impostors.

At the conclusion of the interview, participants were requested to share the survey link within their academic networks to help the author find more participants through “snowball sampling” (Sadler *et al.*, 2010). (survey → optional interview → sharing the survey link within one’s academic network). Data collection lasted 10 months, after which the author determined that adequate data had been collected for analysis and no new information would emerge if more interviews were conducted (Fusch and Ness, 2015). The interviews were transcribed through a professional transcribing company. There were no monetary incentives to participate in the study. The author conducted all the interviews.

Data Analyses

Survey. Surveys captured demographic data about the interviewees. Additionally, individual item scores of the 20-item CIPS were added for each participant to compute total survey scores out of 100 indicating the extent to which participants felt like impostors (Clance, 1985). A higher total score indicated greater frequency and severity of impostor phenomenon. Scores ≤40 indicated few, 41–60 indicated moderate, 61–80 indicated high, and >80 indicated intense impostor experiences (Clance, 1985). CIPS scores were used to compute frequency, mean, and SD (descriptive statistics) for the current study sample, also presented in Table 3. Data were not included for the survey respondents who chose not to be interviewed.

Interview. Interviews were coded using both a priori codes and emergent codes (Blair, 2015) and were analyzed to construct

themes. After a first reading of all the interview transcripts, the author picked a priori codes from the larger study that were relevant in the current study (e.g., Chakraverty, 2020a,b,c). Examples of a priori codes used were: “judgment,” “fake,” “luck,” “deserve,” “belonging,” “mental health,” “fear,” and “conference.” Following this, the author individually read and coded the interviews with two PhD trainees from her university using both a priori codes and emergent codes developed after reading the transcripts (Blair, 2015). Examples of emergent codes included: “research,” “teaching,” “grant,” “evaluation,” “tenure,” “award,” “alienation,” “academic culture,” and “professional development.” These codes expanded the scope of our understanding of impostor phenomenon by going beyond its treatment as an individual, internal experience to consider oppressive academic climates that could activate it. The coders met three to four times during data analysis to discuss and

TABLE 3. Participant demographics

Demography	N = 56
Field	Science: 35 Engineering: 12 Mathematics/Statistics: 9
Rank	Assistant professor: 28 Associate professor: 12 Professor: 11 Lecturer: 5
Sex	Male: 10 Female: 46
Race/ethnicity	White: 38 Hispanic: 10 Asian: 6 Black: 2
Age range (years)	20–29: 1 30–39: 34 40–49: 13 50–59: 8
Geographic location	Forty-two higher education institutions (35 R1, four R2, and three baccalaureate colleges based on Carnegie Classification) from 23 U.S. states and Washington, DC
CIPS scores (0–100)	Moderate (41–60): 6 High (61–80): 37 Intense (81–100): 13 Mean: 72.92; SD: 10.71

resolve any differences in the understanding or interpretation of any segment of the interview and how codes could be applied to those segments. Using iterative comparison and inductive analysis, the interviews were analyzed to develop themes (Marshall and Rossman, 2014; Glaser and Strauss, 2017). For example, certain words or descriptions of those words or ideas in the transcript indicating codes such as “award,” “research award,” “teaching award,” “(self)-nomination,” “selection,” “apply,” “expertise,” “appreciation,” “spotlight,” “judged,” and “winning” were used to develop the third theme, “public recognition.” Using multiple modes of data collection helped in identifying participants with impostor phenomenon (by computing CIPS scores in the survey), which were further explicated using a constructivist approach (Creswell and Clark, 2017) during interviews through narrations of what it meant to experience impostor phenomenon (characterized from the operational definition of feeling lucky, fraudulent, fearful of being found out, discounting one’s abilities, and attributing success to others; Clance and Imes, 1978).

Strengths and Limitations

The present study examines, in detail, faculty narratives of impostor phenomenon. To the author’s knowledge, no prior study specifically focused on STEM disciplines has included faculty members of all ranks and used a sample of this size. Studies about impostor phenomenon among faculty are few (Table 1), representing participants from a few institutions within and outside STEM. Semistructured interviews allowed a deeper, more granular examination of the phenomenon (that survey studies do not).

Study limitations included a sample that is predominantly White and female (male participants and racial and/or ethnic minorities in STEM were underrepresented); the findings thus may not reflect the experiences of groups not represented in the study. Prior research in STEM shows that women may be more likely to experience impostor phenomenon than men (King and Cooley, 1995; Ivie and Ephraim, 2009; Ivie *et al.*, 2016; Jössl *et al.*, 2015; Lee *et al.*, 2020). This could explain the predominance of women in the sample. Second, due to the limitations of convenience and snowball sampling, participants are predominantly from universities with very high research focus (R1). Research shows that emotional distress and fear about achieving tenure could make faculty members vulnerable to impostor phenomenon (Hutchins, 2015), and pre-tenured faculty could be questioning their academic productivity, experiencing distress, and feeling like an impostor (Dancy and Brown, 2011; Seritan and Mehta, 2016). Narratives of faculty members from universities with a lower focus on research productivity are not well represented. Third, a onetime interview may not answer whether feelings of being an impostor persisted over time, or for how long. Fourth, only those who felt like impostors self-selected to participate; it is possible that those who did not experience impostor phenomenon may have also experienced similar challenges in research, teaching, and presenting themselves as faculty members. Fifth, the study did not interview those who may have left academia due to impostor phenomenon. Finally, qualitative findings are not generalizable across the larger population of U.S.-based faculty members in STEM. Future studies could focus on addressing some of these limitations.

Author Positionality

The author was a tenure-track faculty member at an R1 institution in the northwestern United States at the time of the study. As a faculty member, she was familiar with faculty experiences and had access to the faculty population. Her position, background, and experience of studying and working in the United States could have influenced how she conceptualized and conducted the study. The author identifies as female, person of color, immigrant, and non-native English speaker with graduate degrees in STEM and science education. She is a first-generation PhD and the only person in her family to hold a faculty position. She used reflexive journaling to document her possible biases. The memos she wrote after each interview became an audit trail highlighting key points discussed during the interview and her own interpretation of it. Documenting author positionality could help in addressing some of the study limitations. For example, the current sample is predominantly female and from R1 institutions, possibly because the author’s background enabled her to reach out to those with similar backgrounds.

Rigor and Trustworthiness

In addition to being cognizant of her positionality with respect to her research, the author undertook certain steps to improve the rigor and trustworthiness of the study. One, the interview questionnaire was kept simple and covered daily experiences of impostor phenomenon the participants described (Table 2). Two, the author shared interview transcripts with the respective participants, who could edit their responses to reflect accuracy (member checking; Birt *et al.*, 2016) and have an agency in data analysis and presentation. Three, the author sought feedback from several faculty colleagues from her institution with expertise in qualitative research, conducting large-scale studies, and faculty development research while designing and implementing the study. Four, all interview questions were optional to be mindful of the potential discomfort participants could experience during the interview. The participants were informed at the beginning of the interview that they could refuse to answer any question that made them uncomfortable, stop the interview any time, and/or withdraw the transcript after the interview if they wished to. The author contacted each participant within 24 hours of the interview to ensure that they did not experience any psychological discomfort after the interview (none of them said that they did). Finally, the author created a Twitter handle during the study to apprise everyone (including the participants) of the scholarship that would be emerging out of this research, inviting all participants to connect with her, if interested. This was done intentionally to shift the author’s role from being a data extractor to a sharer of the knowledge that participants helped create (San Pedro and Kinloch, 2017).

FINDINGS

Fifty-six participants came from 42 higher education institutions (35 R1 universities or universities with very high research activity, four R2 universities or universities with high research activity, and three baccalaureate colleges) from 23 U.S. states and Washington, DC. This was based on the Carnegie Classification of Institutions of Higher Education (n.d.). Survey analysis (Table 3) revealed that participants were predominantly White and female. Emergent interview themes with participant quotes are

TABLE 4. Themes related to impostor phenomenon among faculty in STEM

Themes	Quotes
Peer comparison	Martha: “I feel [I am] not achieving as much as my colleagues of the same rank, and that I lack sufficient training in methods as well as in other areas of academic professionalism. I feel like everyone else seems to know things that I’ve never heard of before. I have to always go out and find information for myself and then wonder if I’m performing my research methodologies correctly. I just doubt myself all the time.”
Faculty evaluation	Joanna: “The constant feedback that I got for years was you’re not doing enough. You’re not publishing enough, your teaching isn’t good enough, all of these messages, grant rejections, paper rejections. It was really difficult for me to wrap my head around what the actual contributions that I had made were.”
Public recognition	Lucy: “I did not feel like the research I got an award for is my best work, and it doesn’t seem particularly novel, either. The panel of judges weren’t really evaluating the quality of the work.”
The anticipatory fear of not knowing	Tasha: “I’m somewhat anxious about the questions I might get and whether or not I’m capable of answering them efficiently ‘cause it’s spontaneous. It’s not a presentation. You never know what [questions] you’re gonna get. Those moments make me more anxious than the ones that I can prepare and practice for.”
A perceived lack of competency	Chris (concerning his selection as a faculty member): “I have strong thoughts that they made the wrong choice or only picked me because they had no other options. I’m not really sure how I got my foot in the door.”

presented below and in Table 4. Participants felt like impostors with respect to both conducting research (publishing, writing grants, and making conference presentations) and teaching (content knowledge and pedagogical practices). Five themes from interview analysis related to impostor phenomenon: 1) peer comparison, 2) faculty evaluation, 3) public recognition, 4) the anticipatory fear of not knowing, and, 5) a perceived lack of competency (Table 4). To ensure anonymity, faculty rank or department is not mentioned unless it was a part of a quote or needed for context. However, participant rank, pseudonym, and field are presented in Table 5.

Theme 1: Peer Comparison

Individuals tend to self-evaluate and contextualize their competencies and characteristics by comparing themselves with their peers in a social setting (Festinger, 1954). Such comparisons could be conscious or subconscious, used to assess one’s abilities accurately for career advancement. In this study, participants from all ranks compared themselves unfavorably with their peers, feeling insecure, unworthy, incompetent, and with nothing valuable to offer. Transitioning from being a PhD student or postdoctorate to a faculty member made participants feel unqualified, mistakenly selected, and like impostors. Sarah, like many others, expressed surprise at even being selected for a faculty interview, deeming herself less competent or less deserving

than other applicants from better-ranked universities. Emily experienced anxiety and panic attacks before interviews. To grapple with these panic attacks, she prepared weeks in advance:

I had practiced my presentation maybe 50 times, just to a bare room, until I felt like I was on autopilot. I dealt with the feelings of inferiority by putting my head down and pushing through it. Yet it didn’t make them go away.

Research. Participants receiving research funding doubted themselves, suspecting that the grant that funded their research was poorly written and not as competitive. On receiving federal funding, Jane felt, “My colleagues earned it and I was not a real contributor to our success. I did not have the same level of experience in that application as they did.” Jane, Martha, and Rose felt surprised at receiving the National Science Foundation (NSF) CAREER Award, the most prestigious award for early-career faculty members. Jane felt she received the grant “because my name sounds a lot like a peer of mine who works at an Ivy League University and our research areas overlap a bit.” Even as an associate professor with many years of grant-writing experience, Lucy experienced self-doubt and felt undeserving of the NSF grant she had recently received, explaining, “My research is not as high-level, and I do not work particularly fast compared

TABLE 5. Participant rank, pseudonym, and field

Rank	Participant (Field)
Assistant professor (tenure track)	Adam (Engineering), Amy (Biological Sciences), Annie (Engineering), Bill (Evolutionary Biology), Cynthia (Biochemistry and Molecular Biology), Ellen (Neurosciences), Fiona (Forestry), Grace (Mathematics), Jane (Geosciences), Jerry (Public Health), Jessica (Paleontology), Joanna (Engineering), Martha (Biology), Megan (Engineering), Naomi (Engineering), Nina (Biology), Roger (Engineering), Sarah (Chemistry), Sharon (Biology), Sonia (Health Sciences), Tara (Statistics), Zeenat (Medicine)
Assistant professor (non-tenure track)	Jennifer (Assistant Professor of Teaching, Biology), Lynne (Clinical Assistant Professor, Human Genetics and Molecular Biology), Tasha (Assistant Professor of Teaching, Biology)
Associate professor	Aria (Mathematics), Claudia (Medicine), Jay (Engineering), Karen (Plant and Soil Sciences), Liz (Environmental Sciences), Lucy (Mathematics), Mary (Biological Sciences), Monica (Mathematics), Natasha (Biology), Robert (Genetics), Rose (Engineering), Susan (Biology)
Professor	Chris (Physics), David (Computer Science), Emily (Neurobiology), Frank (Medicine), Linda (Mathematics), Michelle (Engineering), Paula (Marine and Environmental Science), Ronald (Mathematics), Shirley (Neuroscience)
Lecturer	Becky (Physics), Kari (Anatomy and Physiology), Maya (Physiology)

with many colleagues.” Amy shared that she did not deserve the prestigious National Institutes of Health (NIH) Pathway to Independence Award (a K99 Career Transition Award) after a postdoc, because she felt she was less productive compared with her colleagues. “It seems like others of equal rank have an easier time bringing things to completion or know how to negotiate papers into publication,” she added.

Ellen felt like a “lone wolf” for not being at a top institution. “There are large centers that get multimillion-dollar funding for this [research] and here we are in a small academic institution. It’s difficult to break through in such a highly competitive area. So you wonder, ‘Should you be there?’” Grace felt a lack of belonging because her peers

came from Harvard, MIT, Stanford, Johns Hopkins, Chicago. People who do this research are at top-tier schools. I always felt I struggled with it when no one else did. These people are definitely out of my league no matter how hard I work. I could never get to that level.

Roger felt that his peers were brighter, with longer curricula vitae and more success to show, because they were “always in their labs talking about some obscure scientific stuff.” On being promoted to associate professor, Claudia felt like “I had not accomplished nearly as much as others who were promoted. If I’m a leader in this field, my field has some problems.” Cynthia felt overwhelmed at conferences, because others there seemed more competent. She spoke in particular about a peer:

You could list off 10 proteins that worked on something, and she’d remember it 30 years later and have an understanding of those proteins just off the top of her head. I could never recall like that. That always made me very doubtful or less confident.

Teaching. Participants felt inferior when comparing themselves with other teachers who they thought taught better. Some felt that, when they shared their teaching and/or classroom management challenges, their peers were dismissive, indifferent, or replied that they do not face such issues. There was a lack of support system for those who were new teachers. Sharon, a faculty since 3 years, shared:

Teaching makes me feel the most like an impostor. We have a lot of phenomenal teachers who are very good at what they do. They have won awards, written books on how to teach, done such amazing things in the classroom. I haven’t had a lot of opportunity to experiment with classrooms. Sometimes I just feel I’m not living up to the standards that are here.

Theme 2: Faculty Evaluation

Faculty evaluations for tenure, promotion, and career advancement are mainly dependent on two factors: research productivity and teaching quality (Cadez *et al.*, 2017). The anticipation of such evaluation made some participants judge themselves negatively. They felt that they were not good enough, not producing enough work, and were impostors. Tenure evaluations and annual reviews caused stress. The tenure-track journey seemed particularly lonely; some questioned their value or contribution to the field, because their papers and grant applica-

tions were frequently rejected. Michelle spoke about a toxic academic culture where people are told that they are not good enough and rarely get the recognition they deserve, adding,

I never felt as much like an impostor as I did when I was preparing my tenure materials. The process can really be toxic, because no matter what you do, tenure committees constantly tell you that you’re not doing enough.

Even approvals or positive reinforcements did not necessarily quell these fears. On receiving positive feedback, Sonia wondered if she got lucky because the reviewers had not noticed the flaws in her research.

Research. Conducting research involves creative problem solving and thinking of new and interesting ideas, all of which requires not only hard work, but creativity and luck. Some doubted their ability to conduct research, were self-critical of their ideas, and felt others were better at conducting research and generating data. Others feared that someone might challenge their research findings and call them a fraud, questioning their faculty positions. Jennifer shared:

It’s so open-ended that I’m not really sure what it’s gonna take. Will someone notice that I’m not strong enough to deserve to be tenure-track? I’m just showing up bright-eyed, bushy-tailed and oblivious, hoping to figure that stuff out.

Ellen described the constant evaluation of everything she did that heightened her impostor phenomenon. She had to be productive all the time.

If your publications are limited or your grant funding is low, it gives you now a concrete tangible to question again your ability to be there. Or the reverse. You get raving reviews through that process and you think, you don’t want to let them down.

Writing grants made faculty members of all ranks feel like impostors. Competitive grants had high rates of rejection, which some internalized as incompetence, doubting their effort and the quality of their work. Bill shared, “You learn to have a thick skin and grow with criticism, but there is still that feeling of being constantly rejected.” Faculty members across all ranks felt inadequate when applying for large grants, especially when it entailed proposing partnerships with colleagues well known in the field. Some worried about being entrusted with a lot of money to produce something novel, fearing that their ideas were not worth funding. Even those with many years of grant-writing experience felt like impostors. Megan shared that, while her grant received excellent scores,

there were elements of some technically challenging experiments that one reviewer had valid issues with. I feel that they gave me the benefit of the doubt that somehow, I’d surmount the technical challenges. I felt like I had pulled the wool over their eyes again.

Frank shared that unconstructive peer reviews in particular made him experience impostor phenomenon:

Every time that you receive an NIH study section critique, and your grant is trash or your paper receives critiques, some of them even not justified. I have been told to my face, “Why did you submit this? This is trash.” It took me 6-7 years to publish my original idea because nobody gave me funding because of those strong opinions from individuals.

Such fears induced self-doubt, procrastination, and a fear that Frank was clueless about the idea he had proposed. Liz shared, “This leads me to read, and reread repeatedly. I find myself cramming. It seems like an inefficient and grueling process.”

Harsh journal reviews made some participants feel judged, experiencing a dissonance between how they versus the peer reviewers perceived their research. “I really thought that this was high-quality work, but this is really not what is good in the field and I got totally smacked down. I’m just not calibrated appropriately. The reviewer of my paper completely shred[ded] everything,” Shirley shared. It took her months to work on the reviews objectively. Instead of viewing herself as a field expert, she let the rejection define her potential as a scientist, feeling like she did not know what she was doing and was not good enough. Ronald shared:

I have 3–4 recent articles now that I consider unpublishable. Getting rejection after rejection can be tough on your self-esteem. Sometimes, when writing, I get really bogged down in all the tiny little details, and feel like it’s not good. I don’t always make enough contribution broadly to the field of science because I hold myself back.

Receiving harsh reviews affected productivity. A publication was viewed as permanent record, putting one’s work out there for colleagues to judge. Monica wondered:

Is it good enough? Have I done everything right? Maybe I don’t belong, maybe I don’t know this as well as I think I do and I’ll be discovered by putting that work out there. I push through it anyways, but it is always a struggle. Even if the article is published, I think, “Wow, I managed to deceive them into thinking I’m competent and worthy!”

Presenting research at conferences (in front of an audience) caused anxiety, making some uncomfortable for being in the spotlight and fearful of being evaluated harshly. Jessica expressed this fear:

I thought I might have found something interesting, but I must have missed some previous work. People are gonna be, “Oh, well, obviously, that could be explained with this simple phenomenon that you should have learned in Biology 101.” I feel like I’m being judged, and everyone’s gonna go, “What? She thinks that? I can’t believe you hired her. What’s she doing?” They might think I’m an idiot and don’t belong here.

Many felt overwhelmed and anxious about meeting well-known members of their fields at conferences. David shared, “Whenever I’m meeting somebody new, I’m always wondering, ‘Are they laughing on the inside?’ or ‘Are they judging me?’ and because of that, I can never remember somebody’s name.” The spontaneity of these interactions were nerve-racking, “chatting with people that you’ve never met, hoping

that you don’t somehow slip up and reveal your lack of knowledge.”

Faculty members with certain personality traits feared in-person interaction and talking about their research in front of an audience. Mary shared,

Conferences are really hard for me. I’m introverted. Putting myself out there to talk to others is quite challenging for me. With famous people in my field, I actually am an impostor or out of place. I end up feeling like I’m such a failure, I don’t know who to talk to, I feel so lonely, I’m in the wrong field, maybe I shouldn’t go to this meeting anymore, why did I even come, I’m not doing it well and not meeting people.

Such fears and anxieties had health repercussions, including insomnia. Jerry did not sleep for 3 days before a conference.

I just reviewed all my material, my PowerPoint. I made 20 pages of potential questions anyone could possibly ask me about my topic, and reviewed that. Then I did the presentation and just crashed. I slept for 18 hours after that. I was just so tired from all the mental energy that I had expended.

David described the fear of freezing while answering questions. He would tend to remember the image of someone who intimidated him during his talks, adding, “I haven’t frozen in a long time, but it’s always there as a possibility.”

Teaching. Teaching undergraduate and/or graduate courses made some feel underqualified and like an impostor, especially for new faculty members who received little formal training in teaching during their PhD/postdoctorate. Nina taught an upper-division genetics lab, and “despite my entire career using transgenic model systems of *Drosophila* and finishing my postdoc in a quantitative genetics lab, I feel that I’m just waiting for them to realize that they have made a mistake.”

Other participants felt like impostors because of new pedagogical approaches they used. Naomi tried new ways of making her teaching more interesting, but feared things may not have been taught before this way and somebody might question why she was doing that. “When I’m teaching, I worry about it. I have to go back and find evidence-based practices. Kinda doing the new things, that’s when I’m most likely to feel like an impostor.”

Theme 3: Public Recognition

In academia, it is common practice to publicly recognize meritorious work through competitive, prestigious awards (Bazner *et al.*, 2021). Faculty members felt like impostors after receiving public recognition in the form of awards (both research and teaching awards), criticizing themselves for not having worked hard enough to get recognition. “Definitely any time that there is an award coming my way, that’s when the impostor syndrome attacks,” Grace shared. Many felt reluctant to even apply for awards. Paula shared, “The issue is that I don’t apply for awards to begin with. I can think of many instances of awards that allow self-nominations for which I may have qualified, but I never have the guts to apply.”

Research Awards. Faculty members of all ranks felt undeserving and uncomfortable when nominated for awards in recognition of their research, feeling less qualified than others who won in previous years. Joanna shared, “I had done the entirety of the analysis and worried that my conclusions were wrong due to ignorance. I’m not a subject matter expert and felt like the scientific contribution was perhaps not as great as I hoped.” Ellen felt like an impostor on receiving a national award “given to the top 2% among 1200 applicants for presenting a topic that was innovative, transformative, providing a significant contribution to the discipline.”

Teaching Awards. Those who got teaching awards suspected that their student evaluations must not have been strong enough and that they received the award because few people were considered for it. “I did not feel that I was a strong candidate for the award,” shared Robert, who was chosen for the highest university-wide teaching award, adding, “I put in a lot of effort, but continually feel I fall short as a teacher due to being behind in grading, making mistakes.” On getting the “Outstanding Teaching Award,” Monica shared:

I didn’t expect it and it actually shook me to my core. I was home sick. I had the flu and I was really grateful that I missed the award ceremony because I couldn’t stop crying and felt really embarrassed and an emotional wreck. Everybody else would be, like, “Oh, hey! Congratulations!” I’m, like, “That’s not how I think of myself.”

Additionally, some faculty members felt like impostors when appreciated by their students. Sonia felt uncomfortable when students regarded her as their favorite teacher, adding, “Those activities where I’m getting compliments and awards worsen impostor syndrome. It has nothing to do with me. Any kind of recognition is really hard for me.”

Theme 4: The Anticipatory Fear of Not Knowing

Fear of the unknown is considered one of the oldest and strongest fears that is associated with distress due to perceived unknowns or perceived lack of information (Carleton, 2016). In the current study, participants felt like impostors when there was a fear and anxiety in anticipation of not knowing certain things despite being experts in their respective fields. For example, when regarded as an expert in the field, Tara feared:

I’m not gonna be able to answer this question that they’re asking me. I think when I’m asked to function as a specialist, which logically I am after 9 years of training, I fear I’m gonna say something stupid and someone’s gonna look up the right answer, and they’re gonna catch me. Those are probably the most acute situations.

Research. Participants feared not fully understanding others’ research during conference presentations. Becky shared, “You feel like you should be understanding what’s going on, but not quite, that can definitely cause impostor syndrome. Just talking with people about their research makes me feel pretty overwhelmed. Everybody’s gonna know the answers except me.” At conferences, participants feared being asked spontaneous questions that could expose their weaknesses and lack of knowledge in the field. Aria feared:

That’s gonna be the conference where everybody finds out that I’m not doing that great of work after all. I have never gotten any negative feedback from anyone, but I’m just waiting for the day when it happens. Public speaking is the place for impostor syndrome.

Lynne shared similar anxieties, not knowing different theoretical frameworks used in others’ research, hesitating to ask questions, because others could judge her as an impostor. She added, “I dread it, I wouldn’t understand half of it and couldn’t ask questions because everyone would think I was stupid. I would just hate that I come off being like, ‘What am I doing here?’”

Aria shared that while interacting with other mathematicians,

I don’t always know their notation or what they’re working on. They expect that because I’m a mathematician, I will remember every little part of differential equations that they’re talking about. Talking with other academics at school is probably where I feel it [impostor phenomenon] the most.

Teaching. Teaching was viewed as a performance; participants felt they should know all the facts and be able to perform well. “Getting up in front of the class. Even though I’ve been teaching for so long, I still feel like I should be doing better than I do,” Kari shared.

To compensate for impostor feelings, some overprepared their lectures, using multiple textbooks to be ready for any student question. While teaching, Tara might “have to field questions from students or have to explain a complicated topic in the best way possible. Those are spikes in my impostor syndrome.”

Participants felt they did not always know how to teach well or who to ask for help. When something did not work, either due to lack of experience or trying something for the first time, participants berated themselves, considering it to be their fault. Some felt anxious about not being able to answer student questions. Maya dreaded being asked questions, sharing:

When students ask me questions about really complicated physiology, I know how to figure it out if I just sit down quietly and work through it, but I can’t off the cuff explain it. That’s really hard for me. I feel like anything that is a classroom setting for me, enhances my impostor syndrome.

Theme 5: A Perceived Lack of Competency

Participants tended to feel like impostors when they believed that they lacked core competencies as a faculty member in some of the important areas of their profession, such as research and teaching. Some were surprised at getting a faculty position and doubted if they had the skills to keep their job, succeed, earn tenure, and get promoted. Jay, who did not think he deserved a faculty position even after 3 years of being a faculty member, summarized the constant self-doubt he experienced, sharing:

Every transition was linked with the idea that I was competitively inferior. I feel like I’m barely holding things together myself and I would be responsible for mentoring graduate students. It is very scary to me. Not sure if I have the skills to get grants and the kind of recognition that I need to achieve tenure.

Research. Some participants doubted their own research competencies. Adam shared:

When it comes to successfully completing experiments with enough precision and accuracy, I'm never confident. I do not have enough training to properly address the flaws in methods and data analysis. I have to rely on a statistician, because statistics is not something I'm ever gonna be good at.

Those who did not prolifically publish felt like impostors. Some were not confident about their articulation and communication skills/style. Roger feared, "I feel like I have knowledge, but I don't have the words to say it yet. They're gonna know how inarticulate I am. Written communication is not my area. I doubt my ability to communicate." Some felt they did not deserve the federal grants they received because of their inability to publish as much as their peers. Others worried about not being able to keep up with multiple projects, grant writing, and publishing. Annie felt that she was involved superficially in a number of projects, adding, "I worry that I can't keep up. There's so much literature out there. It's publishing and trying to keep up with the evolving field where I feel the most impostor syndrome."

Finding a position was a long and challenging process, and in spite of obtaining grants (such as a K99 transitional grant), participants wondered if they were competent. Those who were in a department different from their PhD specialization also felt like impostors. Zeenat explained, "This position was not entirely in my field and was quite a stretch for me given my educational background." To explain the extent of her fears, Fiona explained:

When someone says, "nice work," I assume they haven't looked at what I've done, because it won't stand up to scrutiny. I'm assuming I won't get tenure, which is how I will know that I wasn't correctly selected for this position.

For some faculty members, such fears persisted over time, even after being promoted. Karen added, "I still feel like I'm the faculty member with the least value. They must have lost all the other better candidate files at some point." Participants continued to feel insecure even when they received affirmation from colleagues. Linda shared, "I question myself every day if I'm capable of this. My colleagues tell me I'm doing a good job, but I worry that they have rose-colored glasses and a very unrealistic view of me."

Interestingly, some who described research as difficult were less critical of their teaching. Fiona shared,

With teaching, you only have to know 10% more than they [students] do. I don't always know what I'm doing in the classroom but I feel like it's okay to not know how to teach everything immediately. But because of my perception that I wasn't super well trained in doing research, the research aspect causes [the] most impostor syndrome.

Teaching. Content-wise, those who taught a new course or had not taught specific content in a long time felt like impostors. Natasha, who was teaching cellular respiration for the first time in 10 years since she studied it herself, shared, "I got the basics, the equation, but I didn't know the nitty-gritty of that to

go on, so I totally felt like an impostor in front of my students." She felt nervous about the course content, which was exhausting. While teaching an upper-level class on plant identification, Susan experienced impostor phenomenon, because she was new to the area and did not know the native plants very well. She explained:

I learned Midwest plants, prairie plants, some wooded plants, then more from the Appalachian and South area. Now, I'm trying to learn the plants here, which are very different. Starting to teach this course that doesn't have any curriculum, any textbooks associated with it, and trying to figure out how I can teach an upper-level course, which I haven't taught a lot, figuring out what content to include. Am I really comfortable pronouncing this crazy Latin word that I'm not good with and, in front of the students, I'm gonna forget? It's gonna make me look like a crazy person. I feel like I'm just flailing and just making stuff up on the fly.

DISCUSSION AND IMPLICATIONS

In this study, the following themes were constructed based on faculty experiences in relation to their impostor experiences in research and teaching in STEM: peer comparison, faculty evaluation, public recognition, the anticipatory fear of not knowing, and a perceived lack of competency. This study has two unique contributions to the literature. First, it shows that antecedents of the impostor phenomenon could be similar for academics across the STEM pipeline (e.g., PhD students, postdoctorates, and faculty). This is supported by findings from the larger study, in which PhD students and postdoctorates in STEM who experienced impostor phenomenon were interviewed (Chakraverty, 2020b,c). Findings indicated some of the common antecedents of impostor phenomenon. This includes a fear of public recognition (e.g., receiving awards), comparing oneself unfavorably with one's peers, fear of public speaking or scientific writing, hesitation to apply knowledge, and feeling undeserving of and unqualified for a role. It is possible that such insecurities around lack of research competencies or identity development as a scholar may be long-term for those experiencing impostor phenomenon. Addressing this phenomenon early on among PhD students and postdoctorates (some of whom are future faculty members) might ensure that more faculty learn to manage their impostor feelings or fewer faculty experience impostor phenomenon in the first place. Interestingly, a survey study with 1326 women in academia across all ranks showed a moderate degree of impostor phenomenon among tenured faculty (mean 62.53/100), master's students (mean 67.79/100), and doctoral students (mean 69.31/100; Vaughn *et al.*, 2019). While there is some overlap between the findings of the current study with that of Hutchins and Rainbolt's (2017) study that interviewed 16 faculty members across two institutions, the current study made an in-depth examination of experiences across all faculty ranks and identified additional themes such as faculty evaluation, public recognition, the anticipatory fear of not knowing, and a perceived lack of competency.

Second, even among faculty members of different ranks and experience levels, antecedents of the impostor phenomenon could be similar, characterized by a persistent fear of being exposed as incompetent or incapable. This could have implications for professional development activities for PhD students

and early-career researchers, which could be tailored to address both competency development (writing, public speaking, teaching) and improving sense of belonging through better support systems, mentorship, role modeling, networking, and community building.

Impostor phenomenon could be prevalent in hypercompetitive academic environments with a culture of “publish or perish,” where achievement goals are often open-ended and undefined, publications take a long time, and funding and support systems are sparse (Hutchins, 2015). This may make those from the marginalized groups, such as women and racial and/or ethnic minorities, question their place in the profession (Clance and Imes, 1978; Martinez *et al.*, 2007; Sheltzer and Smith, 2014; Jöstl *et al.*, 2015; Vaughn *et al.*, 2019). Many faculty members, especially early career faculty, experience impostor phenomenon because of the nature of academia, where achievements are celebrated but failures are not normalized, leading to feelings of inadequacy and a distorted view of one’s abilities (Woolston, 2016). Further, the anticipatory fear of the unknown is associated with certain maladaptive responses that tend to overestimate threat, increase one’s reactivity to uncertainty, and trigger avoidance mechanisms, such as avoiding social interactions (Carleton, 2016).

A somewhat overlooked facet is how external environments could contribute to impostor phenomenon. The larger study found that, despite being portrayed as an internal phenomenon, external, negative academic environments, including sexual and nonsexual harassment, could make women experience impostor phenomenon (Chakraverty and Rishi, 2022). Additionally, faculty members of all genders experienced academic incivility from their students (Lampman, 2012), rendering the emergence of these insecurities neutral to authoritarian relationships or power differences (Limeri *et al.*, 2019). Faculty members who experience negative academic environments may avoid activities that involve their interaction with students, such as supervision and mentoring; they may lecture more (rather than using student-centered, active-learning practices); they may discourage student questions, and consequently, they may be seen as less-effective teachers and rated poorly on their teaching evaluations (Brems *et al.*, 1994).

A strong identity and a sense of belonging are key to success in a field (Alston *et al.*, 2017; Strange, 2020). While examining professional socialization in relation to faculty identity development, impostor phenomenon (that is described as a personal experience) could be viewed as stemming from negative academic environments and interactions in which some fail to see themselves thriving despite their competencies (e.g., women in male-dominated fields; Chakraverty and Rishi, 2022), racial and/or ethnic minorities at predominantly White institutions (Chakraverty, 2022a), and education researchers working with science researchers (Chakraverty, 2021). Integration into a profession could be influenced by organizational cultures; socialization experiences could vary by one’s identity and professional environment (Felder *et al.*, 2014). Prior research has identified several challenges to developing an identity and belongingness in STEM, including the lack of adequate mentoring, networking opportunities, professional development, and support while transitioning between jobs or training phases (Butts *et al.*, 2012; Thomas *et al.*, 2015; Chakraverty *et al.*, 2018, 2022). Mentorship support could be especially valuable for women in improv-

ing their retention and advancement, providing scholarly support (e.g., in grant writing), reducing isolation through informational and psychosocial support (Chesler *et al.*, 2010), and helping them manage their impostor feelings.

CONCLUSION

Key challenges in strengthening the STEM workforce include an oversupply of PhD students and postdoctorates with fewer faculty positions available and a workforce that is predominantly male and White, especially at research-intensive institutions. Women and people of color are underrepresented, especially in higher ranks in the professoriate, and are more impacted by lack of career flexibility (Alberts *et al.*, 2014; Villablanca *et al.*, 2011). This signals a perception that faculty careers are meant only for a few from specific backgrounds, which might deter those from underrepresented and marginalized backgrounds to aspire for a faculty career. That, along with a hypercompetitive environment, expectations of high research productivity (Horta, 2009), and an undefined training time spanning over a decade (Kaplan, 2012), adds to the complexity of meeting the needs of the workforce (PCAST, 2012). While considerable effort is put into broadening interest and participation in STEM careers (Dabney *et al.*, 2012; Dasgupta and Stout, 2014), it is also important to focus our attention on those individuals already in STEM careers who may not be achieving their fullest potential because of several traits related to impostor phenomenon (Chakraverty, 2013). A deeper examination of how impostor phenomenon manifests among faculty members will not only help in designing tailored mentorship and professional development opportunities for them, but also for PhD students and postdoctorates who will constitute the future faculty workforce.

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REFERENCES

- Adams, K., Hean, S., Sturgis, P., & Clark, J. M. (2006). Investigating the factors influencing professional identity of first-year health and social care students. *Learning in Health and Social Care*, 5(2), 55–68. <https://doi.org/10.1111/j.1473-6861.2006.00119.x>
- Alberts, B., Kirschner, M. W., Tilghman, S., & Varmus, H. (2014). Rescuing US biomedical research from its systemic flaws. *Proceedings of the National Academy of Sciences USA*, 111(16), 5773–5777. <https://doi.org/10.1073/pnas.1404402111>
- Alston, G. D., Guy, B. S., & Campbell, C. D. (2017). Ready for the professoriate? The influence of mentoring on career development for Black male graduate students in STEM. *Journal of African American Males in Education*, 8(1), 45–66.
- Austin, A. E. (2002). Preparing the next generation of faculty: Graduate school as socialization to the academic career. *Journal of Higher Education*, 73(1), 94–122. <https://doi.org/10.1353/jhe.2002.0001>
- Aycok, L. M., Hazari, Z., Brewster, E., Clancy, K. B., Hodapp, T., & Goertzen, R. M. (2019). Sexual harassment reported by undergraduate female physicists. *Physical Review Physics Education Research*, 15(1), 010121. <https://doi.org/10.1103/physrevphyseducres.15.010121>
- Baker, L. A., Chakraverty, D., Columbus, L., Feig, A. L., Jenks, W. S., Pilarz, M., ... & Wesemann, J. L. (2014). Cottrell Scholars collaborative new faculty workshop: Professional development for new chemistry faculty and initial assessment of its efficacy. *Journal of Chemical Education*, 91(11), 1874–1881. <https://doi.org/10.1021/ed500547n>

- Bazner, K. J., Vaid, J., & Stanley, C. A. (2021). Who is meritorious? Gendered and racialized discourse in named award descriptions in professional societies of higher education. *International Journal of Qualitative Studies in Education*, 34(2), 108–124. <https://doi.org/10.1080/09518398.2020.1735559>
- Bernard, D. L., Hoggard, L. S., & Neblett, E. W., Jr. (2018). Racial discrimination, racial identity, and impostor phenomenon: A profile approach. *Cultural Diversity and Ethnic Minority Psychology*, 24(1), 51. <https://doi.org/10.1037/cdp0000161>
- Billot, J. (2010). The imagined and the real: Identifying the tensions for academic identity. *Higher Education Research & Development*, 29(6), 709–721.
- Birt, L., Scott, S., Cavers, D., Campbell, C., & Walter, F. (2016). Member checking: A tool to enhance trustworthiness or merely a nod to validation? *Qualitative Health Research*, 26(13), 1802–1811. <https://doi.org/10.1177/1049732316654870>
- Blair, E. (2015). A reflexive exploration of two qualitative data coding techniques. *Journal of Methods and Measurement in the Social Sciences*, 6(1), 14–29. https://doi.org/10.2458/azu_jmmss_v6i1_blair
- Brems, C., Baldwin, M. R., Davis, L., & Namyniuk, L. (1994). The impostor syndrome as related to teaching evaluations and advising relationships of university faculty members. *Journal of Higher Education*, 65(2), 183–193. Retrieved September 4, 2022, from www.tandfonline.com/doi/abs/10.1080/00221546.1994.11778489?src=recsys
- Brownell, S. E., & Tanner, K. D. (2012). Barriers to faculty pedagogical change: Lack of training, time, incentives, and tensions with professional identity? *CBE—Life Sciences Education*, 11(4), 339–346. <https://doi.org/10.1187/cbe.12-09-0163>
- Butts, G. C., Hurd, Y., Palermo, A. G. S., Delbrune, D., Saran, S., Zony, C., & Krulwich, T. A. (2012). Role of institutional climate in fostering diversity in biomedical research workforce: A case study. *Mount Sinai Journal of Medicine*, 79(4), 498–511. <https://doi.org/10.1002/msj.21323>
- Cadez, S., Dimovski, V., & Zaman Groff, M. (2017). Research, teaching and performance evaluation in academia: The salience of quality. *Studies in Higher Education*, 42(8), 1455–1473. <https://doi.org/10.1080/03075079.2015.1104659>
- Canning, E. A., LaCrosse, J., Kroeper, K. M., & Murphy, M. C. (2020). Feeling like an imposter: The effect of perceived classroom competition on the daily psychological experiences of first-generation college students. *Social Psychological and Personality Science*, 11(5), 647–657. <https://doi.org/10.1177/1948550619882032>
- Carleton, R. N. (2016). Fear of the unknown: One fear to rule them all? *Journal of Anxiety Disorders*, 41, 5–21. <https://doi.org/10.1016/j.janxdis.2016.03.011>
- Carnegie Classification of Institutions of Higher Education. (n.d.). *Basic classification description*. Retrieved April 24, 2022, from https://carnegieclassifications.iu.edu/classification_descriptions/basic.php
- Chakraverty, D. (2013). *An examination of how women and underrepresented racial/ethnic minorities experience barriers in biomedical research and medical programs (Doctoral dissertation)*. Charlottesville: University of Virginia. Retrieved September 4, 2022, from <https://digitalcommons.unl.edu/dberspeakers/43>
- Chakraverty, D. (2019). Impostor phenomenon in STEM: Occurrence, attribution, and identity. *Studies in Graduate and Postdoctoral Education*, 10(1), 2–20. <https://doi.org/10.1108/SGPE-D-18-00014>
- Chakraverty, D. (2020a). The impostor phenomenon among Black doctoral and postdoctoral scholars in STEM. *International Journal of Doctoral Studies*, 15, 433–460. <https://doi.org/10.28945/4613>
- Chakraverty, D. (2020b). The impostor phenomenon among postdoctoral trainees in STEM: A US-based mixed-methods study. *International Journal of Doctoral Studies*, 15, 329–352. <https://doi.org/10.28945/4589>
- Chakraverty, D. (2020c). PhD student experiences with the impostor phenomenon in STEM. *International Journal of Doctoral Studies*, 15(1), 159–180. <https://doi.org/10.28945/4513>
- Chakraverty, D. (2021). Impostor phenomenon among engineering education researchers: An exploratory study. *International Journal of Doctoral Studies*, 16, 757–776. <https://doi.org/10.28945/4883>
- Chakraverty, D. (2022a). A cultural impostor? Native American experiences of impostor phenomenon in STEM. *CBE—Life Sciences Education*, 21(1), ar15. <https://doi.org/10.1187/cbe.21-08-0204>
- Chakraverty, D. (2022b). Impostor phenomenon and identity-based micro-aggression among Hispanic/Latinx individuals in science, technology, engineering, and mathematics: A qualitative exploration. *Violence and Gender*, 9(3), 135–141.
- Chakraverty, D. (2022c). Impostor phenomenon among Hispanic/Latino early career researchers in STEM fields. *Journal of Latinos and Education*, 1–9. <https://doi.org/10.1080/15348431.2022.2125394>
- Chakraverty, D., Cavazos, J. E., & Jeffe, D. B. (2022). Exploring reasons for MD-PhD trainees' experience of impostor phenomenon. *BMC Medical Education*, 22(1), 1–11.
- Chakraverty, D., Jeffe, D. B., & Tai, R. H. (2018). Transition experiences in MD-PhD programs. *CBE—Life Sciences Education*, 17(3), ar41. <https://doi.org/10.1187/cbe.17-08-0187>
- Chakraverty, D., & Rishi, M. (2022). Impostor phenomenon and discipline-specific experiences of violence in science, technology, engineering, and mathematics. *Violence and Gender*, 9(1), 22–29. <https://doi.org/10.1089/vio.2021.0025>
- Chesler, N. C., Barabino, G., Bhatia, S. N., & Richards-Kortum, R. (2010). The pipeline still leaks and more than you think: A status report on gender diversity in biomedical engineering. *Annals of Biomedical Engineering*, 38(5), 1928–1935. <https://doi.org/10.1007/s10439-010-9958-9>
- Cisco, J. (2020). Exploring the connection between impostor phenomenon and postgraduate students feeling academically-unprepared. *Higher Education Research & Development*, 39(2), 200–214. <https://doi.org/10.1080/07294360.2019.1676198>
- Clance, P. R. (1985). Clance Impostor Phenomenon Scale (CIPS). In *The impostor phenomenon: When success makes you feel like a fake* (pp. 20–22). Toronto: Bantam Books. Retrieved June 11, 2022, from www.paulineroseclance.com. Available at: https://paulineroseclance.com/impostor_phenomenon.html
- Clance, P. R., & Imes, S. A. (1978). The imposter phenomenon in high achieving women: Dynamics and therapeutic intervention. *Psychotherapy: Theory, Research & Practice*, 15(3), 241. <https://doi.org/10.1037/h0086006>
- Creswell, J. W., & Clark, V. L. P. (2017). *Designing and conducting mixed methods research*. Thousand Oaks, CA: Sage.
- Cruess, R. L., Cruess, S. R., Boudreau, J. D., Snell, L., & Steinert, Y. (2014). Reframing medical education to support professional identity formation. *Academic Medicine*, 89(11), 1446–1451. doi: 10.1097/ACM.0000000000000427
- Dabney, K. P., Tai, R. H., Almarode, J. T., Miller-Friedmann, J. L., Sonnett, G., Sadler, P. M., & Hazari, Z. (2012). Out-of-school time science activities and their association with career interest in STEM. *International Journal of Science Education, Part B*, 2(1), 63–79. <https://doi.org/10.1080/21548455.2011.629455>
- Dancy, T. E., & Brown, M. C. (2011). The mentoring and induction of educators of color: Addressing the impostor syndrome in academe. *Journal of School Leadership*, 21(4), 607–634. <https://doi.org/10.1177/105268461102100405>
- Dasgupta, N., & Stout, J. G. (2014). Girls and women in science, technology, engineering, and mathematics: STEMing the tide and broadening participation in STEM careers. *Policy Insights from the Behavioral and Brain Sciences*, 1(1), 21–29. <https://doi.org/10.1177/2372732214549471>
- Deshmukh, S., Shmelev, K., Vassiliades, L., Kurumety, S., Agarwal, G., & Horowitz, J. M. (2022). Imposter phenomenon in radiology: Incidence, intervention, and impact on wellness. *Clinical Imaging*, 82, 94–99. <https://doi.org/10.1016/j.clinimag.2021.11.009>
- Felder, P. P., Stevenson, H. C., & Gasman, M. (2014). Understanding race in doctoral student socialization. *International Journal of Doctoral Studies*, 9(19), 21–42. <http://ijds.org/Volume9/IJDSv9p021-042Felder0323.pdf>
- Festinger, L. (1954). A theory of social comparison processes. *Human Relations*, 7(2), 117–140. <https://doi.org/10.1177/001872675400700202>
- Fields, L. N., & Cunningham-Williams, R. M. (2021). Experiences with impostor syndrome and authenticity at research-intensive schools of social work: A case study on Black female faculty. *Advances in Social Work*, 21(2/3), 354–373. <https://doi.org/10.18060/24124>
- Fusch, P. I., & Ness, L. R. (2015). Are we there yet? Data saturation in qualitative research. *Qualitative Report*, 20(9), 1408. <https://doi.org/10.46743/2160-3715/2015.2281>
- Gibbs, K. D., Jr., McGready, J., Bennett, J. C., & Griffin, K. (2014). Biomedical science Ph. D. career interest patterns by race/ethnicity and gender. *PLoS ONE*, 9(12), e114736. <https://doi.org/10.1371/journal.pone.0114736>

- Glaser, B. G., & Strauss, A. L. (2017). *Discovery of grounded theory: Strategies for qualitative research*. New York: Routledge. <https://doi.org/10.4324/9780203793206>
- Horta, H. (2009). Holding a post-doctoral position before becoming a faculty member: Does it bring benefits for the scholarly enterprise? *Higher Education*, 58(5), 689–721. <https://doi.org/10.1007/s10734-009-9221-1>
- Howe-Walsh, L., & Turnbull, S. (2016). Barriers to women leaders in academia: Tales from science and technology. *Studies in Higher Education*, 41(3), 415–428. <https://doi.org/10.1080/03075079.2014.929102>
- Hutchins, H. M. (2015). Outing the imposter: A study exploring imposter phenomenon among higher education faculty. *New Horizons in Adult Education and Human Resource Development*, 27(2), 3–12. Retrieved September 4, 2022, from <https://onlinelibrary.wiley.com/doi/abs/10.1002/nha3.20098>
- Hutchins, H. M., & Rainbolt, H. (2017). What triggers imposter phenomenon among academic faculty? A critical incident study exploring antecedents, coping, and development opportunities. *Human Resource Development International*, 20(3), 194–214. <https://doi.org/10.1080/13678868.2016.1248205>
- Ivie, R., & Ephraim, A. (2009, October). Mentoring and the imposter syndrome in astronomy graduate students. In Kinney, A. L., Khachadourian, D., Millar, P. S., & Hartman, C. N. (Eds.), *Proceedings of Women in Astronomy and Space Science, Women in Astronomy and Space Science: Meeting the Challenges of an Increasingly Diverse Workforce: Conference held at The Inn and Conference Center University of Maryland University College October 21–23, 2009* (pp. 25–33). Retrieved September 4, 2022, from https://attic.gsfc.nasa.gov/wia2009/WIA2009_proceedings.pdf
- Ivie, R., White, S., & Chu, R. Y. (2016). Women's and men's career choices in astronomy and astrophysics. *Physical Review Physics Education Research*, 12(2), 020109. <https://doi.org/10.1103/PhysRevPhysEducRes.12.020109>
- Jarvis-Selinger, S., Pratt, D. D., & Regehr, G. (2012). Competency is not enough: Integrating identity formation into the medical education discourse. *Academic Medicine*, 87(9), 1185–1190. doi: 10.1097/ACM.0b013e3182604968
- Jöstl, G., Bergsmann, E., Lüftenegger, M., Schober, B., & Spiel, C. (2015). When will they blow my cover? The impostor phenomenon among Austrian doctoral students. *Journal of Psychology [Zeitschrift für Psychologie]*, 220(2), 109–120. <https://doi.org/10.1027/2151-2604/a000102>
- Kaplan, K. (2012). Postdoc or not? *Nature*, 483(7390), 499–500. <https://doi.org/10.1038/nj7390-499a>
- King, J. E., & Cooley, E. L. (1995). Achievement orientation and the impostor phenomenon among college students. *Contemporary Educational Psychology*, 20(3), 304–312. <https://doi.org/10.1006/ceps.1995.1019>
- Knights, D., & Clarke, C. A. (2014). It's a bittersweet symphony, this life: Fragile academic selves and insecure identities at work. *Organization Studies*, 35(3), 335–357. <https://doi.org/10.1177/0170840613508396>
- Lampman, C. (2012). Women faculty at risk: US professors report on their experiences with student incivility, bullying, aggression, and sexual attention. *NASPA Journal About Women in Higher Education*, 5(2), 184–208. <https://doi.org/10.1515/njawhe-2012-1108>
- Laursen, S., & Austin, A. E. (2020). *Building gender equity in the academy: Institutional strategies for change*. Baltimore, MD: Johns Hopkins University Press.
- Lee, H., Anderson, C. B., Yates, M. S., Chang, S., & Chakraverty, D. (2020). Insights into the complexity of the impostor phenomenon among trainees and professionals in STEM and medicine. *Current Psychology*, 54(1), 1–12. <https://doi.org/10.1007/s12144-020-01089-1>
- Limeri, L. B., Asif, M. Z., Bridges, B. H., Esparza, D., Tuma, T. T., Sanders, D., ... & Dolan, E. L. (2019). "Where's my mentor?": Characterizing negative mentoring experiences in undergraduate life science research. *CBE—Life Sciences Education*, 18(4), ar61. <https://doi.org/10.1187/cbe.19-02-0036>
- Marshall, C., & Rossman, G. B. (2014). *Designing qualitative research* (5th ed.). Thousand Oaks, CA: Sage.
- Martinez, E. D., Botos, J., Dohoney, K. M., Geiman, T. M., Kolla, S. S., Olivera, A., ... & Cohen-Fix, O. (2007). Falling off the academic bandwagon: Women are more likely to quit at the postdoc to principal investigator transition. *European Molecular Biology Organization Reports*, 8(11), 977–981. <https://doi.org/10.1038/sj.embor.7401110>
- Monroe, K. R., & Chiu, W. F. (2010). Gender equality in the academy: The pipeline problem. *PS: Political Science & Politics*, 43(2), 303–308. <https://doi.org/10.1017/S104909651000017X>
- Nash, M., Davies, A., & Moore, R. (2017). What style of leadership do women in STEM fields perform? Findings from an international survey. *PLoS ONE*, 12(10), e0185727. <https://doi.org/10.1371/journal.pone.0185727>
- Neureiter, M., & Traut-Mattausch, E. (2016). Inspecting the dangers of feeling like a fake: An empirical investigation of the impostor phenomenon in the world of work. *Frontiers in Psychology*, 7, 1445. <https://doi.org/10.3389/fpsyg.2016.01445>
- Nielsen, M. W. (2016a). Gender inequality and research performance: Moving beyond individual-meritocratic explanations of academic advancement. *Studies in Higher Education*, 41(11), 2044–2060. <https://doi.org/10.1080/03075079.2015.1007945>
- Nielsen, M. W. (2016b). Limits to meritocracy? Gender in academic recruitment and promotion processes. *Science and Public Policy*, 43(3), 386–399. <https://doi.org/10.1093/scipol/scv052>
- Obers, N. (2015). Influential structures: Understanding the role of the head of department in relation to women academics' research careers. *Higher Education Research & Development*, 34(6), 1220–1232. <https://doi.org/10.1080/07294360.2015.1024632>
- Peteet, B. J., Montgomery, L., & Weekes, J. C. (2015). Predictors of imposter phenomenon among talented ethnic minority undergraduate students. *Journal of Negro Education*, 84(2), 175–186. <https://doi.org/10.7709/jnegroeducation.84.2.0175>
- Posselt, J. (2018). Normalizing struggle: Dimensions of faculty support for doctoral students and implications for persistence and well-being. *Journal of Higher Education*, 89(6), 988–1013. <https://doi.org/10.1080/00221546.2018.1449080>
- Pratt, M. G., Rockmann, K. W., & Kaufmann, J. B. (2006). Constructing professional identity: The role of work and identity learning cycles in the customization of identity among medical residents. *Academy of Management Journal*, 49(2), 235–262. <https://doi.org/10.5465/amj.2006.20786060>
- President's Council of Advisors on Science and Technology. (2012). *Engage to excel: Producing one million additional college graduates with degrees in science, technology, engineering, and mathematics*. Washington, DC: U.S. Government Office of Science and Technology.
- Pulliam, N., & Gonzalez, C. E. (2018). Success or fraud? Exploring the impacts of the impostor phenomenon among high achieving racial/ethnic minority and first-generation college students. *Journal of Access, Retention, & Inclusion in Higher Education*, 1(1), 33–45.
- Read, B., & Kehm, B. M. (2016). Women as leaders of higher education institutions: A British–German comparison. *Studies in Higher Education*, 41(5), 815–827. <https://doi.org/10.1080/03075079.2016.1147727>
- Reybold, L. E. (2003). Pathways to the professorate: The development of faculty identity in education. *Innovative Higher Education*, 27(4), 235–252. <https://doi.org/10.1023/A:1024024430041>
- Robinson, J. L. (2018). *Imposterized: The experiences of tenured and tenure-track Black women instructional faculty at California community colleges (Doctoral dissertation)*. Long Beach: California State University.
- Sadler, G. R., Lee, H. C., Lim, R. S. H., & Fullerton, J. (2010). Recruitment of hard-to-reach population subgroups via adaptations of the snowball sampling strategy. *Nursing & Health Sciences*, 12(3), 369–374. <https://doi.org/10.1111/j.1442-2018.2010.00541.x>
- San Pedro, T., & Kinloch, V. (2017). Toward projects in humanization: Research on co-creating and sustaining dialogic relationships. *American Educational Research Journal*, 54(Suppl 1), 373S–394S. <https://doi.org/10.3102/0002831216671210>
- Seritan, A. L., & Mehta, M. M. (2016). Thorny laurels: The impostor phenomenon in academic psychiatry. *Academic Psychiatry*, 40(3), 418–421. <https://doi.org/10.1007/s40596-015-0392-z>
- Sheltzer, J. M., & Smith, J. C. (2014). Elite male faculty in the life sciences employ fewer women. *Proceedings of the National Academy of Sciences USA*, 111(28), 10107–10112. <https://doi.org/10.1073/pnas.1403334111>
- Sims, W. L., & Cassidy, J. W. (2019). Impostor phenomenon responses of early career music education faculty. *Journal of Research in Music Education*, 67(1), 45–61. <https://doi.org/10.1177/0022429418812464>
- Stains, M., Pilarz, M., & Chakraverty, D. (2015). Short and long-term impacts of the Cottrell Scholars Collaborative New Faculty Workshop. *Journal of*

- Chemical Education*, 92(9), 1466–1476. <https://doi.org/10.1021/acs.jchemed.5b00324>
- Stephan, P. (2012). *How economics shapes science*. Cambridge, MA: Harvard University Press. <https://doi.org/10.4159/harvard.9780674062757>
- Stone, S., Saucer, C., Bailey, M., Garba, R., Hurst, A., Jackson, S. M., ... & Cokley, K. (2018). Learning while Black: A culturally informed model of the impostor phenomenon for Black graduate students. *Journal of Black Psychology*, 44(6), 491–531. <https://doi.org/10.1177/0095798418786648>
- Strange, K. Z. (2020). *The impact of identity: Faculty identity and professional development in higher education (Doctoral dissertation)*. Flagstaff: Northern Arizona University.
- Thomas, N., Bystydzienski, J., & Desai, A. (2015). Changing institutional culture through peer mentoring of women STEM faculty. *Innovative Higher Education*, 40(2), 143–157. <https://doi.org/10.1007/s10755-014-9300-9>
- Topping, M. E. (1983). *The impostor phenomenon: A study of its construct and incidence in university faculty members (Doctoral dissertation)*. Tampa: University of South Florida. *Dissertation Abstracts International*, 44, 1948B–1949B.
- Vaughn, A. R., Taasobshirazi, G., & Johnson, M. L. (2019). Impostor phenomenon and motivation: Women in higher education. *Studies in Higher Education*, 45(4), 780–795. <https://doi.org/10.1080/03075079.2019.1568976>
- Villablanca, A. C., Beckett, L., Nettiksimmons, J., & Howell, L. P. (2011). Career flexibility and family-friendly policies: An NIH-funded study to enhance women's careers in biomedical sciences. *Journal of Women's Health*, 20(10), 1485–1496. <https://doi.org/10.1089/jwh.2011.2737>
- Whittaker, J. A., & Montgomery, B. L. (2014). Cultivating institutional transformation and sustainable STEM diversity in higher education through integrative faculty development. *Innovative Higher Education*, 39(4), 263–275. <https://doi.org/10.1007/s10755-013-9277-9>
- Woolston, C. (2016). Faking it. *Nature*, 529(7587), 555–557. <https://doi.org/10.1038/nj7587-555a>