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Academic Motherhood: Considerations of STEM Postdoctoral Scholar Women

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This instrumental case study explores the messages STEM postdoctoral scholar women received and understood from faculty about having children and an academic career. Of concern, women with children are less likely than men with children or individuals without children to be offered tenure-track positions or to be promoted. This reality suggests academic motherhood is in opposition to professional legitimacy in higher education. Furthermore, postdoctoral scholars who are mothers are more likely than their peers to cite children as their primary reason for not entering the faculty job market. Through inductive and deductive methods, interview transcripts of 22 demographically diverse STEM postdoctoral scholar women were analyzed using the ideal worker conceptual framework. Two themes were identified: (1) messages interpreted as disparaging suggest to STEM postdoctoral women they must sacrifice the choice to have children for an academic career and (2) messages interpreted as supportive promote the belief that academic motherhood is achievable. These findings illustrate a systemic conflict for STEM postdoctoral scholar women who have children or are considering becoming mothers in the future. Due to disparaging messages from faculty, most interviewees felt the constraints of ideal worker norms; however, through supportive messages from faculty, particularly positive modeling, these women saw the feasibility of having children and a successful academic career without the necessity of conforming to these norms. Inclusive, family friendly higher education policies and practices must be instituted to ensure more women enter and thrive in the STEM professoriate, and women who have or desire to have children are not marginalized.

While pursuing a career as a professor often is identified as the single most valued career option among science, technology, engineering, and mathematics (STEM) postdoctoral scholars (van der Weijden et al., 2016), the path to the professoriate can be daunting for women who have or plan to have children (Bird & Rhoton, 2021). Negative messages cause many women to depart the STEM professoriate trajectory, further reducing STEM faculty gender diversity, which remains primarily dominated by men. Consequently, Cech and Blair-Loy (2019) found 43% of women leave STEM after having their first child.

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While concerns for academic mothers and those who plan to be have received attention in the literature for women faculty, few studies have focused on the perspectives of post-doctoral scholar women.

As postdoctoral scholars are positioned to be the next generation of tenure-track faculty members, understanding the way in which motherhood intersects with their career decisions is vital (Cheng & Rosenbloom, 2023). The average age of postdoctoral scholars is 33, which overlaps with the prime fertility time of cis women; thus, many women who wish to bear children at this time feel they must choose between an academic career or building a family (Williams & Ceci, 2012). This instrumental case study (Stake, 1995) explores the way in which STEM postdoctoral scholar women receive and understand messages from faculty about having children and an academic career. The ideal worker conceptual framework furthered by Kossek et al. (2021) and established by Acker (1990) and Williams (1989) grounds the study to highlight the norm that prized employees prioritize work over personal responsibilities and interests. This research is sponsored by the National Science Foundation (NSF) Alliances for Graduate Education and the Professoriate (AGEP; award number 1821008).

LITERATURE REVIEW

While the rate of women obtaining doctoral degrees in STEM fields continues to increase, a lack of women in the STEM professoriate remains (Ahmad, 2017; Casad et al., 2020; Miller & Riley, 2022; Wonch Hill et al., 2014). Women comprise 34.5% of STEM faculty in U.S. colleges and universities and only 28.2% of tenured STEM faculty (National Science Foundation [NSF] National Center for Science and Engineering Statistics, 2019). Furthermore, although women account for 34% of the U.S. STEM workforce, disciplines show stark discrepancies (National Science Board & National Science Foundation [NSB & NSF], 2022). For instance, women in life sciences represent nearly half of the workforce but only 35% of physical scientists, 26% of computer and mathematical scientists, and 16% of engineers. In an antiquated argument, this imbalance is said to be a result of men's greater aptitude in STEM; however, this argument has been disproved time and time again (Bird & Rhoton, 2021; Kossek et al., 2021; Miller & Riley, 2022; Thébaud & Taylor, 2021; Williams & Ceci, 2012). Instead, a growing body of research documents that women depart academia due to high rates of isolation resulting from less support and fewer mentoring networks (Bird & Rhoton, 2021; Kahn & Ginther, 2017; Lester, 2008; Ysseldyk et al., 2019), hiring and promotion discrimination (Gregor et al., 2022; Hughes et al., 2022), and sexual harassment (Blake, 2022; Casad et al., 2020; Ecklund & Lincoln, 2011; Kahn & Ginther, 2017; Miller & Riley, 2022). Kahn and Ginther (2017) cited sexual harassment as a prevalent concern for women in STEM fields.

Indeed, these forms of microaggressions and discrimination lead women to leave STEM academia at a rate five times higher than that of their peers in other disciplines, such as the social sciences (Glass et al., 2013). The high rate of women leaving STEM is important to note, as gendered experiences are dramatically different in STEM (Hart, 2016; Lester, 2008). Hart (2016) attributed these results to department leaders frequently assigning women to greater teaching and service loads, which comes at the expense of their research. Some scholars refer to this as institutional housekeeping and note that, more often, women are given less prestigious, lower-skilled work in STEM (Bird et al., 2004; Hart, 2016). Lester (2008) noted women's roles

in their departments are limited based on men's perceptions of stereotypical feminine gender roles.

Women in academia who wish to be or are mothers face additional adversities, as motherhood can directly conflict with an academic career. This is referred to as the "maternal wall" (Hughes et al., 2022; McKinnon-Crowley et al., 2021) and is especially true in STEM. This phenomenon is even more complex when one considers the complexity of gender on a spectrum, not the dichotomous female/male sex assigned at birth (Lindqvist et al., 2020). Women in the STEM professoriate often report choosing between a career and having children at higher rates than women from other disciplines (Ward & Wolf-Wendel, 2012; Wolf-Wendel & Ward, 2015). Also, occurring in all fields, women with children are less likely than men with children or individuals without children to be offered tenure-track positions or to be promoted (Bird & Rhoton, 2021; Cech & Blair-Loy, 2019; Gahlon et al., 2022; Gregor et al., 2022; Williams & Ceci, 2012; Ysseldyk et al., 2019). Moreover, women with children are less likely to be principal investigators on sponsored research projects, which could have long-term implications for their academic careers, especially in STEM (Martinez et al., 2007). To combat these potential career consequences, some women choose to hide their families from their workplace, fearing their work will be devalued if they are discovered to be mothers (Thébaud & Taylor, 2021; Ward & Wolf-Wendel, 2012; Wonch Hill et al., 2014). These realities suggest motherhood is in opposition to professional legitimacy in academia (Hughes et al., 2022; Thébaud & Taylor, 2021; Wonch Hill et al., 2014).

Higher education institutions are viewed as notoriously unsupportive of women with children because the professoriate was not designed for employees to have responsibilities outside the workplace. This sentiment is a result of the professoriate evolving from a predominantly masculine organization within a primarily men-dominated society (CohenMiller et al., 2022; Lee et al., 2017; Lester, 2008; Williams & Ceci, 2012). The professoriate typically rewards individuals who prioritize work above all else (Kossek et al., 2021). Although Title IX and the Family and Medical Leave Act (FMLA) were created to promote equal employment opportunities and access to paid and unpaid leave, many higher education leaders have failed to enact equitable policies (Ahmad, 2017; Bornstein, 2000; Lee et al., 2017), e.g., paid time off for family emergencies, prospective parent leave (e.g., natural, nongestational, adoptive, etc.), and caregiving responsibilities (Gregor et al., 2022; Levitt et al., 2020).

In addition, more women than men report institutional policies, such as dual-career hiring opportunities and paid maternity leave, influence their choice of where they work (Blake, 2022; CohenMiller et al., 2022). Of the higher education institutions that offer maternity leave in the United States, few have adequate or supportive policies, leading women to feel they must return early or forego a break because they fear these options will stall their careers (Bird & Rhoton, 2021; CohenMiller et al., 2022; Gahlon et al., 2022; Gregor et al., 2022; Lee et al., 2017; Ward & Wolf-Wendel, 2012). Thus, college and university leaders must evaluate current policies and establish new maternity and family friendly initiatives, especially for LGBTQ+ families (Levitt et al., 2020) to promote healthier work-life management in the academy and ensure gender bias does not undercut these efforts (Cech & Blair-Loy, 2019; Gregor et al., 2022; Hughes et al., 2022).

To mitigate these issues, institutional leaders must invest in mentoring programs and child-focused support such as subsidized childcare, evening and weekend childcare, and campus lactation spaces (Allen-Ramdial & Campbell, 2014; CohenMiller et al., 2022; Mason et al.,

2013; Rybarczyk et al., 2016; Yadav et al., 2020). However, these types of programs address individual rather than system-level needs. The COVID-19 pandemic magnified these gendered experiences in the academy, forcing higher education leaders to redress them (Lufler & McNulty, 2022). Attention to these issues has occurred with systemic stop-the-clock options (i.e., tenure clock pauses for personal reasons); examination of gendered salary and workload inequities; and instituting inclusive, family friendly policies (Smith et al., 2022; Witteman et al., 2021).

Unlike other disciplines, many postdoctoral scholars and faculty in STEM fields must work long hours in a lab or at the bench (Canti et al., 2021). STEM academics with benchwork report they are expected to be on call 24/7, as they may have responsibilities tending to animals or chemicals that require around-the-clock monitoring and care (Ward & Wolf-Wendel, 2012; Wolf-Wendel & Ward, 2015). Mason et al. (2013) indicated these demands are particularly strenuous for individuals in the biological sciences and dramatically reduce the amount of time spent outside of work, further inhibiting work-life management and restricting time for women to attend to any caregiving responsibilities. In addition, Wolf-Wendel and Ward (2015) noted STEM women faculty, more than those from other disciplines, report significant strains between managing work and family duties.

Women in the professoriate have faced many challenges in navigating a career and having children, although STEM postdoctoral scholars often face even more precarious issues. The average age of women in postdoctoral positions is 33, but optimal fertility begins to decline at 31 for cis women, causing many to feel they must choose between having children and an academic career (Williams & Ceci, 2012). The trade-off is apparent, considering 25% of women and 38% of men are childless between the ages of 24 and 30, and these figures increase to 75% of women and 65% of men in STEM postdoctoral positions (Martinez et al., 2007). In studies of postdoctoral scholars, nearly 50% of women reported their postdoctoral position impacted their plan to have children, which was identified as a top reason to leave the academic track (National Postdoctoral Association [NPA] ADVANCE, 2011). Researchers note transitioning from postdoctoral scholar to tenure-track faculty member results in a large attrition rate of women from STEM (Glass et al., 2013; Tanenbaum & Upton, 2014).

Not all postdoctoral positions offer health insurance (Hoffman et al., 2009) or maternity leave (NPA ADVANCE, 2011). To counter this lack of protection, women tend to synchronize their child's birth with a specific work transition or school break to minimize time away from work (Bird & Rhoton, 2021). Nonetheless, timing the birth of one's child or minimizing time away from work for caregiving responsibilities is not always possible. As a result, postdoctoral scholar women with children are twice as likely as men to leave the academic track, citing excessive pressure in academia and insufficient time with family (NPA ADVANCE, 2011), which is known as the "baby penalty" (Ysseldyk et al., 2019). These compounding stressors are common causes of attrition for women in STEM academia and may influence a woman's decision to pursue a career in industry or government because they are considered more family friendly.

CONCEPTUAL FRAMEWORK

This study utilizes the ideal worker conceptual framework (Kossek et al., 2021) to consider the messages STEM postdoctoral scholar women receive and understand from faculty about having

children and an academic career. The ideal worker paradigm indicates the prized employee is the individual who prioritizes work above all else and whose work goals and performance are closely tied to constant productivity (Acker, 1990; Kossek et al., 2021; Miller & Riley, 2022; Sallee, 2020; Williams, 1989). This framework is built on the gender-focused work of Williams (1989) and Acker (1990). The paradigm is a product of the Industrial Revolution and traditional societal gendered schemas of work-related responsibilities (Davies & Frink, 2014). As the economy shifted from producing just enough to maintain to producing at maximum output, White, middle-class gender norms promoted working outside the home to earn an income as more important than working in the home, such as housekeeping and rearing children. Thus, work that earns money was deemed more valuable and was primarily performed by men (Acker, 1990; Davies & Frink, 2014). The ideal worker extends beyond earning a paycheck and rewards those who work incessantly without any external responsibilities (Collins, 2019; Hart, 2016; Kachchaf et al., 2015; Mason et al., 2013; Miner et al., 2019; Sallee, 2020). Consequently, women traditionally bear the brunt of childrearing, family, and caregiving; therefore, ideal worker norms reflect gender stereotypes and marginalize the work of women (Sallee, 2020; Williams, 1989).

These ideal worker norms reflect typical success trajectories in academic tenure-track positions, which are rigidly sequential and time-sensitive (Ahmad, 2017). Moreover, ideal worker norms are instilled via institutional policies and practices and interpersonal perceptions and values among colleagues, which tend to prize those whose research productivity is highest. This issue is particularly true in the STEM disciplines, which remain predominantly White, cisgendered men, and patriarchal (Glass et al., 2013; Hsain et al., 2020; Kachchaf et al., 2015; Miner et al., 2019; Ruder et al., 2018; Wolf-Wendel & Ward, 2015). Thus, the intense competition between the goals and demands of having children while maintaining a career is most prevalent in STEM fields (Thébaud & Taylor, 2021) and is compounded by a lack of family friendly policies in higher education and the unequal gendered expectations frequently cast upon women in the academy (Hsain et al., 2020; Miller & Riley, 2022).

Ideal worker norms that expect prioritization of work exist in a tense duality with motherhood, which requires flexibility, attention, energy, and time. Naturally, motherhood does not conform to the ideal worker norms and can lead to conflict when academic mothers are seen as less committed to their work, which affects their professional legitimacy (Thébaud & Taylor, 2021). As women tend to shoulder more domestic responsibilities than men, they experience professional conflicts at a higher rate (Bird et al., 2004; Kossek et al., 2021; Sallee, 2020). This study employs the ideal worker conceptual framework as a deductive lens in the data analysis process and in considering the study's implications and conclusions (Anfara & Mertz, 2014).

METHOD

Research Design

To explore the ways in which STEM postdoctoral scholar women receive and understand messages from faculty about having children and an academic career, this research employed an instrumental case study design (Stake, 1995). Case studies focus on developing an in-depth

description, analysis, and understanding of a unique experience or phenomenon (Creswell & Poth, 2018). More specifically, instrumental case studies allow researchers to uncover a specific problem or concern from the participants' perspectives, which others may interpret as unimportant (Stake, 1995). A case study was appropriate for this study, given the research question, because the goal was to develop a detailed description of a real-world lived experience rather than to explore the life of an individual, understand the essence of an experience, develop a new theory, or describe a culture-sharing group (Creswell & Poth, 2018). Interviews grounded in the ideal worker conceptual framework (Kossek et al., 2021) provided insight into the messages received and understood by 22 STEM postdoctoral scholar women about this topic. The research question guiding this study was: How do STEM postdoctoral scholar women receive and understand messages from faculty about having children and an academic career?

Participants

The interview transcripts of 22 STEM postdoctoral scholars who self-identified as women were included in this study. The interviews were part of a larger project that included 50 STEM postdoctoral scholar interviews conducted with women and men on their career trajectories. Only participants from the larger project who self-identified as women were included in this study. Participants were recruited in 2019 from the National Postdoctoral Association (NPA) via an e-mail alert and were incentivized with a $25 e-gift card. The sample for this study included a racially/ethnically diverse group of women STEM postdoctoral scholars, three of whom were from outside the United States. All worked in the United States at research-intensive higher education institutions. They ranged in age from 28 to 38, with an average age of 33. Eight identified as single, one as divorced, three as cohabitating, and 10 as married or in a common-law partnership. Seven reported having one child, while all intimated some desire to have children during their interviews. General STEM fields included biology, chemistry, engineering, environmental science, neuroscience, psychology, and radiology.

Twelve participants aspired to work in academia, 11 in the professoriate, and one in an administrative role. One was interested in working in industry, as she believed it to be the best venue for her work to reach a broad audience. Nine were undecided, as they were in the process of weighing the career path that would offer the best opportunity for work-life management and time to have children and be with family. At one time, these nine firmly planned to become professors. Generally, all participants aspired to have a career where they could conduct meaningful work, be paid well, and work in a collaborative environment. Of the women with children, five were preparing to enter the tenure-track faculty job market, and two were undecided. A summary of participant demographics is listed in Table 1.

Data Collection

Following Institutional Review Board approval, all participants were provided with a consent form detailing the purpose of the study, interview procedures, and safeguards in place to protect their privacy and confidentiality. Interviews averaged 60 min in length and ranged from 20–75 min. Three researchers (one professor and two graduate assistants) completed the interviews virtually via web conference or phone. A semi-structured interview protocol was designed to focus on academic and personal experiences that led

TABLE 1
Postdoctoral Scholar Demographics

Pseudonym	*Race/Ethnicity*	*Age*	*Marital Status*	*Number of Dependents*	*General Field of Study*	*Career Aspiration*
Analia	White	38	Single	0	Biology	Undecided
Angela	Columbian	32	Single	0	Engineering	Academia
Charity	Black/White	34	Single	0	Psychology	Undecided
Dahlia	Asian	38	Married	1	Engineering	Academia
Eya	Black	31	Single	0	Chemistry	Undecided
Jade	Asian	35	Cohabitation	0	Engineering	Undecided
Jayla	White	37	Married	1	Neuroscience	Academia
Kaia	Black	33	Single	0	Environ. Science	Undecided
Katrina	Latina	28	Single	0	Psychology	Academia
Kelsey	Puerto Rican	30	Single	0	Psychology	Academia
Kinsley	Black	31	Divorced	0	Biology	Undecided
Luna	White	37	Married	1	Biology	Undecided
Lyla	White	32	Married	0	Engineering	Academia
Meadow	White	30	Married	0	Engineering	Academia
Melanie	Dominican/Polish	32	Cohabitation	1	Biology	Academia
Morgan	White	33	Cohabitation	0	Neuroscience	Undecided
Natalie	White	31	Married	0	Engineering	Academia
Sadie	White	33	Married	0	Neuroscience	Industry
Scarlett	Black	31	Single	0	Engineering	Academia
Sophia	Latina	29	Married	1	Biology	Undecided
Suzanne	Latina	30	Married	1	Biology	Academia
Sylvie	Brazilian/White	38	Married	1	Radiology	Academia

General field of study was used to aid in participant masking; Married also may indicate a common-law partnership.

them to a postdoctoral position, aspects of their appointment that made the professoriate appear appealing and unappealing, and the process used to identify their career goals. While the interview protocol did not probe specifically for children and family formation decisions, the influence of such decisions permeated the interviews. Sample questions included:

1. Who in your life encouraged you to pursue a Ph.D., and why were they influential?
2. What academic experiences led you to seek a postdoctoral opportunity?
3. Talk to me about your postdoctoral work. What are some of your favorite and least favorite experiences so far?
4. What are the most important factors in determining your career path moving forward?
5. How do your career goals intersect with your life goals?

The protocol allowed for rich data collection through the predeveloped questions, providing space for the interviewers to seek clarification and meaning from the participants (Patton, 2015). Pseudonyms were assigned to all interviewees, and only deidentified participant interview transcripts were stored on a secured server accessible to only the research team.

Reflexivity and Positionality

Throughout the study, the research team engaged in individual and collective reflexivity (Watt, 2007) by reflecting upon; bracketing out; and dialoguing about experiences, values, and beliefs concerning the messages women receive about having children and an academic career. In qualitative research, reflexivity is a crucial component of inquiry, positioning researchers to consider their bias and its potential impact on meaning making and interpretations during data collection and analysis. Lincoln and Guba (1985) contended that researchers must disclose their positionality so readers are aware of the unique perspectives they bring to the study. Our research team comprises social science academic women trained in qualitative research methods within educational settings. One is a professor, and the other is a postdoctoral scholar. Neither possesses an educational background in STEM, but one initially pursued a STEM baccalaureate degree. Both are in long-term relationships, and one has children; the children were planned and timed purposefully to avoid interrupting her academic career. Each received derogatory messages about being an academic mother (e.g., questions about whether mothers are "serious scholars"), and both were told not to have children if they desired to advance into an academic administrative role. While an academic career provides the desired level of job flexibility and autonomy, the lack of policies supporting academic mothers has created undue stress and decreased job satisfaction for the one with children.

Data Analysis

Silverman's (2019) and Stake's (1995) data analysis strategies were employed to examine how STEM postdoctoral scholar women receive and understand messages from faculty about having children and pursuing an academic career. Throughout the data analysis process, we were mindful of focusing on the participants' lived experiences and perspectives rather than on our internalized points of view and experiences, which were acknowledged through reflexivity. Silverman's thematic content analysis technique followed an inductive approach to search for themes and patterns related to the research question. Using this method, we coded the transcripts using in vivo (participants' exact words/phrases) individually in a comprehensive manner and then collectively identified cross-references between the data and the evolving themes while memoing. This method allowed for flexibility when approaching research patterns inductively (Silverman, 2019).

The in vivo process and evaluative codes were created, collapsed, and amalgamated into initial themes to summarize the ways in which STEM postdoctoral scholar women receive and understand faculty messages about having children and an academic career (Patton, 2015). Process codes included observable and conceptual actions taken by the participants, such as planning for children and sharing career and family struggles with trusted academic advisors, mentors, and colleagues. Evaluative codes included judgments about their ability to be academic mothers, such as the value of positive modeling and feelings that the "clock is ticking" on motherhood. We viewed incorporating an inductive analysis process as critical to this inquiry because the interview protocol did not query specifically on children and family planning. Yet, this topic pervaded the women's interview transcripts and arose organically and clearly across race/ethnicity, age, marital status, dependent status, disciplinary background, and career aspiration.

We employed Stake's (1995) four-step deductive data analysis process of direct interpretation, categorical aggregation, pattern recognition, and naturalistic generalizations to refine the themes identified during the inductive data analysis process. The ideal worker conceptual framework (Kossek et al., 2021) was utilized to develop a deductive coding protocol directing attention to the way in which the prized employee was viewed as one who devotes their life to work over personal responsibilities and interests such as children and family. We used the coding protocol to independently make direct interpretations of the interview data by determining whether messages about the ideal worker were shared, as well as the participants' understanding of those messages. In the second step, we completed categorical aggregation by collectively reviewing the codes identified in step one and grouping the codes into large conceptual ideas.

Using Stake's (1995) third step of pattern recognition, we developed more precise codes by refining the grouping of associated data, developing fuse codes, and identifying preliminary themes, which allowed us to decipher between positive and negative messages shared by faculty and the ways in which those messages were received and understood. This process resulted in two themes: (1) messages interpreted as disparaging suggest to STEM postdoctoral women they must sacrifice their choice to have children for an academic career, and (2) messages interpreted as supportive promote the belief that academic motherhood is achievable. In the last step, we evaluated the themes to assess their naturalistic generalization by ensuring the final themes represented the totality of the data and could be applied broadly (Stake, 1995).

Trustworthiness

We employed multiple verification strategies to ensure the findings were trustworthy by attending to credibility, transferability, dependability, and confirmability (Lincoln & Guba, 1985). We utilized cross-case synthesis to address credibility, assessing whether themes were similar or different among the participants' perspectives (Patton, 2015). Direct quotes from the participants enabled us to develop thick, rich descriptions to aid transferability (Lincoln & Guba, 1985). In addition, engaging in reflexivity and stating our positionality bolstered the findings' dependability by providing transparency about our backgrounds and experiences on this topic. Last, we safeguarded confirmability by involving multiple researchers in the data analysis process and providing several feedback loops to finalize the themes (Patton, 2015).

Limitations

As in all research inquiries, this study has several limitations. First, attention to the issue of having children and an academic career surfaced naturally during the interviews and was not probed from the start, which could have inhibited the depth of understanding. We did not conduct member checks due to the difficulty of scheduling and conducting interviews because of participants' demanding schedules. Member checking might have provided more complex and nuanced depictions of the participants' experiences related to messaging about academic motherhood.

FINDINGS

This instrumental case study explored the ways in which STEM postdoctoral scholar women received and understood messages from faculty about having children and an academic career. Participants indicated messages came from a variety of faculty, such as postdoctoral supervisors, Ph.D. advisors, and other faculty in their departments, including those with and without children. Throughout the interviews, the women described weighing messages from faculty relative to whether they were married, with a partner, or single. Each expressed a desire to have children and build a family along with a successful career, whether within or outside academia. However, nearly all aspired to the professoriate at the start of their postdoctoral appointment. The two themes that resulted from the inductive and deductive data analyses aligned with the ideal worker conceptual framework (Kossek et al., 2021). Participants shared feelings of being constricted by faculty expectations of constant productivity and prioritization of work. However, some received supportive messages from faculty, mainly through positive modeling, indicating they could depart from these norms and successfully be academic mothers.

Disparaging Messages Suggest STEM Postdoctoral Scholar Women Must Sacrifice Their Choice to Have Children for an Academic Career

The first theme identified from the data analysis indicated nearly all the women in the study experienced disparaging messages from faculty suggesting they must sacrifice having children to pursue an academic career. Each desired to have children and build a family but felt overwhelming pressure to dedicate their time to advancing their careers over family pursuits, which aligned with the ideal worker conceptual framework (Kossek et al., 2021). Interestingly, some women chose to pursue a postdoctoral appointment rather than move into a tenure-track faculty position because they wanted to have children and start a family. Jade, an engineer who is cohabitating with no children, stated, "I knew that having a postdoc would be a good time to have a baby. So, I felt comfortable taking the postdoc years to kind of grow my family and get more [research] experience." Jade shared she perceived a postdoctoral position to be more flexible than a faculty position, so she felt it would be the best time to have children. Conversely, Morgan, a neuroscientist who also is cohabitating with no children, shared she felt she was sacrificing her time to have children by continuing down the academic career path: "These are my baby-making years too, and it's like, 'Am I going to see kids if I have them?'" Morgan's statement reflected her perception that academic motherhood may be impossible.

Those who already were mothers shared a sense of guilt for struggling to manage their work responsibilities and time with their children. They noted the demands of work and the messages from faculty that having a baby was not conducive to a successful academic career, believing strategies for academic motherhood were nonexistent. Suzanne, a biologist who is married with one child, said:

> My daughter is 14 months, so I think after she was born, it took a lot to get back into the lab. I think that was one of the most challenging times. Trying to know how to balance everything, you know the guilt of not being with her.

Sylvie, a radiologist who is married with one child, also had a baby during her postdoctoral appointment and struggled to resume the heavy workload of her position. She commented, "I

spent a couple of months not being able to do anything in a good way. I couldn't concentrate on my work, and it wasn't good work. I was a little bit lost trying to manage everything." She added she received little to no acknowledgment about her struggles and the need for extra care, feeling her lab team did not support her as a mother. Concepts of sacrifice and guilt were palpable in the interviews. The women's sentiments amped into stress and frustration as they realized productivity expectations exacerbated these feelings for academic mothers.

Postdoctoral scholars planning to be mothers expressed concern about the lack of family friendly policies in higher education, which were perceived as covert messaging that higher education and STEM department leaders are unsupportive of family pursuits. Melanie, a biologist who is cohabitating with one child, shared, "I would like to have kids, and I know that not every university or company has policies supporting mothers or families. So that will be important." Melanie's comments reflected her perception of limited higher education policies and practices that actively support women having children in academia. Lyla, an engineer who is married with no children, indicated her university's healthcare options did not meet her family planning needs. She declared, "My health insurance doesn't cover fertility treatments for me because I'm gay. So that is one of my biggest struggles right now in fighting with not only my employer but the insurance company too." Lyla also discussed the importance of working in a state that allows same-sex, second-parent adoption, which limited her job search since only 10 states have these protections in place. Lyla's experience reflected the intersectionality of being a gay woman in STEM and the systemic policy barriers associated with family planning. For Lyla to naturally have children and work in her field, she was restricted from living in 80% of the nation.

Nearly all participants at universities with supportive family policies expressed concern that the intense workload in academia is in opposition to being a mother. Dahlia, an engineer who is married with one child, and Sophia, a biologist who also is married with one child, indicated their lab responsibilities preempted most of their time. Similarly, Kelsey, a psychologist who is single with no children, explained:

> I just work, work, work, and I have no time for a life … everyone works too many hours in higher education, the lab never shuts down … it seems that it can consume your life, and not in a good way. I'm not sure what that would look like if I ever had children or a spouse.

Kelsey's insights further reflected an environment that does not actively promote having children or even a family because it is outside the ideal worker norms. Eya, a chemist who is single with no children, expanded on this sentiment: "I also would like to have a family of my own, but I think that the thing is that I work too much." Clearly, women are not receiving ample messages from faculty that they can succeed as academic mothers.

In addition, some participants indicated faculty messages suggested greater acceptance of men having children as opposed to women in academia. Luna, a biologist who is married with one child, contended:

> I met with some women PIs that were 5 years ahead of me, and I went to ask, so I really want to be a PI because it's all about freedom. And they told me it's about freedom if you're a man … if you made the decision to have a kid, then all your colleagues might just say, "apparently your career is not your first objective," so I'm not sure I will be able to proceed and write you a letter [of recommendation] for you. So I was like, "holy cow."

Luna added her experience reflected overt messaging by faculty that women are held to different expectations regarding work dedication and family building. Meadow, an engineer who is married with no children, echoed, "So my husband and I are going to start a family . . . I feel like I'm going to be more judged for taking time off or not doing things he'll be doing [in his postdoctoral position]." Meadow gave voice to the internalization of messages received by women, highlighting the double standard of gendered expectations in academia. For others in dual-academic career families like Analia, Charity, Sadie, Meadow, and Jade, messages from faculty about pursuing an academic career and having children often suggested women are expected to make the sacrifices.

These "messages of sacrifice" led many women to reconsider their career paths and purposefully contemplate career goals that would allow for family time. Kinsley, a biologist who is divorced with no children, said:

> I don't want to be one of those people where all you do is work, and then you don't get to enjoy the family life . . . I want [my career] to be a blend of my passion for bench science as well as being able to have a family life. Like to be able to, if I have kids, to be able to see them and not be past their bedtime when their mom's coming home.

Katrina, a psychologist who is single with no children, also reported her desire for a "full life" weighs heavily on her career decisions. She shared:

> I want to publish papers, and I want to be successful in academia, but I also want to have a full life. I want to have children, and I want to have a husband . . . I'm more than what I publish, and I'm more than just my job.

Some participants were compelled to consider government or industry employment opportunities due to their interest in having children. Eya stated, "In academia, I will be sacrificing my personal life because, at the end of the day, the work that I'm doing, it is personal . . . as compared to working for a company . . . I would consider a position in industry." Disparaging messages from faculty and a culture of gendered double standards suggested academia is not the place for women to have thriving careers as mothers. This reinforced ideal worker norm can place limitations on the number of women who move from postdoctoral scholars to tenure-track faculty members in STEM.

Supportive Messages Promote the Belief That Academic Motherhood is Achievable

The second theme identified through the data analysis showed only a few women experienced supportive messages from faculty that promoted the belief that academic motherhood is achievable. These supportive messages, which largely came by way of positive modeling, suggested although the work of the professoriate is demanding, women could divert from the ideal worker norms (Kossek et al., 2021). Participants who reported receiving supportive messages from faculty stressed those messages were critical to their desire to continue down the STEM professoriate pathway as academic mothers. Katrina noted a faculty member during her Ph.D. studies was very encouraging of her career goal to be a professor and shared his "key to success:"

> Work like 8:00–5:00 pm, 9:00–5:00 pm, and then after 5:00 pm, don't answer any emails, spend time with your family. And on the weekends, I don't work at all. Be focused at work and then enjoy

> life. He says it's not all about academia, and he's very well published, and I think that's the model that I want to follow.

She ultimately chose her postdoctoral institution because the departmental faculty demonstrated healthy work-life management and could serve as positive role models.

Scarlett, an engineer who is single with no children, likewise intimated she chose her postdoctoral position because of the positive modeling she witnessed: "I saw people having a family not worrying about their career, things a woman worries about like I have to wait until this age to have a family. I see things very differently now. People are very open-minded." In addition, Kaia, an environmental scientist who also is single with no children, shared:

> My graduate advisor was a good mentor in terms of what good science looks like, but not in terms of what a happy life looks like. So that was something that always made me think, "Oh, academia may not be for me" … I'm significantly happier and less stressed and less guilty than when I was a graduate student.

Favorable comparisons between graduate student life and postdoctoral work also arose in the interviews of Charity, a psychologist who is single with no children, and Natalie, an engineer who is married with no children. They stated the increased autonomy post-Ph.D. helped them see a clear pathway toward academic motherhood.

Meadow shared being in close proximity with ambitious women faculty who display healthy work-life management has been essential: "They understand that I'm pushing myself, but they also want me to be happy in general … I don't really think you can have super great work-life balance if the people you're working with don't have respect for work-life balance." Lyla, who has been trying to have a baby, felt her postdoctoral advisor would support her desire to start a family: "I'm really grateful that my job is very flexible, and my boss is understanding. I feel like I could have a child at this point in my life." Sentiments like these reinforced the idea that academic motherhood was possible and supported in academia.

A few women had a baby during their postdoctoral position. While they were ecstatic about motherhood, they also worried about others' opinions of their commitment to the work, mainly their postdoctoral advisor and other faculty in their departments. Fortunately, all had positive experiences in this regard. Jayla, a neuroscientist who is married with one child, shared, "Personally, having a baby could have been a tricky thing, but my advisor was really enthusiastic right out the gate, which was awesome." Suzanne said:

> [My postdoctoral advisor] has a family, she has two boys … she had young kids throughout this process, and she has been really instrumental in helping me navigate those early months back in the lab. And she has always been very clear in letting me know that I could take whatever time I needed before coming back to make sure I was okay. So, definitely, I would say she has been a really good model.

The postdoctoral women's commitment to enter the tenure-track job market was strengthened by these clear messages of support from faculty, as they felt it possible to be academic mothers and counter the ideal worker narrative that work must be prioritized above all else (Kossek et al., 2021).

DISCUSSION

This instrumental case study (Stake, 1995) explored the ways in which 22 demographically diverse STEM postdoctoral scholar women received and understood messages from faculty about having children and an academic career. While a growing body of research exists on the experiences of STEM women in academia, this study is the first to explicitly examine the tension of academic motherhood among STEM postdoctoral scholar women. Using the ideal worker conceptual framework, we identified two themes relative to the negative and positive messages from faculty and the ways in which those messages were understood: (1) messages interpreted as disparaging suggest to STEM postdoctoral women they must sacrifice their choice to have children for an academic career and (2) messages interpreted as supportive promote the belief that academic motherhood is achievable.

These findings illustrate a systemic conflict can exist for STEM postdoctoral scholar women who have children or are considering having a family in the future. Interestingly, none of the participants believed they had a right to have children (see Onwuachi-Sanders et al., 2019 on reproductive justice); they couched it as a dualistic, personal choice. Most interviewees felt the constraints of ideal worker norms because of disparaging messages from faculty (Kossek et al., 2021). However, through supportive messages from faculty, these women saw the feasibility of having children and a successful career in academia without conforming to these norms. Traditionally, tenure-track faculty positions have been strictly bound by ideal worker expectations of prioritizing work in terms of time and obligation (Ahmad, 2017; Gahlon et al., 2022; Kossek et al., 2021; McKinnon-Crowley et al., 2021; Miller & Riley, 2022; Sallee, 2020). This viewpoint holds to the belief that women cannot succeed in a high-demand academic career due to their role as primary caregivers (Gahlon et al., 2022). Participants who experienced supportive messages from faculty, and particularly positive modeling, realized they could be "serious scholars" and academic mothers while not falling prey to the baby penalty or maternal wall that reinforces ideal worker norms (McKinnon-Crowley et al., 2021; Ysseldyk et al., 2019).

These findings are well-situated in the literature and expand the academy's understanding of the way in which ideal worker norms (Kossek et al., 2021) may contribute to the high attrition rate of postdoctoral scholar women from STEM academia. Participants noted their desire to have children influenced their career decisions. Many felt they received disparaging messages from faculty about having children, which suggested a career in academia was incompatible with having a family. As a result, several questioned their career path, as not all were confident they would be taken seriously as an academic mother if their sole focus was not on work, as noted by others (Mason et al., 2013; Sallee, 2020). Rather than abandon their plans to be a mother, they began to rethink their professoriate career goals and to consider careers in industry and government, as others have found (Ahmad, 2017; Bird & Rhoton, 2021; Cech & Blair-Loy, 2019; Gregor et al., 2022; Lee et al., 2017; Miller & Riley, 2022; Thébaud & Taylor, 2021). Clearly, when postdoctoral scholar women who are well-positioned to move into the STEM professoriate are reconsidering their career plans to pursue paths in which ideal worker norms are considered to be less prevalent, leaders in the academy must question their role and the academic environment perpetuated in these decisions (Glass et al., 2013; Hart, 2016; Kachchaf et al., 2015).

While a few participants entered a postdoctoral position to allow themselves time to start a family before pursuing a tenure-track faculty role, most shared anxiety about having a child

during their postdoctoral appointment or tenure-track faculty position due to their understanding of the messages received from faculty. Several postdoctoral scholars reported reviewing their institutions' family policies to determine a commitment to work-life management and openly speculated whether their careers would stall if they had children. These findings are consistent with existing literature on this topic (Casad et al., 2020; CohenMiller et al., 2022; Kahn & Ginther, 2017; Kossek et al., 2021; Martinez et al., 2007; McKinnon-Crowley et al., 2021; van der Weijden et al., 2016; Williams & Ceci, 2012; Wonch Hill et al., 2014; Ysseldyk et al., 2019). While this study focused on messages from faculty, the lack of family friendly policies and practices among institutions was equally telling to the participants. This information was an additional consideration by which the women felt "burdened," as Mason et al. (2013) described.

The findings also add to the literature highlighting the importance of supportive messages from faculty, specifically positive modeling, for women in STEM (Allen-Ramdial & Campbell, 2014; CohenMiller et al., 2022; Rybarczyk et al., 2016; Yadav et al., 2020). The postdoctoral scholars who received affirming messages from faculty about academic motherhood indicated those messages were critical to their decision to continue down the pathway of the professoriate. Specifically, faculty who demonstrated healthy work-life management while being highly productive professionally were inspirational to the participants, as Mason et al. (2013) found. While this modeling demonstrates that women in STEM can be successful without conforming to ideal worker norms, it appears to be an exception rather than a rule. In addition, the postdoctoral scholars planned to emulate faculty who verbalized their support for the women in STEM who desired to build their families. This finding is important because women have felt the need to avoid having children or to hide them when pursuing an academic career due to limited positive role modeling (Thébaud & Taylor, 2021; Wonch Hill et al., 2014). Despite these supportive messages from faculty, all participants with children described managing their family and work responsibilities as a "challenge" or "strain."

Implications for Policy and Practice

This study generates important implications for policy and practice. First, higher education leaders must reflect critically on the disparaging messages received by STEM postdoctoral scholar women concerning the need to sacrifice having children for an academic career, as the gender diversity of the academy may be limited, and women who have or desire to have children may be marginalized. Instead, institutional decision-makers must ensure human resource policies clearly communicate and offer support for having children and family-building if recruiting and retaining more women in the STEM professoriate is indeed a goal. This support must begin with systemic, inclusive, family friendly policies and practices that are inclusive of all parents (e.g., natural, nongestational, adoptive) and specific to LGBTQ+ families.

Department chairs and postdoctoral advisors must intentionally communicate these human resource policies and practices to new hires and existing employees through onboarding and campus meetings to ensure all are aware of their support options. Nearly all participants shared feelings and experiences suggesting caring cultures and safeguards to support postdoctoral scholars who are mothers are nonexistent in higher education, even when protective policies and practices are in place. Mason et al. (2013) found institutions that offer formal mentoring, affordable childcare, family housing, paid family and caregiving leave, healthcare for children

and other dependents, parent centers, and lactation rooms foster more supportive cultures and shift away from ideal worker norms. In this post-Roe era, greater protections are also needed for pregnant mothers and miscarriage care (Talarid, 2023). Institutional cultures must align with the needs of families and caregivers to ensure women in the academy are properly supported (CohenMiller et al., 2022; Mason et al., 2013).

Higher education leaders must also establish training on the importance of modeling healthy work-life management, which may also aid in more broadly recruiting and retaining women in STEM academia. STEM faculty must engage in and be guided through unconscious bias training that encourages a shift in the paradigm from ideal worker to new ideal worker norms. This shift would be especially valuable to women since they tend to appreciate more collaborative work environments than men (Hart, 2016). Promoting individuals who are effective in this area could pay dividends. Faculty demonstrating healthy work-life management while being highly productive sends positive messages that a successful career and family are possible and ideal worker norms can be dismantled. This dismantling would not only support academic mothers, but all in the academy would benefit from greater flexibility and fluidity in their personal and professional lives because ideal worker expectations do not align with realistic role expectations in the academy (Hughes et al., 2022; Kossek et al., 2021; Miller & Riley, 2022). This realignment could be accomplished by shifting the narrative from how employees fit into an institution to how institutional leaders can best support the diverse lived experiences of its employees, thus increasing employee retention and boosting feelings of inclusion and belonging.

Campus leaders also must be cognizant that ideal worker norms do not dominate institutional culture and marginalize women and their work. Not surprisingly, women are most affected by the lack of effective family friendly human resource policies and practices (Bird & Rhoton, 2021; Gahlon et al., 2022; Gregor et al., 2022; Lee et al., 2017); therefore, ideal worker norms must be dismantled. The NSF ADVANCE program, designed to increase the representation and advancement of women in STEM academia, is an excellent place to begin dismantling these norms, as the program has resulted in more gender-inclusive policies and practices in higher education institutions (Laursen & Austin, 2020). For example, recent promising policies and practices include shifting faculty research, teaching, and service workloads for those planning to have children or expand their families; instituting stop-the-clock promotion and tenure options that can be reversed; and offering extended caregiver leave and pay.

Future Research

Further inquiry should occur to understand the policies and practices most beneficial in recruiting and retaining women in STEM academia when they have or wish to have children. This research would ensure academic mothers thrive in their postdoctoral positions and careers. Recent policies and practices instituted due to the COVID-19 pandemic may be fruitful inquiries, such as the success of stop-the-clock options and the persistence of women in the academy. Researchers also must search for successful policies and practices outside the United States, particularly in socially democratic countries known as family friendly, such as Sweden, Norway, Denmark, and Finland (Collins, 2019). In addition, researchers should examine the policies and practices of countries like Germany and France, where a shared responsibility exists between the government and industry, which is more similarly structured to the United States (Collins, 2019). However, the United

States is the only country in the Organization for Economic Cooperation and Development (OECD) without mandatory paid family leave (Hsain et al., 2020). Collins (2019) noted the United States, like Canada and Australia, provides social benefits when the market fails, and only for a select few (e.g., Medicare and other welfare benefits).

While this study focused specifically on women-identifying STEM postdoctoral scholars, future research could focus on the experiences of gender-nonconforming and nonbinary individuals and the messages from faculty they receive about having children and an academic career. Likewise, attention must be directed to family friendly policies inclusive of LGBTQ+ family planning needs. Exploring the ways in which postdoctoral scholar men interpret these messages from faculty also may be fruitful. Important and instructive work in this vein has thus far focused on faculty fathers (Reddick et al., 2012; Sallee, 2012, 2014). Last, research is needed relative to examining the perceived family friendly environment of industry and government, as that perception swayed at least some participants in this study to follow that career pathway.

CONCLUSION

This instrumental case study (Stake, 1995) provides insight into the messages received by STEM postdoctoral scholar women from faculty about having children and an academic career and how they understand these messages, which aligns with and expands prior research in this area (Ahmad, 2017; Bird & Rhoton, 2021; Cech & Blair-Loy, 2019; Gregor et al., 2022; Lee et al., 2017; Miller & Riley, 2022; Thébaud & Taylor, 2021; Ysseldyk et al., 2019). The women in the study reported receiving disparaging messages from faculty on the need to sacrifice having children for an academic career. However, faculty messages that were interpreted as supportive promoted the belief that academic motherhood is achievable and even critical for more postdoctoral scholar women to continue down the professoriate career path. Higher education leaders must consider the way in which these messages may limit the tenure-track faculty candidate pool's gender diversity and marginalize women who have or desire to have children while recognizing the power of positive role models. Institutional leaders must fully adopt and implement inclusive, family friendly policies and practices that ensure more women enter and thrive as postdoctoral scholars and into the professoriate.

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