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Environmental Influences on the STEM Identity and Career Intentions of Latinx STEM Postdoctoral Scholars

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Abstract

This study employs an instrumental case study design to explore the environmental context of Latinx postdoctoral scholars in relation to their STEM identity and intended STEM career pathway. Interviews were conducted using an interactionist approach to STEM identity development. Deductive data analysis techniques reveal the impact of supervisor relationships on the work environment, the importance of fostering a mentoring atmosphere for others, and the value of seeking and creating safe and supportive spaces.

Resumen

Este estudio emplea un diseño instrumental de estudio de caso para explorar el contexto ambiental de estudiantes post-doctorales latinx con relación a su identidad CTIM y su intento de carrera CTIM. Se condujeron entrevistas usando un modelo de interacción del desarrollo de identidad CTIM. Técnicas de análisis deductivo de información revelan el impacto de la relación de supervisión en el ambiente de trabajo, la importancia del acogimiento familiar como atmósfera de mentoría para otros, y el valor de buscar y crear espacios de apoyo seguros.

Keywords

Latinx postdoctoral scholar, STEM identity, environmental context, case study, deductive analysis

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This instrumental case study (Stake, 1995) advances the understanding of the manner by which the environment of Latinx postdoctoral scholars influences their science, technology, engineering, and mathematics (STEM) identity and career intentions. STEM identity is understood as "a reflection of how one understands and positions oneself within the STEM culture and the recognition one receives from others in that community" (Rodriguez, Cunningham, et al., 2019, p. 2). An interactionist approach to STEM identity development (Kim & Sinatra, 2018) is employed as the conceptual framework, and an interpretivist lens is applied to ensure empathy underpinned the experiences and perspectives shared by the 10 Latinx participants (Patton, 2015). Postdoctoral supervisors and the academy at large may benefit from possessing a greater appreciation of how the environment influences STEM identity and subsequently STEM career pathways, as it may be critical for increasing the number of Latinx postdoctoral scholars who successfully transition to the STEM workforce, and specifically the professoriate. The research questions that guide this study are:

1. In what way does the environment influence Latinx postdoctoral scholar STEM identity and intended career pathways?
2. In what way do Latinx postdoctoral scholars enhance their environments to strengthen their STEM identity and STEM career intentions?

Literature Review

Diversifying participation in STEM fields is of paramount importance to the scientific and educational communities because Latinx populations continue to be underrepresented in STEM professions despite decades of efforts toward improvement (Allen-Ramdial & Campbell, 2014; National Science Foundation [NSF], 2019b). While Latinx individuals represent 7% of the STEM workforce (NSF, 2019a), less than 5% serve as postdoctoral scholars, which impedes the diversification of the professoriate because future faculty typically are derived from this career group (Wilson, 2020). Postdoctoral appointments in STEM are a considerable influencer and determinant on whether one ascends to a faculty position. Therefore, this career stage is quite important due to its echoing effect on representation in the professoriate (Andalib et al., 2018; Levy, 2014; Yang & Webber, 2015). Presently, only 3.8% of engineering professors identify as Latinx (Roy, 2019) despite comprising 18% of the U.S. population (Noe-Bustamante et al., 2020).

Researchers and practitioners have attempted to broaden STEM participation by furthering the understanding, formation, and growth of STEM identity for those underrepresented in the field. And while much of the research specific to Latinx STEM identity has been devoted to student experiences, important lessons can be transferred to postdoctoral scholars. Inclusive professional development opportunities and encouraging classroom and lab climates bolster Latinx STEM identity and their educational and career pathways (Castellanos et al., 2006; Espino et al., 2010; Malone & Barabino, 2009; Russell et al., 2018). The cultivation of social and cultural capital by way of mentorship and networking is critical to strengthening Latinx STEM identity

(Agbenyega, 2018; Ek et al., 2010; Ramirez, 2017; Revelo & Loui, 2016; Shueths & Carranza, 2012; Talaflan et al., 2019), particularly when accounting for culturally relevant familial responsibilities and social justice goals (Butz et al., 2019; Castellanos et al., 2006; Luna & Prieto, 2009; McGee & Bentley, 2017; Mein et al., 2020; Perez et al., 2020; Rodriguez, Friedensen, et al., 2019).

Additionally, membership in identity-based organizations tends to honor Latinx *familismo* concepts such as mutual obligation and reciprocity, which enhance professional, intersectional identities (Mein et al., 2020; Rodriguez et al., 2017; Rodriguez, Doran, et al., 2019). In a study by Alonso (2015), Latinx engineers found their identity was nurtured through participation in the Society of Hispanic Professional Engineers (SHPE) when they created their own engineering *familia* and obtained disciplinary role models. Nevertheless, Latinx students report their STEM identity and career pursuits often are hampered by a lack of access to socialization opportunities in STEM and all too often experience marginalization, microaggressions, and blatant bias in the academy (López et al., 2019; Malone & Barabino, 2009; Muñoz & Villanueva, 2019; Rodriguez, Cunningham, et al., 2019).

Recently literature has been devoted to Latinx STEM postdoctoral scholars. Kamimura-Jimenez and Gonzales (2018) investigated the employment choices of Latinx postdoctoral scholars through a 10-year longitudinal study. The researchers found these individuals are in high demand and hold a consistent track record of obtaining tenure-track faculty positions. Despite documented success for entering the professoriate, Yadav et al. (2020) noted racially and ethnically diverse postdoctoral scholars often feel isolated within their fields of study and express a yearning for a sense of belonging, social identity, and professional growth during their postdoctoral time. While academia is an attractive career path in which Latinx postdoctoral scholars desire employment, supervisor support of their STEM identity and disciplinary socialization is critical to diversifying STEM academic ranks (Hudson et al., 2018; Kamimura-Jimenez & Gonzales, 2018; McGee et al., 2019; Yadav et al., 2020).

A plethora of studies exist concerning the importance of diversifying the STEM workforce, but scarce research is available on the experiences of Latinx postdoctoral scholars. As postdoctoral scholars are well positioned to successfully enter the tenure-track faculty job market, another piece of the diversification puzzle involves a greater understanding of the manner in which Latinx postdoctoral environmental context influences STEM identity and STEM career intentions. This study responds to the call of Kim and Sinatra (2018) to recognize the interaction of STEM identity and the environment in order to determine possible contextual interventions that can strengthen persistence in STEM (Kamimura-Jimenez & Gonzalez, 2018; McGee et al., 2019; Yadav et al., 2020).

Conceptual Framework

Following a thorough investigation of STEM identity research, an interactionist approach to STEM identity development (Kim & Sinatra, 2018) is utilized as the study's conceptual framework (Anfara & Mertz, 2014). Kim and Sinatra (2018) describe STEM

identity as "a developmental process that unfolds over time . . . and the environment informs the identity the individual develops" (p. 4). This study examines the way in which the environmental context of Latinx postdoctoral scholars informs and shapes their STEM identity and career intentions and how they purposely strengthen their own STEM environment. Therefore, an interactionist approach is employed to understand the development of STEM identity and its manifestation in practice. The postdoctoral scholar environment is defined by the interaction of Latinx postdoctoral scholars with their postdoctoral supervisor, workspace, and larger disciplinary community.

Focusing on learning environments, such as postdoctoral appointments, can expand consideration of the way in which context intersects with STEM identity and STEM career pathways. This approach can be particularly useful for underrepresented populations that commonly experience structural barriers in STEM (López et al., 2019; Malone & Barabino, 2009; Muñoz & Villanueva, 2019; Rodriguez, Cunningham, et al., 2019; Talaflan et al., 2019; Yadav et al., 2020). As noted by Kim and Sinatra (2018), drawing attention to the STEM environment can provide new understandings of the contextual messages individuals receive relative to their STEM identity, as well as fresh insights for interested stakeholders who can improve STEM spaces. This interactionist approach to STEM identity development served as the foundation for the interview and coding protocol utilized during the data collection and analysis phases of this study, as well as a lens by which to consider the implications of the study (Anfara & Mertz, 2014).

Methodology

Research Design

An instrumental case study design (Stake, 1995) was grounded by an interactionist approach to STEM identity development (Kim & Sinatra, 2018). Instrumental case studies are valuable when seeking to illuminate a specific concern or problem within a setting that may be ambiguous to cursory observers (Stake, 1995). Thus, this study focused on the way in which the environmental context of 10 Latinx postdoctoral scholars informed and shaped their STEM identity and career pathways, as well as the ways in which the postdoctoral scholars strengthened their STEM environments. An interpretivist lens was applied to this study in order to give credence to the fact that the postdoctoral scholars' views of their environment, STEM identity, and intended career pathways was shared through their filters of personal identity, cultural norms, and social constructs (Patton, 2015). Therefore, empathy was foundational to the research design, data collection, data analysis, and interpretations. The research questions that guided this study were:

1. In what way does the environment influence Latinx postdoctoral scholar STEM identity and intended career pathways?
2. In what way do Latinx postdoctoral scholars enhance their environments to strengthen their STEM identity and STEM career intentions?

Table 1. Individual Latinx Postdoctoral Scholar Demographics.

Pseudonym	Ethnicity	Gender	Age	Field of study	Postdoctoral status
Melanie	Dominican/Polish	Female	32	Immunology	Current
Sophia	Latina	Female	29	Microbiology	Current
Eugene	Columbian	Male	41	Biomedical Engineering	Current
Suzanne	Latina	Female	30	Developmental Biology	Current
Katrina	Latina	Female	28	Social Psychology	Past
Angela	Columbian	Female	32	Biomedical Engineering	Current
Sylvie	Brazilian/White	Female	38	Pediatric Radiology	Current
Armando	Columbian	Male	44	Chemical Engineer	Current
Jaime	Latino/Black	Male	40	Mechanical Engineering	Past
Kelsey	Puerto Rican	Female	30	Biopsychology/ Neuroscience	Current

Participants

This study focused on the interviews of 10 self-identified Latinx postdoctoral scholars who were part of a larger project that involved interviews with 50 STEM postdoctoral scholars. All participants were recruited from the National Postdoctoral Association (NPA) through a dedicated e-alert sent via email. Each scholar received a $25 Amazon gift card for their participation. Over 300 respondents expressed their willingness to participate; the final sample was determined through a demographic questionnaire that gathered information on their field of study, as well as on the way in which they identified by race/ethnicity and gender. The Latinx sample was comprised of seven females and three males ages 28 to 44; eight were currently in their postdoctoral appointment and two were new assistant professors. The STEM disciplinary expertise of the postdoctoral scholars included biology, engineering, immunology, neuroscience, psychology, and radiology. Individual demographics are presented in Table 1.

Data Collection

Per Institutional Review Board approval, all participants were provided with a consent form detailing the purpose of the study, interview procedures, and safeguards to protect anonymity. The interviews averaged 60 minutes in length, were digitally recorded, and were administered one-on-one by multiple researchers through web conferencing or phone. An interview protocol was designed and grounded by the interactionist approach to STEM identity development (Kim & Sinatra, 2018) in order to examine the relationship between the postdoctoral environment, STEM identity, and intended career pathways. Queries focused on career interests and goals, perceptions of career successes and challenges, confidence and capacity to succeed in a STEM career, and STEM identity. Concepts such as "career," "success," "challenges," and "confidence" were framed ambiguously to enable participants to individually contextualize each concept, which appeared to be accomplished with ease. As an interpretivist lens was

employed in this study, great effort was made to build rapport with the participants and to ensure they felt heard and respected. Emphasis was given to thoughtfully honor their voices, identities, and experiences in the final product (Patton, 2015). This process created a natural, free-flowing dialogue with the researchers serving as active listeners and participants in the interview. Upon completion of all 50 interviews, the recordings were transcribed by a third-party service and permanently deleted once reviewed and cleaned.

Reflexivity and Positionality

Prior to data analysis, the researchers engaged in the process of reflexivity in which experiences, beliefs, values, and assumptions about STEM identity, and the manner in which it is both nurtured and hindered in higher education, were bracketed out individually and collectively by the researchers (Watt, 2007). Time was also devoted to reflecting on the way in which career pathways are shaped and influenced in the academic environment. Reflexivity is integral in qualitative research, as it forces the consideration and exposure of researcher bias through analytical reflection and dialogue. The theoretical underpinnings of the interpretivist lens were revisited during the reflexivity process to ensure empathy was foundational to the way in which the transcripts were assessed and meanings interpreted (Patton, 2015).

Per the guidance of Lincoln and Guba (1985), the positionality of the researchers must be clarified because it directly influences the way in which the study is conducted, as well as the principal findings and interpretations. All are social science academics trained in qualitative research methods and hold professorship, administrative, and/or graduate student roles in higher education institutions. One identifies as Latinx, while the others identify as White. None possess a STEM background or have held a postdoctoral appointment, yet all demonstrate a commitment to diversifying higher education from research lines to service endeavors that advocate for policies and practices to broaden participation across the academy. The researchers see great value in diversifying the professoriate as both a matter of social justice and for pragmatic national human capital ends. The practices of reflexivity and positionality were purposely embedded to ensure emphasis on the participants' experiences and perspectives rather than on the researchers' points of view.

Data Analysis

The interview data were analyzed using Stake's (1995) four-step deductive data analysis process of direct interpretation, categorical aggregation, pattern recognition, and naturalistic generalizations. A structured coding protocol was first designed using the interactionist approach to STEM identity development (Kim & Sinatra, 2018) focusing on the environmental context of Latinx postdoctoral scholars and its influence on their STEM identity and career intentions. Through the application of Stake's first step, an independent review of the interview transcripts was conducted to identify the relationships between environment, STEM identity, and career intentions. This

process enabled researchers to individually draw direct interpretations from the data before discussing preliminary themes. In the second step, the researchers collaboratively accomplished categorial aggregation by synthesizing the overarching concepts drawn from the transcripts in step one. This stage clearly revealed the environmental spaces the Latinx participants enhanced to ensure they felt accepted and embraced within STEM.

Following Stake's (1995) third step of pattern recognition, precise content was developed through grouping associated data, developing fuse codes, and refining the identified themes. This process yielded greater understanding of the common environmental experiences that influenced the STEM identity of the Latinx postdoctoral scholars and, ultimately, how those experiences shaped their career trajectory. All individuals spoke of their postdoctoral supervisors and how they formed inclusive and supportive, or antagonistic and toxic, environments. In the fourth step, naturalistic generalizations occurred by evaluating the themes to ensure they represented the entirety of the data and could be applied broadly (Stake, 1995). While this study reports specifically on results related to the Latinx interviews, findings resonated with the African American postdoctoral scholar interviews because they shared similar contextual obstacles, such as lack of diverse faculty from which to draw mentorship. At the conclusion of this step, three final themes were identified through an interpretivist lens of empathy: the impact of supervisor relationships on the work environment, the importance of fostering a mentoring atmosphere for others, and the value of seeking and creating safe and supportive spaces.

Trustworthiness

Multiple verification strategies ensured the findings were trustworthy (Lincoln & Guba, 1985). In order to address credibility, cross-case synthesis was utilized throughout the data analysis to examine whether the themes were cases of similar or different perspectives of the Latinx STEM postdoctoral scholars (Hayes, 1997). To achieve transferability, thick, rich descriptions were utilized with participant quotes (Lincoln & Guba, 1985). Bracketing through reflexivity and stating researcher positionality bolstered the dependability of the findings. Confirmability occurred by validating themes in the early and late stages of the data analysis process (Miles et al., 2019). Dependability and confirmability also were accomplished by involving multiple researchers in evaluating and providing several feedback loops on the identified themes.

Limitations

All research is subject to limitations, and this study is no exception. Only individuals who self-selected to participate in the interviews and self-reported their views and experiences were included in this study (Lincoln & Guba, 1985). Those who desired and were selected may have been substantively different than individuals who chose not to participate or were not selected. Additionally, this study shares and analyzes the

postdoctoral scholars' perceptions of their supervisors and institutions but their perceptions were not triangulated which is a limitation of the study design. While the study attended to exposing researcher bias through reflexivity and positionality, we cannot absolve ourselves from its potential in the findings and interpretations. None of the researchers possess a STEM background or held a postdoctoral position; thus, the data were approached largely from an outsider perspective. The researchers chose not to conduct member checks due to the extreme difficulty in scheduling and conducting the inital interviews because of the participants' busy schedules. Member checks may have provided a more complex and nuanced depiction of the Latinx postdoctoral experiences, which could have provided a more in-depth understanding of their environmental perspectives and experiences (Lincoln & Guba, 1985).

Findings

Naturally, at this stage of their career the Latinx postdoctoral scholars possessed a strong STEM identity with a high interest and affinity for a career in STEM. Many expressed their childhood dream of becoming a scientist or engineer, as their parents initially fostered their STEM identity. Eight of the 10 participants had a parent in a STEM career, and their STEM identity was deepened throughout their educational careers and postdoctoral experiences. All individuals began their doctoral degree as hopeful academics, and most continued their commitment to a career in the professoriate. Despite their strong STEM foundation, participants experienced environmental setbacks that caused them to question their ability to be successful in a STEM career, such as difficult postdoctoral supervisor relationships that impacted their work environment. To counter these instances, all participants took ownership of their STEM identity by fostering a mentoring atmosphere for others, as well as seeking and creating safe and supportive spaces in their broader disciplinary communities.

The Impact of Supervisor Relationships on the Work Environment

Postdoctoral supervisors possess the power to influence a postdoctoral scholar's experience and to bolster their STEM identity through the creation of supportive and encouraging work environments. Throughout the interviews, the Latinx postdoctoral scholars discussed the positive workspaces and labs developed by their supervisors. These environments were characterized by attentive supervisors who offered opportunities to improve their technical skills. Jaime observed the smooth operation of a lab he now emulates in his own lab as a new faculty member:

> What I learned was how to run a lab . . . I try to model myself according to the way he did it, I learned that you can't be successful with just one focused research topic. He had three major research areas and I have three. He had people that were leads on his projects, I have people that are leads.

Like Jaime, Eugene expanded his technical knowledge and expertise while learning how to create a well-organized lab. All appreciated the conversations with their supervisors on setting up efficacious labs, which the postdoctoral scholars interpreted as direct mentorship for their future faculty role. These exchanges nurtured their STEM identity because the supervisors showed genuine care about their next career stage. Participants consistently noted mentorship was integral to an effective workspace. The supervisors modeled the necessary attributes of success in academia, which led to the scholars' heightened interest in the professoriate.

Conversely, and unfortunately even more common, the Latinx postdoctoral scholars discussed "toxic" work environments that clouded their success in their postdoctoral appointments. These environments often were described as replete with anxiety, exhaustion, and hostile competition. Much of the comments involved being overworked and of supervisors "taking advantage of them," which negatively affected their STEM identity. Katrina described the "abusive lab environment" she experienced during her postdoctoral appointment: "My supervisor expected us to work ourselves to the bone. She did not believe in taking breaks. She believed in basically exploiting us . . . she created a lot of competition within the lab." The notion of being exploited was a common thread among the participants which, in Katrina's instance, was compounded by competition between lab peers. This type of environment served to weaken the postdoctoral scholars' STEM identity as they questioned their career pathway.

Suzanne also discussed the impact of such experiences noting, "I've also found a lot of mental health stuff comes up for people during the postdoc because they are so stressed and overtaxed." The stress of producing research articles and working long hours, coupled with added pressure from a supervisor with whom the participants had difficulty relating, resulted in anxiety and led to feelings of sadness and guilt. These unhealthy environments diminished many of the Latinx postdoctoral scholars' STEM identity, as they shared "feelings of failure." Those who maintained positive identities rose above the feelings of inadequacy and redefined their perceptions of success by renegotiating work boundaries with their supervisors and reframing their STEM identity in terms of a new career path, which typically alluded to a career in industry or government.

All participants shared the importance of working with postdoctoral supervisors and other faculty who promoted environments in which their cultural identities were honored and recognized, further reinforcing their STEM identity. Jaime spoke reverently of the efforts of his postdoctoral supervisor, an African American professor, to diversify their department during his postdoctoral appointment:

> My supervisor told me that when he came to [this school] he told the Dean and administration that he wanted to provide an impact on the racial landscape of the mechanical engineering department, and you can definitely see that he did in his lab.

Supervisors who were cognizant of the racial/ethnic power dynamics in higher education created a sense of community in their workspaces and lab environments,

strengthening the STEM identity of the participants and subsequently driving their passion for working in academia.

Nevertheless, not all participants had the opportunity to work closely with faculty of color as students or in their postdoctoral appointments. As a woman of color, Angela shared she had not received mentorship from anyone who could speak to her intersectional identity, although it was understood due to the small numbers of women of color in academia:

> If there could be a way for postdocs to get mentors from the few faculty out there . . . see the thing is, you also feel bad sometimes, asking for the few faculty of color to mentor you because I'm burdened sometimes with a lot of work that I get asked to do for minorities, right? And I'm only a postdoc. I can only imagine how much work they have.

The Latinx postdoctoral scholars were keenly aware the lack of diversity among STEM faculty was an impediment to the mentorship available, which held negative consequences for their own STEM identity development. In order to combat this reality, many chose to focus on mentoring others to drive their personal sense of belonging in STEM.

The Importance of Fostering a Mentoring Atmosphere for Others

All the Latinx postdoctoral scholars noted the importance of assuming mentorship roles by fostering an atmosphere to do so. Three trains of thought were expressed by the participants in terms of their goals and intentions when establishing mentoring environments for others: an unbeknown foray into mentorship, a personal sense of pleasure in mentoring and helping others, and mentorship as a mechanism to foster their own STEM identity. Jaime became a mentor and supervisor in a haphazard fashion when his doctoral advisor took an impromptu extended leave of absence from the university:

> I became the surrogate advisor for students, and we stuck together, we fought through, completed projects, tried to get stuff done, tried to be productive. Once he came back . . . we were able to pick back up with very little lost time.

As a new assistant professor, Jaime shared his lack of confidence throughout his educational journey had curbed his interest in supporting peers in previous lab teams. However, this new role served as a turning point that strengthened his STEM identity and desire to pursue a postdoctoral appointment and to become a professor.

Many of the Latinx postdoctoral scholars found their STEM career intentions were solidified by helping and mentoring others. Katrina spoke at length about her passion for mentorship and the realization that she could be successful in a STEM career as a result. She indicated, "I find purpose in helping other people and I'll be able to do so by being a professor, so I'll be able to help undergrads and mentor them and help them

achieve their goals." Armando also shared his mentoring experiences strengthened his STEM identity:

> Experiences that I had during my PhD were very rewarding in terms of teaching others, like being a mentor for all the undergrads and also being a mentor for all my lab mates . . . that experience really helped me to move forward and look for other opportunities [in academia].

Similarly, most of the other participants discussed the importance and appeal of passing on their knowledge and expertise to others, which made a career in the professoriate even more attractive. Kelsey added that her inspiration for becoming a scientist and assisting others was rooted in the challenges she experienced in navigating higher education as a woman of color:

> I just hope others have had a better experience than me, it's really hard to be a woman of color in academia, in psychology there are not too many and the few that are there are overtaxed. I feel a sense of responsibility to give back and be a safe haven for students of color . . . if we don't have people of color researching areas of need and interest to communities of color we will continue to be underserved in the field of psychology, that keeps me motivated to continue to work hard . . . and stay in higher education.

Kelsey discovered a drive and need to provide a more valuable experience for the upcoming generation of diverse scholars, fostering her desire to pursue a career as a professor.

The Value of Seeking and Creating Safe and Supportive Spaces

Latinx postdoctoral scholars not only focused their energy on their local university environments, but also they sought out and created safe and supportive spaces in their disciplinary communities to strengthen their own STEM identity. Conferences, trainings, and other professional development opportunities were viewed as settings that supported their inclusion in STEM. Participants indicated when tensions were high with their postdoctoral supervisors or peers, these offerings afforded the opportunity to meet with others who could provide support and guidance as they attempted to make progress on their STEM career goals. Sophia, who felt isolated as the only person of color in her postdoctoral lab, recounted:

> You go to a conference and oh, there is so many of you. Who knew? So that was huge because then I felt I'm not actually alone. And I have gone to SACNAS [Society for the Advancement of Chicanos/Hispanics and Native Americans in Science] . . . which was really helpful in convincing me that I can stay in science.

Creating networks and building community with others who shared a similar cultural background and story boosted Sophia's confidence and her commitment to a STEM career. Melanie reported a similar experience, finding that commiserating on

common barriers faced by scholars of color united them, along with their shared love of science.

These opportunities were particularly crucial for the Latinx postdoctoral scholars who experienced "toxic" workspaces. As Kelsey noted, "I know I need to be somewhere where I'm supported and where I can have a network of friends who want to see me be successful," which first occurred at a disciplinary conference she attended. Many individuals also indicated the professional development opportunities designed for scholars of color provided valuable information as they pushed forward in their STEM careers. Suzanne shared:

> [Conferences] have given me the opportunity to engage in certain programs aimed toward underrepresented minorities . . . I was part of an initiative for maximizing diversity in research . . . I received opportunities for career development and mentoring.

Occasions to continue progress on their career goals were satisfying, as well as affirmed their STEM identity. This sentiment resonated with Katrina who stated, "We are all trying to work toward increasing diversity and inclusion both in theory and in writing and in reality, in our networks at our annual conferences."

Katrina indicated her troubled relationship with her postdoctoral supervisor made her feel as though she did not belong in psychology, and certainly not in her lab. She noted finding spaces in which she felt supported helped her navigate her poor postdoctoral experience. Safe spaces were characterized as places that allowed postdoctoral scholars to express their insecurities and vulnerabilities and, in which they could further their STEM identity and career goals. Angela shared, "I want to study a lot of problems that primarily affect Latinos, but a lot of the times, even when you share those ideas, other people look at you like you're crazy." To compensate for these types of experiences, her safe spaces included mentoring sessions at her annual disciplinary conference:

> Mentoring sessions were closed, we could ask anything of the faculty. We had peer reviewing of our teaching, a diversity statement, things like that . . . It was also helpful in connecting me to other underrepresented people who were going through similar things.

These connections increased participants' confidence regarding the tools and skills they would need to succeed in higher education and aided their realization they were not alone on their STEM career journeys.

In order to further their STEM identity, some of the Latinx postdoctoral scholars were intentional about building their own communities and networking opportunities within their professional associations. Katrina felt like an outsider in her lab environment, particularly due to her postdoctoral supervisor commenting she would be unsuccessful in a STEM career. Thus, she took the initiative to bring scholars of color together at her national conference:

> I started a disciplinary equity panel . . . I was so sick of feeling like I was alone. And it's funny because my advisor does research on prejudice, discrimination, and stigma, and I

> felt very discriminated against in my experiences with her. So, I wanted to create a panel where we talked about actual experiences of students and study these issues . . . and focusing a more critical lens toward our own field.

The conference panel is hosted annually and continues to receive high praise. She believes an open discussion must occur on the marginalization experienced by scholars of color if higher education truly endeavors to act on addressing issues of inequity and exclusion in the academy.

Even in environments such as professional associations depicted as genuinely inclusive and equitable by the Latinx postdoctoral scholars, participants saw value in carving out more intimate time for Latinx and other scholars of color to gather due to their small numbers. Angela shared, "I think if you ascend in the academic ladder, you look around and you see fewer and fewer people who look like you." Most of the participants spoke of their feelings of isolation in their postdoctoral appointments. They felt as though they did not "fit" with doctoral students or with faculty, which resulted in a sense of separation and even "loneliness." The temporary and short-term nature of their positions served as a barrier to naturally connecting with doctoral students or faculty, which was described as "disheartening" by Melanie.

Discussion

This instrumental case study (Stake, 1995) grounded by an interpretivist lens (Patton, 2015) illustrates the ways in which the interaction of postdoctoral environments, STEM identity, and intended STEM career pathways can aid or deter diversification of the STEM workforce and professoriate from the perspective of the Latinx postdoctoral scholar participants. The call of Kim and Sinatra (2018) to incorporate interactionist approaches to the study of STEM identity was fruitful because it served as a unique lens through which to consider the variety of meanings offered by the participants. While STEM identity and STEM career intentions were high among the participants, they certainly experienced moments of tribulation and self-doubt due to difficult work environments. This issue is a dominant theme shown in the literature to not only hamper STEM identity but also to drive individuals out of STEM (Agbenyega, 2018; Bancroft, 2018; Castellanos et al., 2006; Kamimura-Jimenez & Gonzales, 2018; McGee et al., 2019; Shueths & Carranza, 2012; Talaflan et al., 2019; Yadav et al., 2020).

The findings from this study indicate supportive supervisors create an environment that strengthens postdoctoral scholar STEM identity development and career pathways when they assume the role of mentor and help the scholars view themselves as future faculty. Positive role modeling and mentorship is replete in the literature regarding its importance in positive identity construction and encouraging racially and ethnically diverse scholars to enter the professoriate (Alonso, 2015; Butz et al., 2019; Ek et al., 2010; Luna & Prieto, 2009; Perez et al., 2020; Revelo & Loui, 2016; Russell et al., 2018; Shueths & Carranza, 2012). Despite some challenging relationships with postdoctoral supervisors and toxic work environments, the participants persevered.

Regrettably, these types of experiences are well documented in the literature and often result in feelings of isolation and diminished STEM identity, as well as departure from STEM academia (Kim & Sinatra, 2018; López et al., 2019; McGee et al., 2019; Rodriguez, Cunningham, et al., 2019; Yadav et al., 2020).

Perseverance in large part was bolstered by the Latinx postdoctoral scholars' personal efforts. As mentorship and networking were viewed as critical to their success, the postdoctoral scholars enthusiastically mentored and created safe spaces for others; many expressed a responsibility to engage in this vital service to the field. These experiences served as a driving force for many to enter the professoriate. The literature documents the significance that racially and ethnically diverse STEM scholars attribute to giving back and paying forward the assistance they received (Agbenyega, 2018; Gibbs & Griffin, 2013; Yadav et al., 2020). Additionally, when feelings of isolation surfaced in their postdoctoral appointments, many expanded their social networks by connecting to other scholars of color in their field of study. The literature documents that when successful in crafting this new environment, participants' STEM identity improved, as well as their commitment to train the next generation of Latinx scholars (Bancroft, 2018; Gibbs & Griffin, 2013; Kim & Sinatra, 2018; Luna & Prieto, 2009; Malone & Barabino, 2009; Russell et al., 2018; Shueths & Carranza, 2012).

Implications and Future Research

This investigation illuminates critical implications for higher education administrators and postdoctoral supervisors from the point of view of the Latinx postdoctoral scholar participants. University leaders must create and promote postdoctoral offices and associations on their campuses to enable all postdoctoral scholars to receive institutional support that attends to their unique career stage needs. Creating a safe space is crucial for the effective cultivation of STEM identity. Feelings of isolation and loneliness were all too common among the Latinx participants. While it is noble the Latinx postdoctoral scholars enhanced their own work environments, institutional safeguards must be in place to ensure a positive and encouraging environment for all. Individuals should not be forced to create their own support systems; institutions must take responsibility in this endeavor. Only one of the 10 postdoctoral scholars was aware of a postdoctoral office on campus, and she indicated the activities were helpful in finding a community of individuals with like career interests and goals. The postdoctoral scholars recommend postdoctoral supervisor training to ensure scholars experience inclusive work environments and receive the mentorship they desire, as supervisor support was heralded as crucial for STEM identity production and diversification of STEM academia. Last, institutional mechanisms are necessary for scholars to report hostile work and lab environments; a postdoctoral office can serve in this capacity as a source of support and mediation when conflicts arise.

Future research must involve a continuous examination of the Latinx STEM postdoctoral scholar experience, particularly their career paths into academia, industry, and government. Sustained examination of the supervisor relationship is imperative, as the hostile and exploitive environments intimated by most of the participants should

be concerning to all in the academy. The role of microaggressions and explicit bias in diminishing STEM identity, and ultimately in influencing career decisions, also demands further attention. A follow-up study that triangulates and substantiates these supervisor and institutional experiences would strengthen the findings of this study and offer additional recommendations on the ways in which to improve the postdoctoral experience and promote institutional change in practices and policies. Another fertile Latinx environment to explore would be home, and specifically, the family dynamics that promote early STEM interests and identity as 8 of the 10 postdoctoral scholars had at least one parent in a STEM career.

Conclusion

Using an interpretivist lens, this instrumental case study provides a deeper understanding of the inextricable link between Latinx postdoctoral scholar environments, STEM identity, and STEM career intentions. Few studies have utilized an interactionist approach to examine STEM identity development in general, and none have focused on Latinx postdoctoral scholars specifically. Findings suggest greater attention must be directed to STEM identity development and career intentions as ongoing processes that can be influenced by the environment created by postdoctoral supervisors. Acknowledging the critical role of postdoctoral supervisors is important in creating affirming work environments for those under their charge. The Latinx postdoctoral scholars demonstrated perseverance despite the environmental challenges they faced; they took ownership of their STEM identity and career pathways by fostering a mentoring atmosphere for others, as well as seeking and creating safe and supportive spaces in their disciplinary communities. This study offers new insights for interested stakeholders in a position to improve STEM contexts for Latinx postdoctoral scholars and others, which could pay dividends for those invested in broadening the STEM workforce within and outside academia.

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