



# Characterizing the Socialization of STEM Graduate Students Using the Context of the McNair Scholars Program

EMPIRICAL  
RESEARCH

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## ABSTRACT

**Background:** Despite the increase in studies examining STEM doctoral student persistence and attrition, there is still an incomplete understanding of the factors contributing to a student's successful transition into and through graduate education. As STEM programs seek to become more diverse and inclusive, understanding how to support students best as they consider graduate education is imperative. One of the most successful federal programs in preparing and graduating PhD students in STEM disciplines has been the McNair Scholars Program; however, while its quantitative success has been documented, relatively little qualitative research has been done to understand the benefits conferred to students who went through the program. As such, the McNair Program constitutes the ideal proxy to examine how intentional schema development can impact graduate student socialization.

**Purpose/Hypothesis:** This article aims to characterize STEM graduate student socialization using the McNair Scholars Program, a federally funded TRIO program, as the context of the study. Schema Theory and Bourdieu's theory of social capital provided conceptual models to understand how and why these students developed strategies for success.

**Design/Method:** Data was collected in a qualitative research design through semi-structured interviews with N = 13 participants. A thematic analysis was conducted on the data using an emergent coding schema informed by schema theory and social capital theory.

**Results:** Our findings uncovered five themes related to how the presence, absence, or development of five different forms of capital: technical, cultural, economic, social, and intrapersonal impacted the experiences of the graduate students interviewed.

**Conclusions:** Development of the five forms of capital and the cultivation of individual habitus is critical for the preparation of students for graduate education particularly for first-generation low-income and underrepresented students.

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The experiences of doctoral students have been the subject of a significant and growing body of research. Doctoral students record the highest dropout rate of any degree type in the US (McGee et al., 2019). The high attrition rates associated with PhD programs have been correlated with a host of different factors such as race, nationality, gender (Ampaw & Jaeger, 2011), funding opportunities (Wollast et al., 2018), previous academic experience, and socialization (Groenvynck et al., 2013).

Over the last few decades, there has been a concerted effort to understand and support students pursuing higher education, particularly those from backgrounds historically marginalized in academia. As a result, several programs have emerged over the last several decades to address the gap in opportunity between first generation low-income students (FGLI henceforth) and their counterparts. These programs, collectively known as TRIO (so named because there were originally three), are intended to provide FGLI and underrepresented students the resources and guidance needed to succeed in higher education. Previous work has demonstrated the value and efficacy of these programs, but few studies have characterized exactly how these programs achieve their goals and impact students. This study employs data obtained from participants from one TRIO program, the Ronald E. McNair Postbaccalaureate Achievement Program (hereafter referred to as “the McNair Program” or simply “McNair”), as the research context because of its unique record on preparing successful graduate students. McNair alumni obtain doctoral degrees at six times the rate of their demographically similar peers (Renbarger & Beaujean, 2020), and students who participate in the McNair program have more positive attitudes toward graduate school, were positive about research, and more receptive to faculty careers than those who participated in Research Experiences for Undergraduates (REUs) (Hirsch et al., 2009).

From a scholarly point of view, this lack of theoretical research attention on a program that is a positive case study means that the mechanisms by which McNair programs are successful have not been translated beyond the program’s borders. We posit that understanding how this program facilitates a higher rate of graduate persistence among its alums will demonstrate how attrition can be mitigated proactively at the undergraduate level and will likely provide theoretical insights into graduate socialization that can tie together the small bodies of literature on undergraduate research preparation (Carpi et al., 2017; Carter et al., 2015; Linn et al., 2015; Shanahan et al., 2015) with work on graduate persistence and thriving in STEM (Leshner & Scherer, 2021; Mondisa et al., 2021; Zerbe et al., 2023). While most research or interventions are conducted on students from normative backgrounds before being translated to outside populations or those that are non-normative in some way, we seek to capture the theoretical reasons for the success of the McNair program, thereby inverting this process and show how interventions that do well for specialized groups of students may be able to inform broader interventions, including traditional REUs. To this end, this study was guided by the following research question: How are student schemas about graduate school impacted in ways that influence socialization and persistence among STEM doctoral students in the context of participation in the McNair Scholars Program?

A student’s graduate socialization experience is influenced by numerous factors, many of which are at play long before they begin their graduate education. Weidman et al. define socialization as the process through which individuals gain the knowledge, skills, and values necessary for successful entry into a professional career requiring an advanced level of specialized knowledge and skills (2001). Socialization is often described as the sociological procedure of role identification in which new students create new professional identities through interacting with others (Anderson & Anderson, 2012; Johnson et al., 2017). When students can adequately integrate into the culture of their academic setting, they have an increased likelihood of success in graduate school and long-term career outcomes (Weidman et al., 2001). Crucially, socialization is an ongoing process that begins well before graduate enrollment. For example, students who participate in research internships, mentoring relationships, and summer bridge programs display positive outcomes compared to their peers (Myers & Pavel, 2011). However, this process is highly individualized and requires students to navigate unspoken norms and expectations in their discipline and the

academy. These invisible norms and expectations represent a “hidden curriculum,” an invisible set of rules students are expected to abide by but never explicitly instructed in, which is often attributed to students’ difficulty adapting to academia (McGee et al., 2019). Underrepresented and FGLI students often have fewer resources and connections necessary to contend with the hidden curriculum. Thus, the hidden curriculum exacerbates the existing inequalities between these students and those of their more privileged peers (Renbarger, 2019). The existence of a hidden curriculum only reinforces the perception of academia as mysterious and opaque (Golde & Dore, 2001; Lyons et al., 1990).

Furthermore, most STEM programs organize their students into research groups, with multiple students pursuing their research under the guidance of a primary faculty advisor, a model typically less common in non-STEM disciplines such as the social sciences (Crede & Borrego, 2013; Kyvik & Reymert, 2017). The prevalence of the apprenticeship model in doctoral education, particularly the sciences, means that a student’s preparedness and ability to navigate the hidden curriculum is highly dependent on the health and efficacy of their relationship with their advisor (Yeatman, 1995).

One-way potential graduate students are introduced to academic culture, begin their socialization, and start demystifying the hidden curriculum is through undergraduate research experiences. Sometimes, these experiences are informal, collaborating with professors and graduate students on small, ideally authentic research experiences. Others are formal, funded specifically through REU programs by the National Science Foundation or other funding sources that allow undergraduate students to participate in research at a host institution, typically over the summer (Hirsch et al., 2012). These programs effectively boost graduate enrollment, with statistics showing that participation in these programs doubles the likelihood of a student enrolling in a doctoral program (Wright, 2020). In addition, REUs provide students with experience and technical competence regarding their chosen research interests. These opportunities can be incredibly effective, particularly in encouraging students to attend graduate school or pursue careers in STEM fields (Landis, 1991; Youssef et al., 2016). Hence, REU programs have been promoted in recent years to create a sustainable pathway to graduate school (Youssef et al., 2016). While there are a host of advantages associated with undergraduate research, there are also challenges faced by REU program participants. For example, Follmer et al. found that student participants often need to relocate to the REU home institution for the summer, which requires students to adjust and adapt at the beginning of the program (2017). Furthermore, relocation, in combination with the brief time frame of the REU program (typically ten weeks), may make it difficult for some students to have extended engagement in the summer research project.

The issues surrounding doctoral socialization become even more complex when considering the longstanding role socioeconomic, race, and gender have played in US higher education (Pawley, 2019). Previous research has shown that a student’s parent’s income and education correlate with their collegiate success even when factoring in their last academic performance (Bassett, 2020). FGLI students enrolled in four-year universities consistently complete their degrees at rates far below those students who are continuing-generation students and those who lack both FGLI characteristics (Cahalan et al., 2017). Researchers have documented several factors contributing to the higher attrition rates among FGLI students such as a lack of social isolation (Burt et al., 2018; Burt, McKen, et al., 2019), inexperience with academic norms and culture (Haynes et al., 2012), lack of social support, and lack of academic and social capital (Bancroft et al., 2016).

Furthermore, the education literature has documented the racial and gendered challenges that graduate students of color and women face. These challenges include microaggressions (Burt, Williams, et al., 2019), and imposter syndrome (Haynes et al., 2012). The presence of these issues negatively affect student socialization (Pawley, 2019) and prolong the time taken to degree completion with longer degree durations often correlating to higher attrition rates. In recent decades, underrepresented students and women across have exhibited the highest growth in PhD program enrollment but have notably lower completion rates when compared to men and White students. Furthermore, underrepresented students and women have higher late completion rates underscoring the tendency for them to spend longer in their programs when compared to men

and White students with longer tenures in graduate school increasing the likelihood correlated with higher attrition rates ([Kim & Otts, 2010](#); [Sowell et al., 2008](#)).

When analyzing these trends it is key not to do what Cannady et al. describe as the commodification of people and positioning the STEM economy above human lives ([2014](#)). Critics of the prevailing conceptual model of a “STEM pipeline” address its tendency to homogenize people’s experiences and reduce demographics and contextual factors to variables without addressing how the education system has systemically disenfranchised historically marginalized groups from participating in STEM ([Nardo, 2022](#)). Thus, to properly understand the lived experiences of underrepresented students and women, it is necessary to understand their transition into and experience with graduate education. Much of the previous work on this topic is typically built upon socialization theories that concentrate on identifying differences between these individuals and the more hegemonic White male population ([Williams et al., 2019](#)). Consequently, when studied, underrepresented and FGLI students are often examined through the lens of how they do not fit into the hegemonic mold rather than on the merits of their identity development and exploration within their respective discipline ([Dall’Alba, 2009](#)). Studies in this fashion reinforce the deficit model thinking that often follows traditionally marginalized students and those with non-normative pathways ([Harper, 2010](#)). However, in recent years, newer models have emerged to better characterize the STEM education system, such as that of an ecosystem ([Lord et al., 2019](#)). This model provides a better framework as it acknowledges the agency of the different actors in the same setting, the uneven distribution of resources students must contend with, and the possibility that success in the “ecosystem” can take various forms. In this work, we align with the ecosystem model to understand the socialization of underrepresented and FGLI students.

## RESEARCH CONTEXT: RONALD E. MCNAIR POSTBACCALAUREATE ACHIEVEMENT PROGRAM

The Ronald E. McNair Postbaccalaureate Achievement Program is a Department of Education initiative named in honor of the late African American astronaut who died aboard the Challenger space shuttle. The program became the seventh TRIO program in 1989 to diversify the profile of the national professoriate by supporting members of groups traditionally underrepresented in higher education interested in pursuing doctoral education. Students interested in the program must apply to their institution and fall under one of three eligibility criteria. First, students are eligible if they are first-generation low-income students, defined as individuals for whom neither parent earned a college degree before the student earned their high school diploma and whose household income did not exceed 150% of the poverty line the previous tax year. The DoE requires two-thirds of each program’s students to fall under this criterion, with the remaining one-third eligible if they are members of a racial or ethnic population that has been historically underrepresented in higher education (Black, Latinx, Native American, Alaska Native, Native Hawaiians, and Pacific Islanders) or if they are women pursuing a STEM degree. The Department of Education funded 206 McNair programs during the 2022–2023 school year, spanning forty-seven states and Puerto Rico ([US Department of Education, 2022](#)). Data from the 2021 fiscal year reports that the average grant awarded to universities was \$266,440, which served an average of 28 students per institution ([US Department of Education, 2022](#)).

Since its inception, the McNair program has taken a comprehensive approach to student preparation, providing information about graduate education and life in academia. McNair scholars receive academic advising, faculty mentoring, research experience, graduate admissions counseling, financial aid counseling, career advising, and other opportunities conducive to graduate education ([Grimmett et al., 1998](#)). Programs are free to operate autonomously and tailor their offerings to suit the culture and needs of their institution and thus vary widely in their exact offerings. However, all programs provide their students with a research internship in which they work under the guidance of a faculty member from their institution. McNair directors access their grant’s federal funds through their institutions and spend them purchasing resources, sponsoring travel, or putting on events for their students. Students are generally paid a stipend over the duration of time they conduct their research with most programs opting to have students research during the summer.

The unique benefits of McNair along with its goal of preparing students for graduate studies means that there are few widespread programs to which it can be compared with REUs being the closest the authors are aware of. Unlike traditional REUs, which typically last around ten weeks and are mainly for juniors and seniors, McNair programs engage students year-round with different events and workshops and aim to recruit and cultivate early-level students over a more extended period (US Department of Education, 2022). McNair programs accept students from all majors and career fields, allowing for greater interdisciplinary exposure and collaboration where most REUs typically only serve STEM students. REUs are open for all eligible US citizens and permanent residents to apply to. While broadening participation is encouraged, REUs do not have an explicit goal of recruiting underrepresented students and women. In a review of international REUs demographic information, Black students and FGLI students were found to be underrepresented compared to their general national college enrollment rate with participants disproportionately coming from highly educated families (Speroni, 2021). In contrast, the McNair program targets marginalized populations whose backgrounds might otherwise preclude them from winning the limited number of highly competitive REUs. Because of the program's success in boosting graduate enrollment and doctoral degree completion rates, we propose that by investigating past McNair participants, we can both better understand how STEM graduate students form schemas about graduate school and better understand socialization processes with an emphasis on groups that have historically been marginalized or excluded from STEM higher education.

## MOTIVATION AND POSITIONALITY

While positionality is important to all research endeavors, we find it particularly important to disclose the relevant positionalities in a qualitative enterprise such as this one in which the researcher is the primary “instrument” of analysis (Guba & Lincoln, 1981; Hampton et al., 2021; Louis & Barton, 2002). We view this as an opportunity “to interrogate their motivations, worldviews, beliefs, and embodied components of the research process” (Secules et al., 2021). We, the authors, seek to discuss the positionalities that we deem relevant to this study and will refrain from underusing this opportunity to bolster the integrity of this research by merely listing identities (Pillow, 2010).

**First author:** My motivation for this project is two-fold. As an undergraduate, I participated in and had a positive experience with the McNair program. My previous work, along with that of my research lab, focuses on engineering graduate attrition, persistence, and well-being. Thus, this work represented an opportunity to combine my knowledge of the issues faced by STEM students at the graduate level and explore how the understudied McNair program seems to counteract them. Throughout this project, I have been conscious of my identity and positionality and how any potential bias could have influenced this research. Of the thirteen participants in this study, I shared my identity as Black with two individuals and my identity as a man with four.

The most pertinent consideration for this project was my status as a fellow doctoral student and former McNair Scholar. My status as a McNair alum afforded me great insight and firsthand experience with the benefits and shortcomings of the program. While the program is federally administered and shares common goals and characteristics at each institution, no two programs are exactly alike. I was cognizant of how my favorable view of the program might influence the interviews conducted with participants and the analysis of the transcripts. During the interviews, I intentionally framed questions in neutral ways or phrased them in a way that corresponded with the participant's previous disposition over the given topic. In doing so, I attempted to avoid implanting ideas or sentiments in their responses that aligned with my personal experience and disposition toward what they were saying. I tried to phrase and follow up questions in ways that elicited original organic thoughts from the participants. Discussion and disclosure of these positionalities and potential sources of bias are intended to promote the transparency and integrity of this research.

**Second author:** I bring my current positionality to this study as a woman engineering faculty member specializing in graduate-level engineering education research. Throughout my education, I have had firsthand experience of feeling excluded: While my parents have postgraduate training,

I was Pell-grant eligible and held a job through most of my undergraduate degree to pay for my education and housing. As the first engineer in my family from a very rural part of the US, I learned most of what I needed to navigate graduate school at a large R1 institution through my social connections and resources available through departments, universities, and affinity groups like Women in Engineering. As it relates to this study, this context orients my interest in the study and makes some of the conversations on capital and schema resonate with me: Only through REU experiences did I find my place in research. My role in this study was to guide the project's research design, provide financial support for transcribing the interviews, and assist with manuscript preparation, revision, and support as the PhD advisor of the first author. Although my positions were not informing the coding schema or analysis of data, in my revisions for the manuscript, I believe that my sensitivities to these issues continue to emerge in my identifying how different forms of capital may overlap, what the gaps are in the literature, and how our findings may influence future educational opportunities for low income and first-generation students, and other students marginalized in higher education and STEM.

## CONCEPTUAL FRAMEWORKS

This study leveraged two theories, each with a long history in educational research. Piaget and Bartlett's Schema Theory is a psychological framework that defines learning as adopting schemas to update an individual's understanding of their environment (Piaget, 2005). A schema is an individual's mental model of their environment to organize information and base future interpretations (Bieber & Worley, 2006). Schema theory has been used in higher education to study topics such as memory (Brewer & Treyens, 1981), literacy (Tierney & Shanahan, 1991), and the doctoral student-to-faculty pipeline (Bieber & Worley, 2006). In STEM education, schema theory has been used to evaluate or augment pedagogical practices (Quinlan, 2019).

This work also uses Pierre Bourdieu's theory of capital as an operational framework. Bourdieu's theory of capital asserts that there is an unequal distribution of opportunity among people in a social setting. It proposes that in all social enterprises, people must negotiate this unequal distribution of economic, social, cultural, and symbolic capital (Bourdieu, 1986). The four types of capital are shown and defined in Table 1.

| FORM OF CAPITAL | DESCRIPTION                                                             |
|-----------------|-------------------------------------------------------------------------|
| Economic        | Financial assets or other resources of monetary value                   |
| Cultural        | An understood set of, norms, expectations, and behaviors                |
| Social          | Network of family, peers, mentors, and other advantageous relationships |
| Symbolic        | Qualifications, honors, accolades, memberships, awards, or recognitions |

**Table 1** Bourdieu's Theory of Capital.

In recent years, Bourdieu's theory has received more attention in STEM education as researchers have sought to understand the experiences of students and their emerging identities as scientists and professionals (Archer et al., 2015; Claussen & Osborne, 2013; Turnbull et al., 2019). Relating to our McNair research context, we note that FGLI and underrepresented students have historically had to navigate their collegiate careers with less of the four types of capital when compared to other students (Collier & Morgan, 2008). For example, low-income students enter college without the financial resources and knowledge base needed to remain financially solvent and avoid the stresses associated with economic uncertainty. In an educational setting, cultural capital refers to the preparation individuals bring for their role as a student. Students who received subpar schooling in high school often enter college with an inadequate expectation of what constitutes quality work and how to adjust their work, writing, and study habits to match the standards of their peers against whom they are explicitly and implicitly being compared (Collier & Morgan, 2008).

Further complicating the issue for underrepresented FGLI students is the lack of knowledge concerning how to use these different forms of capital when they acquire them. Bourdieu describes the importance of an individual's "habitus," which he defined as how people utilize the capital

they possess (1986). Students' habitus is the product of their past experiences, socialization, social conventions, and personality (Bassett, 2020). Bassett criticizes the mainstream attitude in higher education, which places almost the entire responsibility of acquiring capital on the student and provides little guidance on utilizing their habitus (2020). This critique suggests that it is not enough to provide an individual with capital without equipping them with the capacity to wield it effectively. This paradigm is particularly problematic given its tendency to mask the barriers and norms preventing students from fully exerting their habitus, which can render their newly held capital useless. Effective educational programs help students develop their capabilities and curate their habitus to become effective stewards of their newly developed or acquired capital. Crucially, we note that the invisible standards, practices, and values that shape the environment students operate in also govern and influence the programs intended to help them overcome these influences.

On the topic of habitus, we see the utility of leveraging both theoretical frameworks and the context of the McNair program. Bourdieu's theory of capital provides a useful framework for categorizing the benefits and skills the McNair program confers to its students. The degree to which a McNair program's events or interventions confer one or more of the types of capital is a valuable metric to assess how students benefit from these efforts. Schema theory allows us to see how many of these benefits make it into the students' minds and help them build a scaffold upon which they can develop their experiential understanding of graduate education. Schema theory was present throughout participants' responses as they discussed the various forms of capital provided to them by the program. For example, several participants joined the McNair program believing that doctoral programs were not suitable for individuals like themselves who come from socio-economically disadvantaged backgrounds. This schema was arrested by the program's guidance regarding pursuing funding for graduate studies. As such, we posit that the difference between students' schemas surrounding graduate education and themselves before and after joining McNair will be a qualitative barometer to gauge how much their conceptualization of the enterprise evolved. Finally, a student's habitus links what the program tries to provide and what the student now understands. Thus, we used these two frameworks as follows. Bourdieu's Theory of Capital was used to develop our interview protocol and orient the questions we asked our participants. We then analyzed and coded their responses to reveal what schemas concerning the relationship between the capital they possessed and their experience of graduate education emerged and how their participation in the McNair program helped them leverage their habitus.

## METHOD

### PARTICIPANTS AND RECRUITMENT

Upon receiving Institutional Review Board approval, we compiled a list of all actively funded McNair programs in the US. Next, we sent our recruitment email with a screening survey to their directors. We chose this sampling method as McNair programs are required to track the academic and employment outcomes of all their students for ten years after their undergraduate graduation. Since our study sought to recruit students who were studying STEM at the graduate level, we opted to leverage the existing data and contacts maintained by the directors. In the screening survey, respondents completed a Qualtrics survey asking them about their graduate school experiences and their experiences in the McNair program. We also asked participants to forward our recruitment email to others in a manner consistent with snowball sampling (Sharma, 2017). Our initial recruitment efforts combined with products of snowball sampling yielded a total of seventy-three survey respondents. Of the seventy-three respondents, thirteen completed the survey and fulfilled our criteria for studying or having studied a STEM subject at the graduate level. We emailed these thirteen respondents to participate in individual hour long semi-structured interviews over Zoom regarding their experiences with compensation taking the form of \$10 Amazon gift cards. The interview protocol was heavily influenced by Liddell et al.'s Survey of Early Career Socialization in Student Affairs used in their study of emergent professional identity (2014) and includes questions such as those sampled in Table 2. The protocol was also influenced by

Bourdieu's framework with several questions inquiring how students benefited if at all according to the different kinds of capital discussed in the model. Participants were briefed on the purpose of the study prior to the interview. The protocol used as the basis for the conversation, however most of every interview was filled with follow-up questions that were presented in accordance with the answers and elaborations offered by the participants.

|                                                                                           |
|-------------------------------------------------------------------------------------------|
| How would you characterize your experience in the McNair Scholars Program?                |
| What aspects or offerings of the program were most impactful for you?                     |
| How would you characterize your transition into graduate education?                       |
| What lasting impact has the McNair program had on your experiences as a graduate student? |
| How has your graduate experience influenced your professional identity?                   |

**Table 2** Sample Interview Questions.

Interview audio files were professionally transcribed, and personal information was de-identified before analysis. All participants whose voices are represented in this work will be distinguished by pseudonyms. Two participants were in their first year of graduate school at the time of the interview, with the majority in their second or third year. Only one participant, Elena, was not a full-time student. [Table 3](#) contains general demographic information regarding the sample with each demographic section presenting mutually exclusive options.

| RACE/ETHNICITY                                               | NUMBER |
|--------------------------------------------------------------|--------|
| White                                                        | 2      |
| Black/African American                                       | 2      |
| Hispanic/Latinx                                              | 6      |
| Native American or Native Alaskan                            | 1      |
| Asian                                                        | 1      |
| Multiple                                                     | 1      |
| <b>Gender</b>                                                |        |
| Men                                                          | 4      |
| Women                                                        | 8      |
| Non-Binary                                                   | 1      |
| <b>McNair Eligibility</b>                                    |        |
| Underrepresented                                             | 2      |
| Underrepresented & Women in STEM                             | 3      |
| Underrepresented & First-Generation Low-Income               | 2      |
| Women in STEM & First-Generation Low-Income                  | 1      |
| Women in STEM, Underrepresented, First-Generation Low-Income | 5      |

**Table 3** Participant Demographic Information (N = 13).

## DATA ANALYSIS AND QUALITY

Following the interviews, participant transcripts were analyzed following the tenets of thematic analysis. Thematic analysis entails identifying and coding themes or patterns of meaning that emerge from the data ([Clarke & Braun, 2017](#)). These themes are identified and coded according to their relevance to our constructs of interest, namely how McNair imparted new capital and habitus to students and how they used them in conjunction with their schemas surrounding graduate school ([Braun & Clarke, 2006](#)). While iteratively reading through the transcripts, we used open and axial coding techniques to develop an emergent codebook that was strongly influenced by the tenets of the theory of capital ([Miles et al., 2014](#)).

Three codes flowed directly from the theory: economic, social, and cultural capital. Symbolic capital did not form a significant or novel role in the analysis and was lightly involved in broader discussions of the more salient forms of capital. Two additional codes emerged from the data because of our open coding schema (technical capital and intrapersonal capital). Schema theory was not explicitly coded for on its own as it existed as an embedded element of the themes derived from the theory of capital. Thus, our discussion of student schemas centers around how students exercised their newly developed habitus during their time in the McNair program.

Thus, this project was predicated on understanding challenges faced by students struggling with persistence in STEM doctoral programs. For example, our understanding of the importance of graduate school schemas was developed from our study of how engineering students developed disenchantment with academia amid negative experiences (Shanachilubwa et al., 2025). The design of this study was largely a follow-up to that investigation, thus ensuring that our theories aligned and were compatible with the reality under investigation, giving this work procedural and pragmatic validity (Walther & Sochacka, 2014). The interview protocol was designed to elicit responses corresponding to schema theory and the forms of capital provided by the McNair program.

Furthermore, pilot interviews assisted in the refinement of interview questions to maximize the uniqueness and relevance of the responses given by participants. Careful attention to research design and data collection continued into our handling of the data during the iterative analysis of the transcripts. The first pass through each transcript was done to reacquaint the researcher with the voices and sentiments of each participant. The second pass through the transcripts was conducted to develop and refine the finalized codebook and definition of themes. The third pass through the transcripts was done to code each participant's story with a consistent and coherent set of themes that mapped to each experience. This iterative coding process ensured that themes generated and coded were aligned with how participants described their experience. This approach reinforced the theoretical and communicative validity of our data handling (Walther et al., 2013).

## LIMITATIONS

As with all studies, this investigation was subject to limitations. Our initial recruitment relied on emailing the directors of all McNair programs to forward our screening survey. Some email addresses compiled in the list returned error messages or belonged to directors whose program grants were not renewed for the school year. Thus, whether students from these lapsed programs received our survey remains unclear. Similarly, not every director replied to our request. This is unsurprising, especially if a program does not retain a master listserv with all the alumni they track from every cohort. Furthermore, despite being three years removed from the onset of COVID-19, the pandemic still played a significant role in our participants' experiences. Most of our participants were undergraduates during the beginning of the pandemic, and thus, their experience with McNair was different compared to cohorts that graduated before the Spring of 2020. Those students slated to do their internships and attend conferences in the summer of 2020 report not receiving the same experience and preparation as cohorts in other years who were able to have all the functions occur in person.

Furthermore, the experiences of McNair students can vary significantly not just among individuals but between programs. The relative autonomy programs enjoy tailoring their operations to their institutional context means that no two programs offer the same services and opportunities in the same way. Thus, apart from critical features such as the summer research internship and some conferences it cannot be assumed that students from different universities received the same preparation and opportunities. Lastly, despite the programmed demographic composition of McNair programs, none of our participants fit purely into the FGLI category without also qualifying via another criteria. As a result, our sample likely underrepresents the voices of McNair students from rural and middle America specifically those who are White men.

FINDINGS

Five themes emerged from a thematic analysis of the interview transcripts. While each theme covers a unique and distinct aspect of students’ journey to becoming doctoral researchers, they all revolve around exposure. Through these themes, participants, in several ways, describe how the McNair program benefited them by exposing them to information, lessons, and opportunities they otherwise would not have had. This exposure provided them with the different opportunities they used to find success enrolling in and beginning their graduate programs. Table 4 defines the five themes which are further discussed below.

Table 4 Overarching Themes.

|                                                                                       |
|---------------------------------------------------------------------------------------|
| 1. Technical Capital—Skills relating to academic writing and how to conduct research  |
| 2. Cultural Capital—Insight regarding life as a graduate student and academic culture |
| 3. Economic Capital—Opportunities and resources previously financially inaccessible   |
| 4. Social Capital—Provision of a sense of community and a support network             |
| 5. Intrapersonal Capital—Self-Confidence and effective self-advocacy                  |

We now present the five overarching themes that characterize our participants’ experiences. While we advise against drawing broad generalizations, we contend that understanding our participants will confer a greater understanding of how graduate students form schemas about graduate school by leveraging their experiences.

THEME 1: TECHNICAL CAPITAL

One of the most important variables for success in graduate education is knowledge of conducting research, which students gain by designing, implementing, writing, and presenting original work. Technical capital refers to the academic skills needed to execute the content of the role of student. While not an explicit part of Bourdieu’s original Theory of Capital, the technical competence students develop during disciplinary-specific research significantly impacts their trajectory. Crucially, we view technical academic skills as distinct from cultural and symbolic capital with which it has previously been lumped in the academic literature (Collier & Morgan, 2008).

The technical abilities described by our participants were typically related to academic writing and presentation skills. Several participants alluded to discipline-specific technical skills but refrained from describing them in great depth, likely because of the interviewer’s relative lack of disciplinary expertise in their specific subfields. Nonetheless, all participants describe the opportunity to develop general and discipline-specific technical skills as a significant influence on their trajectory. They most commonly describe their time in the McNair program as lowering the threshold they needed to cross to become successful graduate students. For example, Cole, a Black third-year doctoral student in engineering education, describes McNair as providing a “step ladder” that lowered the barriers he encountered in his program and gave him a sense of familiarity with the tasks he was asked to do. In his reflection, Cole acknowledges that the McNair program did not eliminate the difficulties and frustrations of his graduate experiences. Instead, he focuses on the scaffolding experiences that allowed him to adapt to his new demands, seeing these demands not as strange or foreign but as more intense versions of what he was already familiar with. Thus, upon entry to his program, he was prepared to perform the familiar tasks, albeit more intensely.

What McNair does is it almost provides a step ladder, or it lowers some of those walls to where you’ve done some of this stuff before, you’ve had experience with this. And so, when it comes time to hurdle those walls, they’re a foot shorter. And so, they’re still the same issues that people come in contact with. They’re still the same difficulties that everybody experiences, McNair doesn’t get rid of them. But they give you a kind of scaffold set of experiences that helps your brain go, “I’ve done this before and I can do it again, even if it’s on a larger scale this time.”

— Cole

Gertrude, a White woman in her first year studying neuroscience, provided an assessment like Cole's regarding the benefits of research exposure and what quality work looked like in her chosen field. However, Gertrude spoke more candidly about the importance of McNair providing her with habitus, technical competence, and an understanding of research work in her discipline.

She lauds the program for going beyond giving her "tools" in the form of technical capital by also teaching her how to wield these tools in the form of her habitus. Gertrude praises the program for showing her how to write, placing her writings in front of the right audience, and leveraging her previous work in pursuit of her ambitions as a doctoral student.

McNair gave me the tools necessary to succeed in conducting research. But I feel like you have to know how to use those. And I feel like McNair students, the way that McNair selects their students and their cohorts' filters through people who know how to use the tools that they are given versus people who are just latent. I don't know because without those... Without the tools they gave me, I probably wouldn't be here. I genuinely don't think I would be here. But also at the same time, if they just said, "Okay, here's what you need for grad school." I personally need to be able to assemble. They don't just hand it to me, I have to do something with it. And so, I feel like it's a mixture between McNair helping me get to where I am, but also what I do with that...

— Gertrude

The McNair program was created partly to provide technical research skills to those students whose demographics have historically precluded them from developing these abilities, inhibiting their transition into graduate education. Being able to model the research process as undergraduates provided them with a frame of reference as new graduate students. Familiarity with the technical aspects of research prevented them from being overwhelmed upon beginning their program and made it easier to adapt, having been introduced to different concepts. Here, we see that the disbursement of technical capital is identical to the act of schema development. By having Cole conduct a research project as an undergraduate, the program provided a schema of what graduate work in his chosen field consisted of, albeit at a more rigorous level. He affirms the utility of the schemas he developed as an undergraduate, which he refers to as "strong background knowledge," and how he exercised his technical habitus by conducting his work through actions such as "designing a study, picking methods, doing interviews, and then actually writing papers."

Technical competence is not an explicit part of Bourdieu's original model; however, we see it as a vital and distinct theory of capital due to its relevance and concordance with the rest of the framework. Our participants drove our recognition of technical skills as a distinct form of capital. Their discussion of the program's benefits delineated between the benchwork skills they developed and the knowledge of how to navigate the higher education ecosystem they were about to enter. Thus, while previous authorship includes the tenets of technical capital within a discussion of cultural capital (Collier & Morgan, 2008), we see the two as separate but heavily integrated parts of each student's development and socialization.

## THEME 2: CULTURAL CAPITAL

Technical capital encompasses the skills and information needed for students to work as graduate students. Cultural capital refers to the skills and information necessary for students to live day-to-day lives as graduate students. For several participants, knowledge regarding how to conduct and write research was only one barrier participants described regarding their preparation for graduate school. It is documented in the higher education literature that success in graduate education depends on various factors beyond academic capability (Bain et al., 2011). Graduate education requires students to become knowledgeable of and adapt to the culture of academia and its associated norms and practices. For many students, misalignment with the norms and culture of academia can produce disillusion with the academies (Long, 1982). This is especially likely when students are confronted with norms and practices they are unprepared for and conflict with their expectations and values (Nyquist et al., 1999). As mentioned, the literature discusses

the existence of the “hidden curriculum,” an invisible set of rules students are expected to abide by but never explicitly instructed in. Underrepresented and FGLI students often enter academia with less academic and cultural capital than other students. Thus, they often have fewer resources and connections necessary to contend with the hidden curriculum. Thus, the hidden curriculum exacerbates the existing inequalities between these students and those of their more privileged peers (Renbarger, 2019).

Delfina, a fourth-year Latina woman studying neuroscience, best articulated the issues surrounding the hidden curriculum. Delfina’s story was underscored by her discomfort of being an underrepresented student, describing situations in which she was one “of the only children of immigrants in a room.” Delfina grew up in a predominantly White city where she felt so isolated that she “didn’t like speaking in Spanish with my mom when we were in public.” Delfina’s sense of cultural exclusion and non-normative identity would influence her takeaways from the McNair program. She describes academia as defined by “pageantry,” or the norms and decorum commonplace in higher education. For Delfina, a clear explanation of this “pageantry” or hidden curriculum guided her in navigating the higher education environment rather than having to piece together a strategy as she went along as she had throughout her education.

[McNair] made it pretty explicitly clear that there’s a lot of pageantry involved in academia, right? It just made the unclear clear, right? Where you might know about this ‘cause your parents are, work in corporate America, but my mom has worked in academia all her life and she... hasn’t imparted me with the knowledge that I need as a grad student. Because she’s been a professor for 20 years, she doesn’t really remember what it’s to communicate as a grad student and how little power you have. I think part of it is exposure, right? In McNair, I was exposed to different resources for summer programs that got me where I am. I was exposed to workshops that taught me some of the hidden curricula.

— Delfina

Interestingly, Delfina struggled with her sense of exclusion and lack of cultural capital despite her mother having two decades of experience as a faculty member. While it was conceivable that Delfina’s mom provided some insight, Delfina found that the structured support and insight she got from McNair far exceeded what her mom provided. This statement challenges the schema that having a parent or close relative in academia automatically means a student has sufficient cultural capital. Consistent with the sentiments of the rest of our participants, Delfina’s comment suggests that while some individuals have easier access to cultural capital than others, it is not something that can be purely inherited but must be actively taught. Without the intentional distribution of this capital, students can be left with little knowledge of how to navigate graduate education, especially when pursuing a different field with a different academic culture than their close relatives. Dispelling the pageantry of academia gave Delfina an accurate schema on which she could base her actions and interactions.

Elijah was a Black sixth-year student studying physics. In his comments, he demonstrates how the cultural capital acquired from the program translates into habitus. Elijah debated where to apply for graduate school and what criteria were most important to him in making this decision. In Elijah’s case, his acquired cultural capital gave him the insight to decide where to apply and if a graduate program was best for him.

I don’t think I would’ve been [prepared for graduate school] at all. I think certain things that would’ve caught me off guard, or at least that I would have had a tough time adjusting to... I think if I didn’t go through the program, I would’ve probably gone after rankings and stuff like that as opposed to seeking a professor that was at least supportive or you could work with... I think if you’re not really told, or let’s say as an undergrad you really have no idea what grad school is like.

— Elijah

Delfina and Elijah clearly articulate the power of the McNair program in preparing students for all aspects of graduate education. Through workshops and mentoring, the McNair program was able to demystify some elements of academia and provide them with the tools needed to do one of the most important tasks necessary even to begin graduate education, which is to communicate with faculty. The two demonstrate how an individual's habitus can take different forms even given the same or similar forms of capital. Delfina used her capital and refined schemas regarding the nature of communication in academia to begin her interactions per the expectations of those around her. Elijah took his understanding of academic culture and based his decision on whether to go to school and which program to apply to.

### THEME 3: ECONOMIC CAPITAL

Many students' socioeconomic status was a significant deterrent to their success and thriving. Eight participants reported qualifying for McNair as FGLI students, and several spoke candidly about their impoverished upbringing. These students talk about how the program did more than expose them to graduate school; it made it more accessible to them in defiance of their economic constraints. While it is widely known that funding opportunities exist for graduate students, logistical and financial barriers often prevent students from being exposed to these opportunities. These barriers are significant for FGLI students, even those given adequate technical and cultural capital. No one articulated this reality better than Elena, a Native American woman who opted not to pursue a doctorate and was working for a non-profit, who describes the economic reality that underscored the impact of McNair's financial assistance.

I was the first person in my family to live outside the same two counties that they'd always lived in, so I was in a new place with a bunch of new people... Oh, also the McNair program, financially compensating for me to go visit grad schools. Huge, huge, huge, huge, huge for poor kids, especially flying into [town of graduate school] where the airport is about two chairs and a stuffed bear, it was huge. People were not capable, and they were not prepared on how to handle those situations.

— Elena

Elena's sentiments were echoed by Anderson, a White man in the third year of his master's program who came from a deeply impoverished background. A broken and toxic family dynamic characterized Anderson's story. For him, getting the financial support needed to facilitate any ambition was quite different from his lived experience, defined by him experiencing only what he could provide for himself.

And then the plane ticket back, the Airbnb, they covered all of that. And there's no way, like it would take me... I mean, I don't know, it would take me forever to save up that much money and there's just no way I could have done that without McNair. So that's, I would say it was very financial, their role in facilitating that. But also, again, it's that encouragement and constantly pushing me to try to do more that helped ultimately get me there because I wouldn't have done it myself because I didn't believe in myself if that makes sense. So, I think ultimately, it just comes down to the financial support.

— Anderson

A core tenet of the McNair program is exposing students of all disciplines to the funding opportunities that exist for them and how to pursue these opportunities. However, for many students, the mere act of researching and applying to graduate school is prohibitively costly. Elena and Anderson personify the impact of poverty and a lack of resources on capable students' ambition and beliefs surrounding their capabilities (Claro et al., 2016; Vandewalle, 2012). Elena and Anderson entered their respective McNair programs with limiting beliefs and self-restricting schemas connected to the circumstances surrounding their upbringing. Upon receiving the backing of the program coupled with their other forms of capital, Elena and Anderson were able to develop new schemas of themselves by exercising their habitus by taking advantage of these opportunities and demonstrating that they could meet these new challenges and break a socio-

economic cycle defined by refusing opportunities that would benefit their futures because of their financial considerations and the limiting beliefs and schemas that often characterize poverty.

## THEME 4: SOCIAL CAPITAL

The McNair program provided participants with a social support network they found invaluable in their journey to graduate school. Elena and Katelyn, a second-year Latinx woman studying biochemistry, both attest to the power of McNair as a social structure and reveal interesting facets of this dynamic. Elena saw her undergraduate McNair community as a “source of power” she would look to her peers and director for encouragement, camaraderie, and counsel, particularly as an underrepresented student. However, in graduate school, she suffered from the withdrawal of this social support structure and could not recreate it in her new setting. Nevertheless, she describes the experience of having a community with peers who share her identities as empowering and nourishing.

It was difficult emotionally being there [in graduate school] on a couple different levels. People there would tend to be very wealthy. I did not have the McNair sort of support system. I felt very alone, and I didn't know how to access the McNair world. If that was a source of power for me before, I did not know how to access that in grad school. I should have asked. I ended up finding a little community here and there. And feel like it could have been a much easier and better experience if I had asked for and been as rigorous about finding my community and my support system as I had been about my research.”

— Elena

Elena alludes to the difficulty of graduate school due to the lack of the same kind of support system she enjoyed in her McNair cohort. Previous work has demonstrated the importance of support networks in fostering the success of underrepresented and FGLI students (Contreras, 2011; González, 2006; Mishra, 2020). Like other participants, Elena's sense of intrapersonal capital was coupled with her sense of community and social capital. Her statements described the cyclical and complementary nature of these two types of capital. In her case, the support and encouragement given by one student to another instilled the latter with confidence and belief that they would similarly reciprocate or share with another student. Her relationship with her McNair peers cultivated a positive feedback loop in which they each co-constructed each other's schemas through encouragement and mutual support.

The social capital these students built with one another gave them a bulwark against self-doubt, isolation, and limiting schemas, allowing them to concentrate on developing their research abilities. Unfortunately for Elena, she did not find comparable support structures upon entry into graduate school, a sentiment shared among other participants in this study. She found it difficult to recreate these structures in her program, particularly where she did not share the same racial or socio-economic background as her new peers.

I feel like I would've definitely let myself get walked all over if I didn't have that support system... Not that I'm super confident now, but I'm definitely more comfortable in my abilities than I was then. And if I didn't have McNair, I feel like I would've just felt like I couldn't do anything, or that I didn't really... I couldn't really be this scientist that I wanted to be. What McNair did for me, which was provide an environment where I could go and feel heard. And also, I could go and be reminded that... just because maybe, one professor tells you one thing, that doesn't define who you are or your work doesn't have to define who you are.

— Katelyn

## THEME 5: INTRAPERSONAL CAPITAL

Participants describe how one of the program's chief benefits was the ability to advocate for themselves and avoid undesirable situations. Katelyn credits McNair with cultivating a space

where she felt free to express herself intellectually without thinking about her socioeconomic or racial status. In her case, she characterizes one form of capital as the gatekeeper to other forms of capital. Taking advantage of her social capital (exercising her habitus) through interacting with her support network gave Katelyn confidence (intrapersonal capital). This injection of confidence gave her the resilience to continue working on her projects even when her experiments failed. Without adequate social capital, students feel disconnected from one of their most potent protections against counterproductive schemas and sources of encouragement amid difficulty.

While not a distinct part of Bourdieu's theory, we found it fitting to incorporate intrapersonal capital as a separate dimension to the framework. The newfound intrapersonal capital afforded to our participants helped them hone their decision-making process regarding their research and choice of program. In contrast with social capital which encompassed the support network and community building students benefitted from, intrapersonal capital describes the sense of confidence and self-efficacy students were taught to cultivate within themselves. Daphne, a non-binary third-year student of mixed heritage studying biology, spoke about how her experiences in McNair carried over into her graduate program.

The McNair program I think was really instrumental in helping me start to realize my own worth as a person, as a researcher, as somebody in STEM and how I could essentially market my worth and really kind of take advantage of the fact that yeah, I am smart and I am worth it and I can do science as well as the next person even if they don't look the same, even if they're not like me.

— Daphne

We see that the personal impact of the McNair program persists long after the respective student has begun their graduate program. The program's instrumental role in her personal growth gave her a positive self-image she could fall back on amid difficulties in her program. In Daphne's experience, the program proactively mitigated a sense of imposter syndrome. We also consider Elena's experiences and her use of intrapersonal capital in deciding not to pursue a PhD. Elena leveraged her personal experience and the knowledge about doctoral programs obtained from her McNair program. She determined that it was unwise for her to enroll in a PhD program because of the degree of isolation she anticipated. Instead, she opted for a master's program that, while still isolating, she reports as having suited her and her goals more closely. Crucially, we do not see this as a failure but as a success and testament to the program. While it is in the purview of the research team and of the McNair program to promote doctoral study, we recognize that entering a PhD program does not suit every student's goal at every point. Instead, we view the optimal outcome in every situation as students choosing the path that promotes and maintains their well-being agentially. This level of critical reflection and self-advocacy, informed by a clear understanding of the sacrifices required as afforded by the McNair program, is a vital component of ensuring graduate programs are populated by individuals who will reap the most from experience.

Research as a practice is not wonderful at bringing value to you as a human being outside of research. So as a practice, research is great for empowering the people who find and derive value from what you do. It is not a great practice for holistic wellbeing and holistic self-care and holistic self-derived sense of self and value... which is ridiculous because you have a bunch of poor people and a bunch of people of color, and you think that America has just gifted us how to survive and do it okay and well, and with sanity? From my experience, no, especially given the family trauma that comes along with all the different demographics you pile on top of them.

— Elena

One of the McNair program's most powerful effects on our participants was its deconstruction of previously held schemas participants had regarding themselves. McNair specifically recruits individuals who are FGLI and underrepresented, demographic groups especially susceptible to limiting beliefs. Developing these students' confidence and self-esteem is vital, especially given their role in academic success, social adjustment, and positive long-term career outcomes

(Grant-Vallone et al., 2003; Salmela-Aro & Nurmi, 2007). Several participants described going through high school and their undergraduate programs as being constantly surrounded by more affluent White students. Even without inappropriate behavior or words from their peers or professors, participants learned to internalize these norms and develop a silent inner schema that characterized them as outsiders to their present setting. These schemas were then reinforced upon witnessing that only affluent White students were visibly pursuing the same graduate programs they were interested in. The power of the McNair program in the lives of these students was the focus on dispelling these negative schemas and showing these students that other underrepresented and FGLI individuals shared their aspirations. The explicit challenges of these limiting schemas and a sense of community helped kickstart the positive feedback loop that empowered these students to exercise their habitus by displaying ambition and taking on new responsibilities and challenges.

## DISCUSSION

This work explored how former McNair scholars formed schemas about and experienced graduate school in STEM programs. Through Schema Theory, we understood how students changed their perspectives regarding their educational attainment. Through Bourdieu's Theory of Capital, we could see how participation in the McNair program broke down participant schemas that hindered their achievement and success in graduate education.

Our research question asked how students' schemas influenced their socialization and persistence in the context of a graduate preparatory program that seeks to shape these schemas. The answer to this question came in the form of arguably the most significant benefit of the McNair program and the overarching concept uniting the five themes discussed previously: exposure. Exposure to different experiences allowed students to build more informed schemas about themselves and their potential future graduate programs. The McNair program exposed students to information and opportunities that caused them to update and adapt their schemas. Our participants spoke strongly of how the program changed their schemas of themselves especially those from underprivileged communities who are susceptible to schemas that undermine their abilities and discouraging participation and ambition (Peña et al., 2022). Additionally, Delfina provided a poignant example of how cultural capital does not necessarily get conferred automatically. Despite having a parent with years of experience working in academia, she gives very little credit to her mum for her graduate preparation instead opting to give it to the McNair program.

As an authentic part of schema development, each participant described how their McNair program never sought to create a rose-tinted depiction of graduate education. Rather, the program sought to inform students about all aspects of graduate school such that they were equipped with the information they needed to decide which graduate program was best for them, if any. We note how three of our thirteen participants were not enrolled in a PhD program at the time of the interview yet spoke glowingly of how the McNair program helped them shape their decision which supports our line of argumentation critiquing the mentality of encouraging students to persist in their PhD program no matter the cost (Sallai et al., 2022, 2023).

Previous work has uncovered the plight of underrepresented and racially minoritized individuals seeking STEM education. Their situation has been described as having "to try to emulate or embody hegemonic values, navigate an environment that is hostile to their identities, or leave the field (Turk-Bikakci & Berger, 2014). Those who attempt to navigate it must cope with and manage their suffering repeatedly" (McGee et al., 2019; McGee 2020). Cultivating collaborative and supportive environments among underrepresented and FGLI students is a significant contributor to their success and well-being. Participants in this study revealed how instrumental these environments created by McNair were and how they suffered in their absence when they entered graduate school and had to face the reality of being isolated from their more hegemonic peers. Crucially, the reciprocal nature of social and intrapersonal capital suggests that every failure to promote the success and well-being of an underrepresented or FGLI student undermines the success and well-being of other students who could have benefited from their presence. We endorse the ongoing work in STEM higher education focusing on reproducing and normalizing diverse

and supportive cultures in graduate programs that align the environments that promote thriving among underrepresented and FGLI with the reality of graduate departments (Mishra, 2020; Palid et al., 2023).

This work adds value to the literature on broadening participation in STEM and graduate-level STEM education by showing specific examples of how the programmatic elements combine to give McNair scholars a more even playing field in graduate school. In this work, we chose to augment Bourdieu's conceptions of capital to split technical capital on its own, engaging with specific new technical foundations and knowledge about research that goes beyond symbolic capital, and we showed that the economic capital required for graduate school infuses the entirety of the graduate school process. For example, if the best advice is to "meet with faculty members and decide who will be the best mentor" (rather than just following funding), visiting the university is an important and often costly step in the process, requiring travel, hotel, and food. We also note specifically that for students who are often marginalized, the development of intrapersonal capital—faith and confidence in oneself—is another aspect essential to acting on any of the other ones: Habitus requires the development of intrapersonal capital. Together, by developing different forms of capital through the protective umbrella of the McNair program, the now-graduate students engaged with how the experiences had helped them develop accurate schemas about graduate programs and the capital to help them thrive.

## IMPLICATIONS

Our primary takeaway from this investigation is the importance of exposure to graduate study environments so students can build schemas and social capital. McNair was a useful context within which to conduct this study largely because of its mandate to serve student demographics that tend to be non-normative when considered in the STEM disciplines. However, rather than carrying out a programmatic evaluation, we conducted this study to find implications that could reach beyond any individual program.

For McNair students, especially those who are FGLI, graduate education represents a foreign environment for which they have limited knowledge (cultural capital) of how to navigate. However, the coaching and mentorship of these students can equip them with the capital needed to negotiate their path through the STEM ecosystem agentially (Lord et al., 2019).

A graduate degree seems inaccessible for many FGLI and underrepresented students because the schemas about graduate school and entering and navigating graduate school are also inaccessible. To this end, we urge mentors of undergraduate researchers, whether they be a part of a McNair program, REU, or any incoming graduate students, to spend time "making the invisible visible" and highlighting useful tidbits about research culture, the academy, or academic jobs. Some of these may seem obvious to faculty members, like "send a thank you note after you meet with a potential advisor" or "always bring a research notebook and a pen to meetings and write notes and deadlines for things discussed." Another way to conceptualize this would be "translating" advisor-speak explicitly for students (e.g., "While it may seem like an option when an advisor forwards a fellowship opportunity or says, 'You should apply for this,'— what they typically mean is 'You need to apply for this unless there is a very good reason not to.'") Other unsaid norms of graduate programs (e.g., "get your documents to your committee members at least two weeks in advance"; "the draft of a paper to an advisor should not be the student's first draft") are also worth translating so that students do not immediately experience frustration from their new graduate advisors.

While the McNair program provides a tailor-made graduate preparatory environment, all research advisors are responsible for attending to this type of mentorship (for undergraduates and graduate students alike). The lessons drawn from this study are widely applicable throughout the higher education ecosystem whenever students can interface with faculty and staff. There are opportunities for departments to embed these kinds of conversations into orientation programs or seminar classes for first-year graduate students to help them come out of the gate as prepared as possible. Because it is often difficult to know if an incoming graduate student is first-generation or low-income (there are no visible signs!), faculty should be cautious about making assumptions

about background and preparation. Further, if a student mentions being part of a federal TRIO program in a conversation or on a graduate application, faculty and departments can infer that they have been well-prepared for graduate school but have also formed these schemas in an environment that is highly supportive and integrated, such that they may struggle without community in a brand new graduate student environment that has not been designed to promote community. Furthermore, just because a student is not FGLI and may even have close relatives in academia it should not be assumed that they have been adequately equipped with all the preparation needed to succeed. We can leverage these findings to help all undergraduate researchers and current graduate students thrive by helping them identify the sources of capital they can leverage, identifying areas where they can continue to build capital, and helping them to form accurate schemas about graduate school. Assisting students—whether they have experience with TRIO programs or not—to find community quickly is likely to reap substantial rewards in promoting student thriving.

## CONCLUSION

A growing body of scholarship is studying the plight of underrepresented and first-generation low-income college students in STEM graduate education. This study sought to capture the experiences of students who benefited from participating in the McNair Scholars Program as undergraduates. We interviewed thirteen participants to understand how their time in McNair impacted their preparation for and experience in graduate school. By leveraging a combination of Schema Theory and Bourdieu's Theory of Capital, we demonstrated how our participants developed five different forms of capital that they leveraged to create graduate school schemas. We offer a few parting recommendations for the different stakeholders relevant to this study. McNair students should adopt a mentality of agency regarding their experiences in graduate education. We encourage students to carefully evaluate the graduate program they are looking to enroll in and ask critical questions beyond what research they will be conducting or how they will be funded as the less tangible aspects of graduate education have a significant impact on their sense of well-being. Furthermore, students should seek to recreate aspects of their McNair experience that they found most useful and life giving such as peer groups comprised of individuals outside of their area of study or informal mentors that look out for their mental health more so than their productivity. McNair directors and other administrators should consider the magnitude of the impact they have on students. In addition to technical research know-how, individuals who occupy positions of authority over students should prioritize instilling in their students that their experiences and backgrounds are assets in their stories and not solely obstacles to overcome.

Through this work, we encourage all stakeholders to more explicitly target the cultivation of the different forms of capital and students to focus on learning how to advocate for themselves in the felt absence of one or more of them. We conclude by noting that a proper conceptualization of graduate school gives students a sense of empowerment and ability make informed decisions regarding where they want to study, with whom they wish to study, and what they need to thrive.

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The authors have no competing interests to declare.

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