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A Multiple Case Narrative Examining the Experiences of Alumni of a Minority Research and Training Program

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A MULTIPLE CASE NARRATIVE EXAMINING THE EXPERIENCES OF
ALUMNI OF A MINORITY RESEARCH AND TRAINING PROGRAM

A Dissertation

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Dedicated to my parents and mentor, Professor Graça Vicente,
for instilling in me the values of education, perseverance, and hard work.

Special tribute to my son, Luke, for his patience and motivation
through my educational journey.

PREFACE

The purpose of this dissertation was to expand the current body of knowledge examining minority research and training (MRT) programs for the science, technology, engineering and mathematics disciplines, and gauge its influence on advanced science degree attainment among undergraduate students. My initial plan was to conduct a mixed methods approach with the use of a survey and interview. However, after a thorough literature search, I recognized a lack of narrative rich studies that examined MRT programs. Participant stories and experiences were lost in surveys and descriptive statistics. Thus, to hear the voices of student experiences, I conducted a multiple case study with a rich narrative approach. By examining common factors or experiences among participants, the reader experiences the unique stories of each participant and feels the participant's sense of contribution and value as we constructed meaning together. With this information, I hope institutions and education programs provide improved supports and resources needed to better serve underrepresented minority students.

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ABSTRACT

The implementation of minority research and training (MRT) programs at the post secondary level has risen to close the educational achievement gap and build undergraduate pathways to generate a highly skilled and diverse STEM pool. Although the numbers of advanced science related degrees have slowly increased over the past decade, partially due to the utilization of MRT programs, this increase has not been adequate to establish an impactful representation in either academic or industry research careers. Numerous studies identify various support interventions influencing positive outcomes among MRT participants achieving graduate degrees. However, majority of the studies utilize quantitative or a mixed methods design. In order to capture student voices and rich descriptive experiences, this study utilized a multiple case study featuring an extensive narrative approach. Informant stories were collected through in depth, open-ended interviews. Individual narratives were described through individual vignettes providing an in depth portrait of each participant. Cross case analysis was then performed to identify variations and common themes across groups. Analysis identified the following four influential factors influencing matriculation into advanced degree programs: belonging and inclusion, near peer mentoring, confidence in science, and family influence. Findings from this study expand the current body of knowledge and provide implications for practice to better serve underrepresented minority (URM) students with science majors.

CHAPTER ONE: INTRODUCTION

National data over the past 40 years indicate a significant educational disparity among racial and ethnic groups in the United States (National Center for Education Statistics, 2005). Students from Hispanic/Latino, African American, American Indian, and Pacific Islander groups are proportionately underrepresented at all higher education levels, especially in STEM related fields (Schultz et al., 2011). In 2005, only 14 percent of bachelor's degrees, 10 percent master's degrees, and eight percent of doctoral degrees were awarded to African Americans, Hispanics/Latinos, and American Indians combined in the biology and life science fields (Shultz et al., 2011; DePass & Chubin, 2008). Furthermore, the number of underrepresented minority (URM) groups that continue into STEM related careers after graduation declines. African Americans represent only 11 percent of the overall workforce of all STEM jobs (Carnevale, Smith, & Melton, 2011). The white population represents more than 70 percent of STEM workers compared to the 65 percent of the general workforce (Carnevale et al., 2011). With racial and ethnic minority groups predicted to make up more than half the national population by 2050, minority students are assets into which educators must tap to strengthen the STEM workforce, the vibrancy of the economy, and healthcare (Museus, Palmer, Davis, & Maramba, 2011). Scientific advancement depends on scientific talent. However, a lack of diversity represents a loss of talent, which impedes scientific progression.

A diverse research and scientific community impacts both financial and social issues (Museus et al., 2011). Herring (2009) found in analyzing more than 1,000 workplaces in the United States that employee diversity positively correlates with sales, number of employees, and profits relative to competitors. Diversity creates an environment of different ideas promoting creativity and innovative solutions to problems (Herring, 2009). According to Herring (2009),

“Diversity is related to business success because it allows companies to ‘think outside the box’ by bringing previously excluded groups inside the box” (p. 220). Organization success depends less on individual thinkers with high intelligence than on diverse groups collaborating and capitalizing on individuality (Herring, 2009). Specific to STEM, a diverse community of practitioners enriches science and creates a responsive market to a global pool of clients (Chubin, 2008). In addition, as STEM careers earn higher salaries, increasing the minority representation in STEM narrows the wage gap between individuals of color and white (Melguizo & Wolniak, 2012). Increasing the success of minority groups in STEM careers produces greater individual rewards and economic returns (Palmer, Davis, Moore III, & Hilton, 2010).

An effort to increase the number of qualified entering underrepresented minorities (URMs) in the healthcare field has become a national initiative (Sullivan, 2004). A diverse healthcare workforce creates an improved level of care and access to healthcare for underrepresented minorities and those of financial hardship and establishes a more culturally competent workforce and research community reflecting the actual population (Arora, Schneider, Thal, & Meltzer, 2011; Grumbach & Mendoza, 2008; Betancourt, Schneider, Thal, & Meltzer, 2002). Thus, diversifying the STEM workforce enhances not only the economy but also the healthcare of the nation.

To close the educational achievement gap and build undergraduate pathways to generate a highly skilled and diverse talent pool that meets the demands of emerging STEM fields, the implementation of workforce training programs at the post secondary level has risen (Riehle & Weiner, 2013). For the past 40 years, the implementation of federally funded minority research and training (MRT) programs has been used across U.S. colleges and universities as a method to patch the leaking science ‘pipeline’ (Shultz et al., 2011; Maton & Hrabowski, 2004; Barlow &

Villarejo, 2004). The National Science Foundation (NSF), National Institutes of Health (NIH), Howard Hughes Medical Institute (HHMI), and other federal agencies provide funding for the development of science support programs serving underrepresented racial minority (URM) students interested in pursuing a career in a scientific related field.

In 2004, the federal government spent \$2.8 billion on educational programs aimed at increasing the number of students in the STEM disciplines (U.S. General Accounting Office, 2005). The National Science Foundation alone spends roughly \$50 million per year to fund minority training programs (Guterman, 2007). In the last decade, the National Institutes of Health funded approximately 15,000 trainees per year with an estimated cost of \$650 million (National Research Council, 2005). In 2014, HHMI announced 37 universities would receive \$60 million in grants aimed at improving STEM education and graduation rates at U.S. colleges and universities (Howard Hughes Medical Institute, 2014). Recent political changes, however, endanger federal funding for workforce training programs serving URM students interested in pursuing a career in a scientific related field. President Trump's 2018 budget request calls for significant cuts on spending on scientific and medical research (Achenach & Sun, 2017). In fact, the administration proposes to reduce the overall National Institutes of Health budget from \$31.8 billion to \$26 billion and the National Science Foundation by \$776 million, an 11% reduction (Achenach & Sun, 2017).

These federally funded MRT programs provide a broad spectrum of educational activities, training opportunities, and professional experiences. Program components include, but are not limited to, undergraduate research, mentoring, academic and career advising, supplemental instruction, tutoring, social and community engagement, financial support, summer training opportunities, and graduate school preparation (Gándara & Maxwell-Jolly, 1999). The

National Institutes of General Medical Sciences sponsored Minority Access to Research Careers (MARC) and Initiative for Maximizing Student Development (IMSD), NSF sponsored Louis Stokes Alliance for Minority Participation (LSAMP), and HHMI's Medical Research Fellows Program are all sample programs with the same goal of strengthening the scientific pipeline by increasing the number of URM pursuing STEM doctoral degrees and research careers (Schultz et al., 2011).

1.1. Statement of the Problem

Although the numbers of science related degrees have slowly increased over the past decade, in part due to the utilization of MRT programs, this increase has not been adequate enough to establish an impactful representation in either academic or industry research careers (Schultz et al., 2011; Haring, 1999). Underrepresented minority groups comprised 28.5 percent of the national population in 2006, but 9.1 percent in science and engineering occupations. Underrepresented minorities comprise 17.7 percent of overall enrollment in science and engineering related graduate programs and only were awarded 14.6 percent master's degrees and 5.4 percent of doctorate degrees (National Academy of the Sciences, National Academy of Engineering, and Institute of Medicine of the National Academies, 2011). Success rates of some training and research programs have been marginal with an estimated direct matriculation into graduate research programs of no more than 50 percent (McGee & Keller, 2007). The purpose of this study was to examine the experiences of participants of federally funded minority research and training programs who matriculated into advanced level degree programs.

1.3. Significance of the Study

The results of this study add to the current body of knowledge examining enrichment activities, such as undergraduate research and training programs, and gauge its influence on

advanced science degree attainment and career choice of URM students. This information provides institutions and education programs with improved supports and resources necessary to better serve URM students with science majors and to enrich minority representation in academic or industry research careers.

CHAPTER TWO: REVIEW OF RESEARCH AND RELATED LITERATURE

Chapter two includes a review of empirical and related literature on undergraduate research training programs and its influence on participant enrollment into advanced science degree programs. The existing literature examines various support interventions often utilized in MRT programs. The second section of this chapter examines limitations of previous studies and the research questions that shaped this study.

2.1. Review of Research and Related Literature

Federally funded minority research and training programs aimed at increasing the representation of URM in STEM disciplines utilize interventions designed to increase student persistence towards the completion of doctoral degrees. Studies identify various support interventions influencing positive outcomes among students. These components include research experiences, social integration, mentorship, and financial support (Fagen & Labov, 2007; Gibau, 2015).

2.2.1. Research Experiences

The Council on Undergraduate Research (2017) defines undergraduate research (UR) as “an inquiry or investigation conducted by an undergraduate student that makes an original intellectual or creative contribution to the discipline” (para. 3). Undergraduate research in STEM disciplines is widely conducted at research universities and primarily undergraduate institutions (PUIs) across the United States as either course based inquiry or apprenticeship style experiences (Laursen, Hunter, Seymour, Thiry, & Melton, 2010). In apprenticeship style undergraduate research, often termed ‘faculty-led’ undergraduate research, students assist on a faculty member’s program of research and contribute to the research process in various levels of

involvement, such as entering data, caring for animals or equipment, locating resources, synthesizing information, problem solving, and interpreting data.

The Council for Undergraduate Research supports undergraduate research as a powerful learning strategy that will benefit students in their future careers and contribute to American innovation and economic development (Hensel, 2012). Undergraduate research provides a unique opportunity of learning through inquiry in a group setting (Riehle & Weiner, 2013). Studies indicate undergraduate research promotes continuous, collaborative interactions with faculty members (Webber, Nelson Laird, & BrckaLorenz, 2013) for a broad range of students (Hensel, 2012). Burke (2013) argued that true learning transpires with supervision from a faculty member who provides appropriate assignments demonstrating learning by a pedagogical foundation, and supplements the skills, abilities, and knowledge gained through practice.

Studies support undergraduate research as an effective practice improving student academic outcomes (Lopatto, 2010) and enhancing technical and scientific skills (Lopatto, 2010; Bennett & Bauer, 2003; Ishiyama, 2002). Undergraduate research helps students understand math concepts, think logically, and analyze literature and data (Janke, 2006). Students develop increased ability of acquiring and synthesizing data from diverse sources and independently solve problems (Bennett & Bauer, 2003). Undergraduate research promotes intellectual curiosity, foreign language skills, and adaptation to changing technology (Janke, 2006). Studies show UR can help students understand the value of teamwork and the scientific process (Hunter, Laursen, & Seymour, 2007; Seymour, Hunter, Laursen, & DeAntoni, 2004). Students gain experience in linking ideas encountered in the classroom to real world applications (Jackson & Moore, 2012; Villarejo, Barlow, Kogan, Veazey, & Sweeney, 2008; Levis-Fitzgerald, Denson, & Kerfeld, 2005).

Empirical studies also suggest positive effects of undergraduate research on college persistence and completion. Barlow and Villarejo's (2004) analysis of more than 300 students found participation in research activities improves completion rates and grades in science courses. URM students participating in research investigations establish stronger connections with their degree program and themselves (Lopatto, 2010), attain increased academic achievement, and are more likely to stay in a STEM major (Cole & Espinoza 2008; Ishiyama 2002; Nagda, Gregerman, Jonides, von Hippel, & Lerner, 1998). They also generate greater interest and commitment to pursuing a STEM graduate program (Eagan et al., 2013; Craney et al., 2011) and to attending graduate degree programs in the sciences at significantly higher rates than students who did not participate in undergraduate research (Slovacek, Jacob, & Flenoury, 2012; Foertsch, Alexander, & Penberthy, 1996).

2.1.2. Social Integration

According to Fagen and Labov (2007), social integration influences a student's sense of belonging to a larger community of scientists and his or her identity development as a scientist. Underrepresented students face many obstacles associated with the educational environment, including cultural and academic isolation, low expectations, and negative stereotypes, suppressing performance, and motivation. Researchers argue underrepresented students lack peer support and encounter unwelcoming classroom climates, particularly African American students (Carnevale et al., 2011; Sasso, 2008). However, studies suggest participation in research projects diminishes ethnic isolation along with other STEM barriers (Villarejo et al., 2008; Gasiewski, Garcia, Herrera, Tran, & Newman, 2010). Undergraduate research provides students with a rewarding, learning environment promoting self discovery, self expression, and appreciation of artistic, cultural, and creative differences (Bauer & Bennett, 2003).

Participation in MRT programs promotes a sense of science identity (Carlone & Johnson, 2007) and participants feel like they belong in science (Villarejo et al., 2008). According to Hurtado et al. (2009), initiatives geared towards URM students provide support systems through mentoring and peer relationships that accustom students to scientific norms and aid in the development of their science orientation. Research training opportunities allow undergraduates to develop competencies necessary to succeed as scientists (Seymour et al., 2004), and the space to envision themselves as scientists as they observe and work with faculty mentors and collaborate with other students (Eagan et al., 2013).

2.1.3. Mentoring and Advising

Empirical studies also examine the mentoring relationship between science faculty and students as an intervention for enhancing URM representation in the sciences. Engaged faculty mentors provide students with appropriate assignments demonstrating learning by a pedagogical foundation, guidance, advising, and support at critical decision points during a student's academic training. Studies suggest intrusive style advising in which mentors meet with students several times through out an academic year positively impact minority college students' success (Museus & Ravello, 2010; Tsui, 2007). Mentoring relationships positively impact higher academic performance and attendance and satisfaction among student participants (Linnehan, 2001; Tenenbaum, Crosby, & Gliner, 2001). A study by Kim and Sax (2009) reported that increased faculty and student interactions improved students' college grade point average for all racial groups of students, but was notably stronger among African American students.

In their study, Foretsch et al. (2000) examined federally funded summer research programs at 15 research universities; findings indicated the quality of the mentoring relationship between faculty and student was a crucial component to the summer intern's success in the

laboratory. Immediate and long-term benefits from effective mentoring also include increased preparation for graduate school (Luchini-Colbry, Wawrzynski, & Shannahan, 2013), clarification on future career options (Craney et al., 2011, Foretsch et al., 2000), and influence on educational trajectories (Witkow & Fuligni, 2011).

2.1.4. Financial Support

As college costs continue to increase, affordability is an issue for all students, especially for underrepresented minorities. Several studies indicated financial factors as one of the most reliable predictors in a decision to leave college among URM students (Perna et al., 2009; Hurtado et al., 2007; Maton & Hrabrowski, 2004). A study by the National Center for Education Statistics (2000) examined entry and persistence of women and minorities in STEM disciplines and found that student attendance, and persistence and degree attainment in science and engineering, positively correlated to receiving financial support. The National Research Council (2005) assessment of NIH funded minority research and training programs found financial support was a critical component to the success of students in biomedical and behavioral programs. Furthermore, evidence suggested financial incentives reduce attrition among low income and minority students when combined with academic support and campus integration programs (National Research Council, 2005).

2.1.5. Other Factors

STEM educational programs serve as an environmental factor supporting a student's career development, but other external factors have shown to influence a supportive or deterrent effect on student career decisions. Russell and Atwater (2005) examined 11 African American undergraduates majoring in biology at a predominantly white institution; one of the most critical factors in persistence in college was participation in advanced science courses in high school.

The participation in a college preparatory curriculum contributed to success in persistence from high school science into the college science pipeline at predominantly white institutions (Russell & Atwater, 2005).

Literature also showed the value of family involvement and support in a student's STEM persistence (Cleaves 2005; Russell & Atwater, 2005; Hrabowski et al., 1998). In a study by Jodl Michael, Malanchuk, Eccles, and Sameroff (2001), career goals among African American and white students can be predicted based on parents' educational values versus other interests, such as sports. Similarly, Stake and Mares (2005) found participants of a summer science program with encouragement from family, teachers, and peers were linked to a student's attitude towards science and their scientific abilities. Thus, Stake and Mares (2005) argued that the absence of support and involvement from significant people, such as family, could reduce a student's feeling of self-efficacy and cause him or her to be less likely to pursue a STEM career.

2.2. Limitations of Previous Studies

The literature focuses on research and training programs as an effective practice for STEM degree attainment and graduate school preparation. However, many studies examining participation of URM students in MRT programs utilize quantitative or a mixed methods approach, which may be influenced by the traditional scientific inquiry of researchers in STEM disciplines. Many of the studies utilize simple descriptive statistics with surveys to measure students' self reported gains (Laursen et al., 2010; Hunter et al., 2007; Lopatto, 2004; Seymour et al., 2004) and commitment to pursue a graduate level degree immediately following a research and training experience (Eagan et al., 2013; Craney et al., 2011). Quantitative methods can be ineffective when researching contemporary research issues or phenomena under study (Webster & Mertova, 2007). According to Webster and Mertova (2007), quantitative methods "frequently

tend to overlook complex issues, which are, for instance, considered significant by the participants in the research” (p. 3). For instance, studies that use graduate student attendance data to promote the value of undergraduate research experiences are unable to demonstrate the research experiences, or other factors, as the cause of continuance into graduate school (Mabrouk & Peters, 2000; Manduca, 1997).

Narrative inquiry provides a rich framework in which researchers study how people experience and perceive the world through their stories (Webster & Mertova, 2007). Narrative analysis allows researchers to hear the multiplicity and complexity of student experiences and focuses on participants’ self generated meanings (Esin et al., 2014). Narratives reveal information about the inner world of the storyteller and the identity, intentions, and feelings of the person telling the story (Murray & Sargeant, 2011) and open a space for researchers to analyze participant experiences related to social issues, such as social inequalities and gender relations (Esin et al., 2014). Unlike quantitative based surveys, narrative inquiry embraces a culturally responsive approach that explores the social context and culture in which the experience took place and in which the knowledge was constructed (Webster & Mertova, 2007).

Only a few qualitative studies exist that capture participant voices during their participation in MRT programs (Hurtado et al., 2009; Johnson, Brown, Carlone, & Cuevas, 2011; Dickens, Levinson, Smith, & Humphrey, 2013; Gibau, 2015). Gibau’s (2015) qualitative study examined the experiences of student participants of an MRT program. Gibau (2015) emphasized the importance of incorporating student voices to understand the experiences of URM students and to examine types of interventions that may or may not work at an institution. Narrative style data was extracted from past program evaluations and analyzed for common themes. However, this study examined experiences of undergraduate students during their

participation in a graduate level MRT program, and utilized a qualitative, narrative-rich approach to explore the experiences of alumni of an undergraduate minority research and training program.

2.3. Research Questions

The questions addressed by this study were: What are the experiences of students who participated in an undergraduate minority research program? Which experiences were most critical to their persistence into graduate school?

CHAPTER THREE: RESEARCH METHODS

Chapter three defines constructivism as the philosophical foundation of this study; constructivism promotes an inquiry design focusing on meaning making through co-constructed narrative between the researcher and participants. According to Stake (1995), case studies are effective for describing and expanding the understanding of a phenomenon and are often utilized in studying people and programs in education. This study utilized a multiple case study featuring extensive use of narrative to generate a thick descriptive environment (Creswell, 2014). A multiple case narrative approach collects information and provides an in depth analysis from multiple people as part of one research project (Shkedi, 2005). Thus, this study provides a constructivist understanding of the multiple perspectives of students who participated in a minority research program and matriculated into graduate programs.

3.1. Philosophical Foundation

In postmodern constructivism, knowledge does not exist in a state pending discovery but rather is constructed by humans through interactions with the world (Gordon, 2009). Thus, learners construct their personal knowledge as a result of reflecting on experiences (Doolittle & Camp, 1999; Driscoll, 2005; Splan, Porr, & Broyles, 2011). The epistemology of constructivism, the method of acquiring knowledge, is both subjective and relative because “although reality may exist separate from experience, it can only be known through experience, thus resulting in a personally unique reality” (Doolittle & Camp, 1999, para. 14). Thus, no single truth exists but rather multiple truths are constructed through personal, active experiences. Under constructivism, an individual acts as an “active agent seeking order and meaning in social contexts where his or her uniquely personal experiences are challenged to continue developing” (Mahoney, 1996, p. 5).

The participatory epistemology of constructivism supports individuals as proactive agents constantly creating new and unique ideas. Knowledge becomes an invented and meaning making process in which individuals seek existence. Constructivism emphasizes the interaction between researcher and participant for the construction of meaning (Mills, Bonner, & Francis 2006; Hayes & Oppenheim, 1997). With narrative research, the sharing of stories with researchers provides a way of understanding people's interpretations of their own worlds and important life events (Murray & Sargeant, 2011). The stories shared represent participants' meaning making and how they select what to tell an audience, which may include societies, cultures, families, and other influential events in their life (Josselson, 2011).

3.2. Research Design

To examine the experiences of students who participated in a minority research and training (MRT) program and matriculated into graduate programs, the researcher utilized a multiple case study featuring extensive use of narrative to generate a thick descriptive environment (Creswell, 2014). Qualitative research provides the flexibility needed for participants to retell their stories in a meaningful form through narratives rather than numbers, and still to employ a systematic approach to gather empirical evidence (Denzin & Lincoln, 2008). The constructivist paradigm recognizes the complex nature of multiple realities in which 'reality' is constructed through personal, unique experiences. In qualitative research, instead of trying to capture 'truth' and generalize and predict 'truth' for a larger population, the researcher tries to understand how participants' social reality is constructed. A multiple case narrative approach collects information and provides an in-depth analysis from multiple people as part of one research project (Shkedi, 2005). Since qualitative interviews are natural extensions of conversations, interviewees become "partners in the research enterprise rather than subjects to be

tested or examined” (Rubin & Rubin, 2005, p. 12). Thus, this study promoted an inquiry of context-focused meaning making through co-constructed narrative between the researcher and participants.

3.3. Population of the Study

3.3.1. Institutional Setting

This study examined participants of a minority research and training program; understanding the institutional context in which students attended was important as it may have influenced their responses. Located in the southern region, the research site was a doctoral degree-granting institution with extensive research activity and a student population of about 30,000. The state in which the institution is located has one of the largest minority general populations in the United States with 32% African American (U.S. Census Bureau, 2015). Although home to a diverse population, many of state’s institutions were not truly integrated until the late 1960s and early 1970s. Despite a state population of 32% African American and a city population of 50% African American, the institution’s 2016 student enrollment was 70% white, 12% African American, and 6% Hispanic/Latino/a. Thus, the research site constitutes a predominantly white institution (PWI).

3.3.2. Program Description

The MRT program selected for this study was funded by a national agency through a competitive grant in which an academic institution may seek funds for program development increasing doctoral level minority researchers. Established in 2004, the program’s mission is to provide a diverse group of undergraduate students in the biomedical or behavioral sciences research training, academic development, and career opportunities while enhancing diversity in the sciences. The program’s vision is to produce graduates who rank among the most talented

research scientists in the nation, who pursue research careers and leadership positions, and who become the most desired candidates nationwide for entrance into doctoral or post doctoral programs.

The MRT program selected 20 undergraduate students per year. During the academic year, participants conducted research under a faculty member for 15 hours per week, received wages and travel expenses to attend and present research findings at scientific meetings, attended bimonthly educational activities and seminars, and received regular academic, career, and personal counseling. Undergraduate student eligibility for admittance included:

- US citizens or lawfully admitted for permanent residence.
- Majoring in the natural, physical or behavioral sciences relevant to biomedical research and planning to enter a doctoral program in the biomedical sciences directly upon graduation.
- Competitive grade point average, good academic standing, and graduating within three years.
- Individuals from underrepresented racial and ethnic groups (defined as Blacks or African Americans, Hispanics or Latinos, American Indians or Alaska Natives, Native Hawaiians and other Pacific Islanders), individuals with disabilities (defined as those with a physical or mental impairment that substantially limits one or more major life activities), and individuals from disadvantaged backgrounds.

3.4. Participant Selection

After receiving institution review board approval (IRB# E10455), the researcher invited all former students who participated in the MRT program at the selected research site. This study employed purposeful and homogenous sampling procedures. From those who responded,

10 participants, five females and five males, were purposely selected based on varying career timelines and paths. Purposeful sampling entails selecting participants from a known sample rich with useful data for a specific study (Patton, 2002). Purposeful sampling was utilized for this study to include participants from various STEM disciplines, gender, graduation cohorts, and career paths. The researcher wanted to include five female and five male participants from various STEM disciplines, including biological sciences, chemistry, engineering, and animal science, and various graduation cohort groups. Of the 10 participants, two earned their bachelor's degree between 2007-2009, four earned their degrees between 2010-2012, and four between 2014-2016. The majority of the participants who responded for the study were African American and one Hispanic/Latino. Of the 10 participants, five were African American females, four were African American males, and one Hispanic/Latino male.

This study also employed homogenous sampling in which participants with similar characteristics were selected. Through homogenous sampling, the researcher can understand an experience shared by participants while also comparing and contrasting those experiences (Glesne, 2011). All 10 participants partook in the MRT program for at least two consecutive semesters, identified as a member of an underrepresented group in the sciences, and enrolled into advanced level degree programs, including masters and doctoral level degrees.

3.5. Data Collection

Data collection for this study began during the Spring 2017 semester from May 2017 and continued until August 2017. The researcher utilized data from multiple sources, including participant interviews, documents from the MRT program, and a researcher journal. The use of multiple sources of data adds to the richness of the study and offers a means of triangulating the data gathered in the interviews (Creswell, 2014). Triangulation entails the use of more than one

method to gather data, such as interviews, observations, questionnaires, and documents, to ensure study trustworthiness (Creswell, 2014).

3.5.1. Interviews

In Gibau's (2015) qualitative study, graduate student experiences were explored through narrative data extracted from archived program evaluations. In keeping with a constructivist approach of meaning making, this study captured student narratives from in-depth interviews between the researcher and participants. Due to geographical locations of the participants, individual interviews were performed online via WebEx videoconference software. Interview times varied in length and by participant. Some interviews lasted approximately 45 minutes while others were shorter. In keeping with the character of qualitative research, the researcher used an emergent design that allowed for the nature of the questions to evolve and shift in accordance with emergent themes and patterns. The researcher used unstructured, conversational style interviews to promote storied responses. Unlike structured interviews that tend to control conversations and skew towards the interest of the interviewer, nondirective interviews are informal and conversation style aimed at gathering in depth information (Gray, 2009). Unstructured interviews occur when the researcher creates questions during the interview without predetermined set of questions (Glesne, 2011; Gray, 2009). For this study, each dialogue began with one broad, open ended prompt, "Tell me about your college experience", to initiate storied responses. As each interview unfolded, non-predetermined follow up questions were asked, encouraging continuous narratives and further investigating emerging themes. Examples of follow up questions or prompts used during the interviews included:

1. Tell me about when your interest in science started.
2. Describe your decision making process to attend college.

3. Walk me through an event where you believed you were treated differently.
4. Tell me more about the individuals who influenced your decision to attend graduate school.
5. What are you are doing now since you have graduated?

3.5.2. Archival Documents

The second source of information consisted of documents from the MRT programs' annual progress reports. The MRT program administrator submits progress reports to the sponsoring agency annually during each four to five year funding cycle (2004 to 2008, 2009 to 2013, 2013 to 2018). In qualitative research, documents allow the researcher to distinguish patterns with another data source for comparison and triangulation with what participants share about their experiences (Freeman, deMarrais, Preissle, Roulston, & St. Pierre, 2007) contributing to graduation and graduate school enrollment. Progress reports include materials from program evaluations, student participation and research activity, academic achievements, and general program outlook.

3.6. Data Analysis

The use of traditional coding and developing themes was utilized to analyze the qualitative database (Stake, 2006). The narrative framework included vignettes about each case and cross case analysis of the codes, themes and categories. Interviews were then recorded and transcribed verbatim by the researcher. The researcher cleaned the data by assigning pseudonyms, fictional names, for each participant and removed identifiable information, such as school and family names and cities (Kaiser, 2009). Selected pseudonyms were discussed and approved between researcher and participants. Initially, individual narratives were described, but not analyzed, allowing the researcher to focus on individual cases and provide an in-depth

portrait of each participant. Each vignette includes fully illustrative quotes from the participant's shared experiences, events, and thoughts. In vivo codes were created directly from the language of each participant to create a vignette and introduce the readers to each case. According to Saldaña (2009), in vivo coding "refers to a word or short phrase from the actual language found in the qualitative data record" (p. 74). Thus, specific words or phrases used by the participants became semantic units of meaning without descriptive labels assigned by a researcher.

In order to identify common themes and variations that also represent individual narratives, analysis included cross case coding (Stake, 2006; Ayres, Kavanaugh, & Knafl, 2003). The individual profiles aided in the discovery of what Seidman (1998) referred to as "connective threads" among the participants (p. 110). According to Ayres et al. (2003), "A qualitative researcher must distinguish between information relevant to all participants and those aspects of the experience that are exclusive to particular informants" (p. 871). Thus, individual vignettes identified unique aspects of individual experiences and cross case analysis identified variations and common themes across groups. According to Saldaña (2009), a second cycle of coding means reorganizing codes into meaningful categories. In the initial phase of coding, the researcher created in vivo codes unique to each participant. During the second coding cycle, pattern coding was utilized to connect material across participants into more meaningful units of analysis (Miles & Huberman, 1994). The descriptive codes from each interview were divided into categories according to word and phrase repetitions and organized by hand on a large wall chart. The researcher reduced codes into the most salient categories relevant to this study. After close examination, the researcher identified several similar themes and events. All categories were combined into four meta-categories: belonging and inclusion, near peer mentoring, confidence in science, and family influence. Supportive information from the four meta

categories included selected fully illustrative quotes from the participants formatted into tabular format and conventional paragraphs.

3.7. Trustworthiness

3.7.1. Credibility

According to constructivist approach, research does not aim at uncovering a “grand scientific ‘truth’ but, rather, at exploring the question of meaning-in context” (Shkedi, 2005, p. 180). Truth explores the perceptions and understandings of a phenomenon under examination. In order to ensure credibility of interpretation, the researcher preserved the chain of evidence collected during each analytical step (Shkedi, 2005). Preserving all transcribed documents and notes protects the researcher from misleading voices and inaccurate interpretation (Shkedi, 2005).

Additionally, the researcher utilized member checking. Member checking consists of “taking data and interpretations back to the participants in the study so that they can confirm the credibility of the information and narrative account” (Creswell, 2014, p. 127). To ensure findings represent the experience of the participants, some respondents participated in follow up discussions involving the verification of emerging theories and inferences formed during the dialogues. Furthermore, a thick descriptive report with contextual information and proper quotations from participants strengthens the persuasiveness of reasonable and valid conclusions (Shkedi, 2005).

3.7.2. Dependability

Reliability in a positivistic approach examines if a research procedure yields similar results when repeated with the same methods and participants. However, in constructivist research, every narrative claim is unique and may not be replicated at a different time or context

(Shkedi, 2005). To address the dependability of a study, however, this researcher demonstrated a comprehensive research design and maintained a chain of evidence in the final report, including data gathering details, and sufficient and accurate citations, allowing the reader to assess the research practices followed (Shkedi, 2005; Shenton, 2004).

3.7.3. Generalization

Generalizability, the degree in which inferences from a study can be generalized to the general population, is often considered a criterion for evaluating the quality of a study (Kerlinger & Lee, 2000). However, with qualitative research, the goal is to provide a rich, in-depth understanding of human experience through the examination of particular cases. According to Stake (1995), the reader of the research, not the researcher, decides which aspects of a case narrative apply to new contexts. Furthermore, multiple case narratives provide more options for generalization than other qualitative research strategies due to the wide range of participants involved (Shkedi, 2005).

CHAPTER FOUR: CASE NARRATIVES

Chapter four includes vignettes with fully illustrative quotes, experiences, events, and thoughts shared by each participant during their interviews. Each vignette contains in vivo codes directly from the language of each participant to organize their narratives and introduce readers to each life event or thoughts. Participants expressed their perceptions and experiences starting with their decision to attend college and continuing throughout their undergraduate studies. Each vignette includes extensive quotes of the participants' own voices, illustrating their undergraduate experiences, and factors influencing their career and academic development. After each case, information collected from archived documents provides additional information pertaining to student participation, research activity, and academic achievements during their undergraduate studies to provide a more full portrait of each participant.

4.1. Bethany

4.1.1. Narrative

In August 2008, Bethany, a 25 year-old African American female, earned her bachelor's degree in biology. Bethany's passion for science evolved at a young age. Bethany stated, "Ever since I was a kid I had a desire for science. I loved science." Her interest was sparked during middle school when she took an elective marine biology science course. Bethany described an event involving the dissection of a baby shark in the class. Bethany claimed, "After that experience, the strong interest in science shocked me. I was like, wow! This is something interesting." She knew from that moment she wanted to pursue a science-related career as either a veterinarian or pediatrician.

"Get out". Bethany reflected on her childhood as growing up "in the heart of the city, the poor area of town." According to Bethany, "Where we grew up one of two things could happen;

some people can get into that life and think that's all they can do or they could say their life is not what they want it to be and choose to fight against it." Despite financial hardships, Bethany reflected on the positive influence her family had on her educational success. According to Bethany:

I would say for me and my siblings we chose to not stay, and I would attribute that to being... that my parents said, "Get out of this.. you don't have to stay like that"... My parents instilled in us education is important. They pushed that we would go to college and do well in school. My parents were like, "You need to get an education, you need to get some type of training." My family pushing education as being very important is the reason why I'm here.

Through hard work and support from family, Bethany attended a magnet, preparatory high school and it was from there she decided to go to college.

"I couldn't leave". Bethany credits her parents for instilling the importance of education and for her going to college. When it was time to go to college, her family further influenced her decision to stay close to home. According to Bethany, "My mom told me I couldn't leave the state... [laugh]. I'm the oldest and the first to leave for college so it was a challenge," Bethany stated with a loud laugh. She continued:

So, I had to pick schools in the state and I applied to five schools... my first choice though was another University because I heard they did a good job in, uh... putting African Americans into the medical field ... so I applied there and I got accepted but ... it was just the cost ... it was just too much. We were just having some financial issues at home and it was just better if I stayed at home and went to school.

Due to family influence and financial hardship, Bethany decided to attend the state's flagship institution located within 15 miles of her parents' home.

"Positive environment". Bethany described her undergraduate experience as "different from most other students." When asked to explain further, Bethany claimed:

I don't know if I can give a good representation of it because I wasn't social ... I just wasn't so ... uhm ... I saw a lot of people doing some stuff ... A lot diverse, you know, things going on but I just didn't participate in them a lot. I just came to school, stayed in the lab or did whatever I had to do with my course work, either study and then went home.

Bethany further stated, "I did not do a lot of partying and stuff. I stayed on campus a lot. I chose not to do the extra or go home. [long pause]... Home wasn't some place I wanted to be. I wanted to stay in a positive environment. I was a very introverted person." Bethany explained about the day she learned about the MRT program, "I saw a flier on a bulletin board or elevator. I was also talking to other students and thought it would be a good opportunity." Bethany's main interest was in medicine but was open to the idea of research.

Bethany described that socializing during her undergraduate years mostly involved her research experience. Her research experience as "an outlet that allowed me do something I liked to do, which was research discovery." With a large smile, Bethany expressed her experience in the research laboratory as "wonderful". She worked directly with her research mentor, doctoral students, and research technician. Bethany claimed, "They took me under their wings. They really took care of me. If I had any questions, I could ask anybody. I really loved my experience."

“Time to regroup”. Despite a positive research experience and a passion for research discovery, Bethany did not immediately pursue a doctoral program upon graduation. Bethany explained, “... at that time when I graduated I knew I was going to take a break, uhhh ... I needed to cause I was just mentally exhausted.” Instead, she pursued a concentration in education and became a sixth grade science teacher at a local school where her mother also worked. Bethany thought the teaching experience gave her an opportunity to “inspire other people to love science at the same age and be eligible for loan forgiveness.” Bethany’s original plans included teaching for five years and getting a master’s degree. However, Bethany did not enroll in a master’s program and started believing she “couldn’t go to grad school because I didn’t feel like prepared. I’d been out of school for so long.” According to Bethany, it took six years of teaching and convincing herself to apply. After her sixth year of teaching, she enrolled in a doctoral program outside of the state but in the southern region. Pursing a career immediately following graduation allowed Bethany “time to regroup from undergrad in which I’d become burned out and to work on my financial situation as well.” Bethany was in her third year of her doctoral program at the time of this study and hoped to pursue a research career after graduation.

4.1.2. Archive Documents

Bethany joined the MRT in 2005 during her third year of undergraduate studies. While in the MRT, Bethany conducted research with a faculty member in the Department of Biological Sciences during the nine-month academic year. She presented her research projects at two conferences: a poster at a regional conference and a podium presentation at a national conference. In 2007, Bethany published her first peer reviewed journal article as third author. She completed her Bachelor of Science degree in biology in August 2008 within five years.

4.2. Lenny

4.2.1. Interview

Lenny, a 25 year-old African American male, was originally from a small town and was a first generation college student. Both of Lenny's parents had some college experience but did not earn a college degree. Lenny originally wanted to be a physician as a child but "fell in love with chemistry in high school." After taking the junior level chemistry class, Lenny enrolled in the Chemistry II Advanced Placement his senior year and had the opportunity to work independently and perform experiments. After that experience, Lenny knew chemistry would be his designated major in college. Lenny stated, "I think I have a natural interest in chemistry. I don't think if I had to go back and pick something else to do, I don't know if I'd be able to pick something."

"Culture shock". Lenny started his undergraduate studies at a smaller state institution but transferred after his freshman year when rumors started that the chemistry and physics programs were dissolving due to budget cuts. Lenny transferred to a larger university closer to his home and described the university as:

Ohh, it's all big, you know, you're just a number but I didn't feel that way. I felt like I was granted the opportunity to have a relationship with all of my professors. It's there if you wanted it and I never had any bad experiences in the classroom even with 700 people.

Although experiencing a "culture shock" moving from a smaller institution to a larger one, Lenny thought making friends in his classes and talking to professors smoothed the transition. Lenny stated, "The instructor-student relationship was there if you really wanted it. I had a very

positive undergraduate experience ... I studied in a world-renowned department and had excellent instructors and classmates.”

“Felt welcomed”. Lenny applied to the undergraduate research program his junior year after a friend in the program encouraged him to apply. Once accepted, Lenny joined a research group in the Chemistry Department. When asked about the lab environment, Lenny replied:

I loved the lab environment. I felt welcomed as soon as I joined ... My advisor told me to make myself at home. When I arrived to the lab my advisor, he just sent me over so I had to introduce myself to all the graduate students and they all welcomed me.

Lenny described the laboratory as his “social network”. He explained how the laboratory provided a space for friendships with fellow students. Lenny stated, “I didn’t have many friends in college. I saw other students in my classes but it was my lab mates I enjoyed being around.”

“Mini graduate student”. Lenny described his role in the research laboratory and the research expectations placed on him by his research advisor. He highlighted the limited level of interactions between him and his research advisor. Lenny continued, “When I went to him for questions he was like, ‘Did you follow the policy? Did you ask three other people before you come in?’ He treated me like a graduate student.” Lenny explained his initial research projects were “off to a slow start cause I was on my own and didn’t receive much help.” Lenny then stated, “After a while I started collaborating with the graduate students, you know, and got my project off the ground. We worked together as a team supporting each other.” He described his participation in the research group as a “mini graduate student” and his contributions to research had potential to be very beneficial to the group.

“Feel like a scientist”. Lenny acknowledged his undergraduate research as an impactful experience during his undergraduate studies that influenced his decision to pursue graduate school. According to Lenny:

I got to include pretty much multiple things I’ve learned in undergrad whereas if you don’t do research, you kind of just forget it along the way. You kind of get to learn how to be a scientist and feel like a scientist in undergrad, as far as figuring things out and what not ... I’ve written abstracts on my own. I’ve done pretty much all my research on my own except use instruments that I couldn’t use alone.

Lenny added, “I went to a few conferences and I felt pretty good about it and I think that’s when I really realized I wanted to go to graduate school.”

“Prepared me well”. Lenny compared his college experience with research as a beneficial opportunity to gain scientific knowledge and techniques that many other students do not have. Lenny claimed, “Compared to those who didn’t, they didn’t get that experience so they just you know when they get a job or something else that’s their first time getting to be on their own figuring it out.” Lenny expressed an academic advantage over students who did not participate in research and felt more competitive for future jobs.

For the previous years, Lenny pursued a career at local chemical companies. Lenny discussed how his undergraduate research experience prepared him for his career. Lenny stated:

As far as like instrumentation and figuring things out and even working well with others, I think it prepared me very well. My bosses- I’ve had three different jobs since I’ve graduated from undergrad- all commended me on how well I work with others and how I have good leadership skills and how I figure things out and get things done.

Although happy at his current place of employment, Lenny stated, “I have not reached my ultimate career goals, which undergraduate research has greatly influenced.” Lenny expressed his strong interest in earning a Ph.D. in Chemistry and pursuing a career in academia. He applied to eight different graduate programs, all located in the southern region of the United States. This past summer he received official acceptance into a doctoral program in chemistry at the same institution he earned his bachelor’s degree. Lenny stated, “I was very excited. It feels great knowing my hard work is paying off plus being able to reconnect with the same people.”

4.2.2. Archive Documents

Lenny joined the MRT program in Fall 2012 during his junior year. He conducted research in the Department of Chemistry under the same faculty member for two years. Lenny attended and presented his research at one regional and one national conference. He earned a Bachelor of Science degree in chemistry in December 2014 with a graduation rate of four and a half years.

4.3. Anna

4.3.1. Interview

Anna, an African American female in her mid twenties, was born and raised in an urban area near campus. She attended the local magnet high school and knew college would be her next destination. According to Anna, “The decision to go to college for me, uhm, ... was not an option. My parents wanted me to go to college.” However, the college path was not an easy journey. Anna explained how her parents did not attend college and so “it was hard to navigate exactly what I wanted to do. I didn’t know what to major in or what majors were available outside of doctors, lawyers, and teachers.” It was not until an eleventh grade physics teacher discussed STEM disciplines as a viable career option. “She said STEM is a lacking area in terms

for minorities and maybe I should take a look into it,” Anna stated. Anna began doing research on various STEM disciplines and concluded:

I knew I didn’t want to do math but engineering was a possibility. Technology, I was like, do I really want to sit in front of a computer and deal with that kind of stuff all day. I knew I didn’t like biology because I didn’t it in high school. So, that left chemistry or engineering.

Through her independent research, she came across a research and training program for incoming freshman interested in STEM disciplines and the program director’s chemistry faculty webpage. Anna stated, “I saw he was a chemistry professor and worked with nanostructures. The images looked cool even though I didn’t know what they meant. So, I decided I would do chemistry.” With assistance from high school counselors, Anna applied for the research and training scholars program at the university. With much surprise and excitement, Anna was accepted into the university and was awarded the research scholarship. Anna explained:

I honestly didn’t think I would get it but I took a chance. Then I got an email that said, ‘You have been selected come in for an interview’. I was excited. Then I got accepted into the university. That was cool as well. When I opened the envelope confetti came out and it was like congratulations you have been accepted for the 2006-2007 school year and so I was like, ‘Yeah!’

“Helped me transition”. Anna credits the undergraduate scholars program for assisting in the transition into college. She discussed the summer bridge experience in which scholarship recipients had to stay on campus and acclimate to the campus prior to freshman year. Anna stated:

For me, not only being the first in my family as a college grad and never been on a college campus, never been on a campus being a minority to say the least on a campus that large. So basically, it helped me transition into college life which I really needed otherwise I would have never been ready for school.

“Often on my own”. When asked to describe the campus climate, Anna described the environment as different compared to her high school. Anna described her high school as rich with diversity with individuals from different cultures, ethnicities, and religions. However, when she arrived to campus, Anna did not witness the diversity she was exposed to in high school and at times felt isolated. Anna stated:

One thing that did get me at the end of the day was when I walked into a classroom and only seeing myself as one of the few minority students. Or in my chemistry classes I may be the only minority student. Sometimes I thought of it as a great way to defy the odds but then I really had no one that can relate to me. There were in their cliques and friends and I was often on my own trying to figure out things you know.

Although recognized as a minority, Anna shared how she never experienced any negative interactions with students. She claimed, “We all came up together and thought this is a generation, we are in it together.” However, Anna discussed how interactions with university personnel were not as supportive. Anna stated, “I did experience issues with faculty and staff with them paying more attention to my white counterparts.” In response to feelings of exclusion, Anna then sought advice and assistance from mentors on how to approach situations.

“Community of mentors”. Through her early years of undergraduate studies, Anna joined other STEM programs, including the MRT program. Anna described her experience with

these programs as a “community of mentors” that helped her throughout her undergraduate studies and onto graduate school. Anna stated:

They accepted me with open arms. I got involved with basically the whole community of mentors and the guidance got me where I am here today. You know there were times along the way I felt like I could not do it. I would break down and cry wanting to give up. I had teachers and advisors tell me I wouldn't make it because I couldn't make the grades. My mentors held my hand and watched me cry. They would be like, 'Look you can cry it out but you are going to do it. You are going to make it.' Through that and fostering of mentors and the support group of people knowing I can do it really helped me get through the process. Of course, I had my parents in the background saying you can do it, you can do it, but I couldn't go to them for technical stuff. So, it took the people in these programs to deal with issues, deal when people who told me I couldn't do it because I couldn't pass physics.

Her mentoring experiences during her undergraduate studies not only motivated and guided her through college but also inspired a career in helping others. When asked about her future, with a big smile Anna expressed interest in pursuing a career helping students like her. Anna stated:

I want to be doing something I love. I want to make an impact. I want to piggyback on the mentoring thing. It really stuck with me. I want to be in a position where I can give back. People told me I wouldn't make it. I had people take a chance with me and look where I am now. So many students are misguided like that. I want to set myself up so I can help student like I was.

Anna plans to complete her doctoral degree in chemistry in December 2017 and seek a position in academia for MRT program development and management.

4.3.2. Archive Documents

Anna started the MRT program in 2009 during her third year of undergraduate studies. She conducted research in chemistry with one faculty member for three academic years. Anna presented her research at three national conferences and one regional conference. She earned second place at a poster competition at one of the national conferences. In 2011, her research contributions lead to a first author publication in a peer-reviewed journal. Anna earned her bachelor's degree in chemistry with a minor in dance in May 2012 with a graduation rate of six years.

4.4. Charles

4.4.1. Interview

Charles, a 27 year-old African American male, grew up in the gulf south region and acquired a passion for animals at a young age. In middle school, Charles volunteered his summers at a local zoo. His dedication to volunteering earned Charles a paid internship through his high school years at the same zoo. Because of his strong interest in animal care, Charles decided to enter the pre-veterinarian program in college with hopes of becoming a veterinarian. However, after working at a veterinarian clinic during his undergraduate studies, Charles decided he did not want to pursue veterinary school but rather get a doctoral degree in something different. Charles changed his pre-veterinarian program to an animal science major.

“Double edged sword”. Charles described his undergraduate experience as “an interesting one”. He described classes as small with limited availability of class sections. Charles explained how he would see the same 15 to 20 students in most of his classes. He described the campus as large yet the class enrollment made it also feel small. Charles explained

how the small classroom environment was beneficial at times but also produced feelings of exclusion. Charles stated:

You know there weren't many black people in my program so I knew every black person in my program. It was different because sometimes I had to wear boots and overalls [laugh] and mess with horses and pigs and stuff. So that was cool and different. It was a double edge sword. On one hand, you knew every person you can relate to because they look like you so you can study together. But at the same time there wasn't a whole bunch of people willing to study with you.

When asked how this experience impacted him, Charles responded:

I don't know. It's [pause] hard. I don't think it impeded me but I never thought about it. I never truly felt ostracized or discriminated against but I think it was a different layer of school but it didn't impact my learning.

Although Charles never felt direct discrimination, he sometimes felt unwelcomed or excluded by classroom peers.

“Real world”. Charles further described the campus environment as a “real world experience”. He explained, “Some smaller schools have family feel vibes and that was definitely not the case which I appreciated that. No one was there to hold your hand and so it made you go after opportunities.” Charles described the importance of self-motivation in order to achieve success. He believed the larger school forced him to acquire skills and perseverance that are currently essential in his professional career.

“See me succeed”. During the interview, Charles discussed influential people during his college experience. Charles discussed the influential impact of his family and church on his college success. Charles stated, “My church as a whole because I was the church's boy because

everybody put their expectations on me. On one hand, everyone wanted to see me succeed but it was also rough because everyone pins their hopes and dreams on your success.” Charles explained how he felt the support and encouragement from his church and mother but also the pressure to succeed in fear of disappointing the community.

“Realized I didn’t want to do research”. Charles briefly discussed his undergraduate research experience but mainly emphasized how the experience clarified his career goals. Charles stated, “I did participate in undergraduate research but I realized I didn’t want to do research. It’s very tedious. I prefer more hands on work. I understand the importance of research but I didn’t want to pursue a research focused program.” He described the experience as “really cool and fun” and “doubled my knowledge in science” but explained how the experience clarified his career aspirations. After graduation, Charles enrolled in a master’s degree program in Environmental Management and Sustainability.

4.4.2. Archive Documents

Charles joined the MRT program in the Fall 2009 semester during his senior year of college. During his participation, he conducted research in a laboratory at the School of Veterinary Medicine in the Department of Pathobiological Sciences with a faculty member for two semesters and presented a poster at a local conference. In 2010, Charles earned a bachelor’s degree in animal science with a four-year graduation rate.

4.5. Patricia

4.5.1. Interview

Patricia, an African American female in her mid twenties, grew up in a large city along the Gulf Coast with her mother, father, and sisters. Patricia’s parents both went to college and her sisters earned graduate level degrees. She discussed how education and learning were strong

foci in her upbringing. Patricia shared how her mother would only buy her and her sisters educational toys and encouraged learning things outside of what they would normally consider. Patricia stated, “Science was not a shock to me. Science itself was never like ‘this is really cool’ because we were always exposed to it in childhood.” However, Patricia did share how exposure to chemistry sets, microscopes, and telescopes sparked her interest in science at a young age.

“Opened my eyes”. Patricia explained how going to college was something she never thought about other than a continuation after high school. She stated, “I just always knew it was something to do kind of like you wake up and brush your teeth every morning and go to school to learn. So, I never had a moment of contemplating if I should go or not.” Even though college was the next natural step in education, Patricia explained how the experience impacted her as a person. Patricia explained:

Going to college actually opened my eyes to different things in the world like how to critically think, how to make friends, and behave in certain situations. I can’t say if I would be a different person if I didn’t go to college but I definitely think it helped shaped my worldview.

“Almost felt home”. Patricia wanted to go away from home but not too far so she decided on the state’s flagship institution about 60 miles from her family home. She initially wanted to become a veterinarian and thought the large university was the smartest choice. She described the campus as a “very welcoming, friendly environment”. According to Patricia, “I didn’t have many friends [in high school] because I couldn’t connect with many people.” However, in college, Patricia explained, “There’s so many different people you can be friends with and meet and talk with. I really enjoyed the community aspect of it.” She explained how

the large campus provided an opportunity to meet new people that share common interests and views.

“Felt confident and sure of myself”. During her interview, Patricia expressed her development of confidence and independence throughout her undergraduate experience. Patricia described herself as “always been independent and big headed”. She explained, “In the classrooms it wasn’t very intimidating. I thought with the large classrooms I would feel like a small fish but I always felt confident and sure of myself.” She also highlighted her sense of confidence when describing her undergraduate research experience. Patricia explained:

Before I started research, I thought, ‘This is so intimidating.’ But then when I did that I was like, ‘Hey, I can do this. This isn’t bad at all’... Being able to do the experiments and do them well and correctly and also write the paper was a good experience for me ... It was a pivotal moment when I was like I can do this.

Patricia described her scientific knowledge as “extensively greater” than those who did not participate in research experiences. Patricia stated:

I can’t explain the divide in the people I see whether be comments on Facebook or just discussions I have with friends on their views on climate change, evolution, GMOs ... I see a huge, huge difference between me and people who haven’t had an extensive research background.

“Here I feel like an outsider”. Patricia described a positive and confident undergraduate experience. However, her experiences during graduate studies revealed a different perspective. Patricia reflected on her current location in the northeast region and how her recent experiences on a different college campus as a graduate student changed her perspective on her undergraduate experience. Patricia stated:

Although you are a technically a minority student in the South, there's a large population of black people and other types of minorities because I never felt out of place. When I went to the dorm I saw black people. When I went to church I saw black people from the community. I never felt for once I was an outsider although statistically I was. The culture in the South we get a bad reputation but different people have lived with each other for so long there's a commonality and respect and understanding to an extent. Here [the northeast region] I feel like an outsider. My friends and I talk and agree racism here is not the same as racism there [the South] for sure. I think it's really because of lack of exposure.

Patricia described recent events where her presence on a different college campus made her feel unwelcomed. Patricia shared:

I'll walk in a building and they will ask, 'What you are doing there?' I'll be like, 'I'm a graduate student' and they will be like, 'Oh, are you?' It's almost if they are not as exposed to people of different backgrounds and when they are they are more shocked and surprised and not as welcoming. It's different here. What they try to do now is recruit so many students of color but there are no professors of color. And so these, you know, most of these professors that have to interact with us, you know, they act like it's a burden and they have to do this because we are minority students and they don't try to hide it...I felt more comfortable and welcomed in the South than here.

As Patricia described her graduate experience, her tone deepened and voice cracked. Patricia's sense of confidence and belonging during graduate studies has been strained by events of racial discrimination.

Despite obstacles in recent years, Patricia plans to complete her doctoral degree by May 2018. Her plans after graduation include working at a law firm specializing in intellectual property and helping other researchers market and patent their research discoveries. Since her parents still reside in the South, she is open to returning to the area.

4.5.2. Archive Documents

Patricia joined the MRT program in 2009 at the start of her junior year. She conducted biomedical research in two different laboratories in the Departments of Biological Engineering and Pathobiological Sciences. During her participation in the program she presented research at one regional conference and one national conference. Patricia also published a peer reviewed journal article as first author in 2010. She completed her bachelor's degree in animal science in May 2011 with a four-year graduation rate.

4.6. Jeremiah

4.6.1. Interview

Jeremiah, an African American male, discussed his strong passion for science and research throughout his interview. His interest in biomedical sciences started when he was eight years old playing a video game that entailed a character obsessed with viruses. Jeremiah explained, "I was like how is this possible? How can someone be obsessed with something that is invisible? Viruses are very small so I was like this doesn't make sense. That is actually what catalyzed my obsession with the sciences." From that moment, Jeremiah sought opportunities to learn more about science. In high school, he participated in a health science academy and volunteered as an intern in a family medicine clinic for a year. With strong interest in a biomedical related career, he knew college would be the best option for him. Jeremiah also described his parent's role in his decision to attend college. "My parents they, you know, kind of

laid down the law; they said that there was no option for me other than to go to, uh, college,” Jeremiah stated. Subsequently, Jeremiah enrolled into the state’s flagship institution.

“Pushed myself”. During his first couple years of college, Jeremiah sought opportunities that expanded his scientific knowledge. “During that time, I immediately pushed myself into conducting biomedical research,” Jeremiah stated. Through federal work study funding, Jeremiah independently approached various faculty members seeking research opportunities. He also explained his efforts in establishing relationships with various classroom professors.

Jeremiah stated:

In the classroom in the early freshman and sophomore years, it’s pretty hands off because too many students. But with office hours, you can really have a relationship with the professors. Being that I idolize these scientists, I would go to office hours and I developed quite a few lasting bonds.

Jeremiah explained his motivation to acquire research opportunities and establish relationships with teaching faculty. He believed these opportunities were vital in achieving his career goal as either a physician or research scientist.

“True passion”. Jeremiah explained his first research opportunity with protein science and his second opportunity with virology, his “true passion”. With excitement in his voice, he discussed in depth his research topics. Jeremiah discovered that his true passion leaned more towards a research-focused career with a doctor of philosophy rather than a medical degree.

Jeremiah explained:

I had always focused on becoming a physician, an infectious disease physician, but the thing is that I realized that I actually cared more about life science research, specifically

the develop of novel therapeutic things of that nature and that obviously skewed more towards getting a Ph.D. rather than getting a M.D.

Jeremiah attributed his undergraduate research experience as an influential factor in pursuing a career centered on research.

“Marriage of my desires”. During his junior year, Jeremiah joined the MRT program and another similar program for first generation college students. Although already involved in research, Jeremiah described his participation in these two programs as a pivotal point in his career and academic training. Jeremiah stated, “These programs, you know, basically served as a way for me to get my research funding and was an excellent marriage of my desires to actually achieve it.” Jeremiah also explained how the programs offered opportunities to seek advice and support. Jeremiah stated:

I felt I needed more of an individualized experience in order to fully realize my talents. That is why I viewed the programs as incubators... They like push you forward and giving you personalized advice and incentives and they're kind of pushing you along to realize that dream of becoming a scientist.

In addition to funding and personalized support from program staff, Jeremiah discussed the importance the MRT program played establishing a sense of belonging in science. Jeremiah explained:

One thing that happens especially among minorities is called the imposter syndrome. This is like all these other students are white or Asians and foreigners so I don't belong there. But in these programs you see other students of color and you know they have the same struggles. If experiments don't work you have to talk somebody and learn. These special programs set me in the path I am today and I owe my current success to that.

After earning his bachelor's degree in biological sciences, Jeremiah participated in a post bachelor research and training program at a medical institute for a year. With his research experiences, Jeremiah co-authored a paper and "gained a skill set to work on an independent project and know the rigor to embark on doing a Ph.D." After his post baccalaureate training, Jeremiah enrolled into a doctoral program in the western region of the United States. Jeremiah expected to complete his doctoral degree in May 2018, and hoped to develop companies around concepts related to his doctoral work.

4.6.2. Archived Documents

Jeremiah joined the MRT program in 2009 during his junior year. He conducted research in two research laboratories in the Departments of Biological Sciences and Biotechnology and Molecular Medicine. He presented his research at one regional and one national conference. He received the top Microbiological Sciences Presentation Award for his poster presentation at the national conference. Jeremiah completed his bachelor's degree in biological sciences in May 2011 within four years.

4.7. Abigail

4.7.1. Interview

Abigail, a 23-year-old African American female originally from the gulf south region, was raised in a home with college educated parents. She attended her junior and senior years of high school at a boarding school in a neighboring state. She claimed her decision to attend college as "always a given. It was like the next step after high school. So I never thought about it. It was just something I was going to do." After receiving a full scholarship, she decided to attend the institution in the same city her parents resided. She explained, "It was easy to be close to them and cheaper money wise."

“An environment I needed”. Abigail was accepted into an undergraduate research scholars program that required undergraduate research starting her first year in college. To meet program requirements and receive the financial stipend, Abigail randomly selected various laboratories on campus to contact. After limited responses, Abigail joined an Analytical Chemistry research group on campus. She described her experience in the research group as supportive and positive. Abigail stated:

Everybody from when I started to the time I finished was so nurturing and got all the help I needed. As I became a more advanced student I started discussing life with the grad students, you know, with navigating grad school and what I should look into. The lab environment was exactly what I needed and I think it’s a big reason why I am succeeding now in grad school.

Abigail discussed experiencing a “climate shift” with peers once becoming more involved in her research laboratory and upper level classes. Abigail spoke of an increased sense of belonging in the laboratory and classroom and the influence it had on her academic success. Abigail stated:

The more you feel comfortable with people, the more you start seeing them all the time, you start working together and start succeeding. I really succeeded later on and feeling more than just a face in the crowd. You know, I knew you and you knew me. We are learning together and I was special. You know, something like that. That really helped me do better. It was like a climate shift.

“Learn new things”. Abigail described her research experience as an opportunity to “learn new things” and “work with cool instrumentation”. According to Abigail, “I never really knew anything until I started working in the lab.” Working the laboratory provided Abigail with “hands on opportunity to learn processes” and take her “scientific knowledge to a whole another

level”. Abigail described how studying research and conducting it are different. “Now when I read I actually know what’s happening because I’ve seen it happen. It just adds to a whole new level to knowledge. It increases your scientific knowledge,” Abigail explained.

“They want this for me so bad”. During the interview, Abigail discussed her support and influence family had during her undergraduate studies and decision to continue into graduate school. Abigail stated:

My family, especially my parents, were supportive of me. Whenever I talk about anything or scientific to them I can see the excitement in their eyes. I know they want this for me so bad. They wanted it just as bad if not more than I did so they had a really big influence on me.

Although Abigail felt she “would have done it anyway”, seeing the excitement of her parents became a source of further motivation. Abigail stated, “Their involvement and excitement encourages me to do it even more.”

“I want to be like y’all”. Abigail credits her mentors and MRT opportunities for being where she is today in her academic and career development. She described how mentors impacted her decision to pursue graduate school. Abigail explained:

I finally came up with that conclusion because a lot of people helped me and kind of introduced me to research, mentored me all along the way from freshman year you know and all way until I left. And you know that really impacted me in a positive way because I was like I want to be like y’all.

Not only did the mentoring she received throughout the years influence her decision to attend graduate school but also to “be a role model or be that person for somebody else while at the same time doing the research”. In five years, Abigail hoped to have her doctoral degree

completed and participate in a post doctoral research opportunity. Among Abigail's career goals were working at an institution conducting research, teaching, and mentoring undergraduate and graduate students.

4.7.2. Archived Documents

Abigail participated in an undergraduate scholars program at the start of her freshman year in 2012. She transitioned into the MRT program for the research opportunity during her sophomore year in 2013. During her participation, she conducted research in a chemistry laboratory and presented her research findings at three national and one regional conference. She received numerous awards for her academic and research achievements, including poster presentation awards and departmental undergraduate research achievement recognition, and honors distinction from the university's Honors College. She also co-authored a peer-reviewed journal article in 2014. Abigail completed her bachelor's degree in chemistry in May 2016 with a four-year graduation rate.

4.8. Brandon

4.8.1. Interview

Brandon, a 26-year-old African American male originally from the gulf south region, described his first memory of interest in science on his ninth birthday after receiving an interactive human body model as a gift. Brandon recalled the model allowed him to "construct the skeleton and the systems and came with a really cool booklet explaining all the parts." His interest in biomedical related science grew from that point on. However, Brandon explained that it was not until his sophomore year of high school that he realized he wanted to pursue a science related career. Brandon explained, "I took a Biology II course. Many students struggled in it but I enjoyed it and didn't mind studying multiple hours for it. I knew then I had a natural gift and

interest for science.” Brandon explained his decision to attend college as “not a choice” and the “next logical step”. He decided to attend the state’s flagship institution because of the close proximity to his home and scholarship funding opportunities for in state students.

“Not personal at first”. Brandon described the first couple years of college as challenging with limited personal connections and engaging courses. Brandon explained, “In the beginning it was very full of general very large classes with 200 to 300 people. It didn’t feel very personal at first. You had no connection with the instructor.” Brandon also spoke of the limited diversity he observed when new to the campus. “There was nothing incredibly shocking for me but definitely moments I could see being the only person of color in a classroom or lab or organization... I did notice the lack of diversity. It was heavily a white male area,” Brandon explained. Despite limited connections and challenged sense of belonging, Brandon explained how participating with the MRT program and taking more specific courses with smaller classrooms the classroom climate changed and he was able to establish relationships with faculty. Brandon described how the climate became “very positive and open” and felt “instructors were more open to ask questions”.

“A leg up”. When asked to describe his undergraduate research experience, Brandon responded, “If you have any research experience under your belt, you really have a leg up on other students.” Brandon shared how research provided him with an academic advantage in comparison with other students. Brandon felt “more experienced” and acquired “more knowledge in application” than other students through exposure to different methods and techniques from undergraduate research. Brandon also explained how research helped in networking and establishing contacts with various faculties on campus and attending different

events and conferences. “It exposed me to things I may not have had the chance to attend or learn and strengthened my resolve to continue into graduate school,” Brandon stated.

“She pushed me”. Brandon explained the strong influence his mother had on his decision to pursue a graduate degree. Brandon stated, “My mother recently received her Ph.D. ...Watching her return to school was a strong influential factor that pushed me to succeed and continue into graduate school.” Brandon described his mother as an inspiration and motivator for persistence into graduate school.

In May 2017, Brandon received his master’s degree in comparative biomedical sciences. He described his graduate experience as a positive experience that allowed him to develop “long lasting relationships with other students,” unlike his undergraduate experience. He hoped to continue his education after a “much needed break”. Brandon hoped to enroll into a doctoral program, and then pursue a career in either industry or academia.

4.8.2. Archived Documents

Brandon joined the MRT program in 2011 during his sophomore year. He conducted research in two different laboratories in the Departments of Chemistry and Biological Sciences. In addition to program meetings and seminars, Brandon presented his research findings at one regional and one national conference. He earned a bachelor’s degree in biochemistry in May 2015 with a five year graduation rate.

4.9. Ryan

4.9.1. Interview

Ryan, a Honduran born 24 year-old, grew up in the gulf south region with his mother and stepfather. Ryan described his upbringing in a very diverse household when his mother “married a man from a different race.” Coming from a majority college educated family, Ryan explained,

“College wasn’t a choice. It was the next step after high school. You go to college, get a degree no matter in what.” In high school, Ryan’s mother enrolled him in a standardized preparatory course. It was during that time Ryan realized not all students in his community viewed college as the next logical, accessible step after high school. Ryan stated:

It was the first time I was ever in a group of kids who when they asked what they want to do in the future they wrote go to college. It was a huge culture shock for me because when I wrote about my future it was like going to the park next week because going to college before me was a sure thing but not for the lower income students.

The experience shaped Ryan’s perception and attitude towards college accessibility. He recognized the value of college and how it is unfortunately not viewed as a natural progression of education to all.

“Hard transition”. Ryan attended a small, magnet high school with a graduating class of 45 students. Ryan explained his transition from a small high school to the largest university in the state as a “huge culture shock”. He described feeling overwhelmed when he registered for an introductory biology class that had 900 students. “The environment wasn’t bad but coming from a small school, it was a hard transition.” Ryan spoke about the use of computer-based testing and limited teacher interactions because of the large classroom size as a “big shift” he had to overcome. Looking back on his struggle of transitioning to a larger school environment, Ryan regrets not utilizing campus housing. Ryan stated, “I didn’t have roommates or dorm mates I could ask about class stuff and tests. It was my biggest regret. I had my small high school group but we figured things out.”

Although Ryan received scholarship to cover school tuition, he still had to work to cover living expenses. He initially worked at an apartment complex as a sales and contract

representative. However, Ryan struggled carrying a full-time job off campus and maintaining his studies. He then sought an on campus position that could aid in his degree attainment and career training. Ryan never had considered research but thought the funding opportunity through the MRT program sounded interesting and would support his academic training.

“Helped me grow as a scientist”. Although Ryan described his undergraduate research projects as not as successful as some other students, but he “gained a lot of valuable experience seeing the real struggle research can have”. Ryan stated:

The lab helped me understand that things don't always work. When starting a new project you will come across walls you have to get through or find other avenues which helped me grow as a scientist. I learned it's okay to struggle and will struggle and you have to keep moving forward.

Ryan explained how unlike laboratory based classes, his undergraduate research taught him the “small struggles and an opportunity to do it again correctly”. Although Ryan had limited interactions with the principal investigators of the laboratory, he credited his decision to pursue a graduate research program to the close interactions with graduate students and financial support and encouragement from the MRT program.

“Political impact”. Ryan was finishing his Master of Science in biotechnology and hoped to enroll into a doctoral research program at the same institution. However, Ryan spoke of the recent political changes and funding cuts to research and their potential impact on his career plans. Ryan stated, “If things go all wrong with science funding, I'll get the M.D. It all depends on the political spectrum right now. If science keeps its legs, I would rather keep doing Ph.D.”

4.9.2. Archived Documents.

Ryan joined the MRT program in September 2013 at the start of his junior year. He conducted research in one laboratory in the chemistry department. He attended and presented one regional and one national conference. Ryan regularly attended program-sponsored events and seminars. He completed his bachelor's degree in biochemistry in May 2015 with a four year graduation rate.

4.10 Elizabeth

4.10.1 Interview

Elizabeth, a 31 year-old African American female, spent her early years in Nigeria and came to the gulf south region of United States with her mother in middle school. Elizabeth spoke of how her mother, who also earned a doctorate degree, always stressed the importance of education. She stated, "I always knew I had to go to college. It wasn't an option in my house. My mother was always like, 'You need an education and it's good for you. It gives you more opportunities in life'." Respecting her mother's desire for her to attend college but also knowing the financial limitations, Elizabeth focused on her high school studies in hopes of earning scholarships.

"Think more in depth". Elizabeth shared her experiences in Nigeria and how those events shaped her interest in pursuing a career in a health care related field. Elizabeth explained:

In Nigeria, I witnessed family members in dire need of healthcare but not able to get the proper healthcare. It was hard seeing that. I think based on those experiences I wanted the healthcare field and thought about being a doctor.

Elizabeth started college with hopes of becoming a medical doctor but changed career tracks after her first research experience during her sophomore year of college. Elizabeth shared how

undergraduate research “changes the way you approach information” and “makes you want more valid information”. She spoke how it made her “think more in depth”. She developed a passion for research and its impact on healthcare.

“Felt like a minority”. Elizabeth described her socialization in college as small and limited to interactions with fellow students in her research laboratories. Elizabeth stated, “I had a very routine schedule. I would go to classes and then the lab where I did research and that’s about it.” On campus, she “felt like a minority but became accustomed to”. When asked to describe incidents on campus where she experienced or observed others being treated differently, Elizabeth shared two events when faculty treated her differently based on her appearance. Elizabeth stated, “Especially being born from a different country and coming here where race is such a huge deal to everyone. It’s sad. You never get use to it but I learned how to adjust to it.” She limited her interactions with others and spent most of her time on her research and studying.

“I stayed in my bubble”. Unlike the campus environment, Elizabeth experienced a sense of inclusiveness and belonging in her research laboratory. She described the lab as “very diverse with graduate students from different countries” and “I never felt out of place and everyone was supportive and encouraging.” Elizabeth stated, “I stayed in my bubble.” She described the laboratory as an opportunity to advance her academic development without the incidents of racism. The laboratory also became her primary source of socialization and support. She enjoyed the interactions with diverse graduate students who shared the same passion for science and research.

“Issue of inclusiveness”. Elizabeth spoke about her experiences of racial prejudice during her graduate studies. Elizabeth left the South and attended a Ph.D. program in molecular and cellular biology in the upper midwest region of the United States. She described being called a

“superior minority” by a faculty member in her graduate program when compared to fellow minority students that attended historically black colleges for undergraduate studies. Elizabeth explained:

One of my friends was told by their professor that their school did not prepare them at all for grad school. So, what does this student supposed to do? My friends that came from historically black universities, a lot of people assumed they were not as smart. In fact, I was called a superior minority [laugh]; I don’t even know what that means, because I didn’t go to an HBCU.

Elizabeth explained how neither institution assisted students or university personnel in becoming cultivated to new environments. Elizabeth added, “The issue of inclusiveness is a problem. University officials don’t do a good job handling it and professors don’t know how to interact with students based on the way they look. It made me want to run away.”

Elizabeth completed her doctoral degree in 2016 and moved with her husband to the East Coast. She described the move as “refreshing”. She explained the excitement she had hearing a bank teller speak Spanish in her new hometown. Although it was not a language she spoke, it was “nice hearing a different language and seeing diverse people”.

Elizabeth hoped to secure a post doctoral fellowship and pursue her career goals of being a research faculty member at a university. Although family still resides in the South, she does not intend to move back to the southern region.

4.10.2. Archived Documents

Elizabeth was accepted into the MRT program in 2005 during her sophomore year of college. She conducted research in two different research laboratories in the Departments of Psychology and Pathobiological Sciences. In addition to attending program sponsored events,

Elizabeth attended and presented posters at one regional and two national conferences. She completed her bachelor's degree in biological sciences and minors in chemistry and psychology in December 2007 with a four and a half years graduation rate.

CHAPTER FIVE: PATTERNS AND OUTCOMES

Multiple case narratives provide a rich framework in which researchers study how humans experience and perceive the world through their stories (Webster & Mertova, 2007). Narratives reveal information about the inner world of the storyteller (Murray & Sargeant, 2011), open a space for researchers to analyze participant experiences related to social issues (Esin et al., 2014) and explore the social context and culture in which the experience took place and the knowledge constructed (Webster & Mertova, 2007). To examine the experiences of students who participated in a minority research and training program and matriculated into graduate programs, the researcher utilized a multiple case study featuring extensive use of narrative (Creswell, 1998). The individual case narratives revealed unique aspects, feelings, intentions, and events of each participant during their college experience. To identify common themes and variations that also represent individual narratives, analysis included cross case coding (Stake 2005; Ayres et al., 2003). The individual vignettes aided in the discovery of connective threads among participants and the integrated narrative analysis identified common themes that occurred among MRT participants.

The cross case analysis suggested four themes that were consistent for all participants in the study. These themes included belonging and inclusion, mentoring, confidence in science, and family influence. Supportive information of the four themes included a tabular format for a comprehensive list highlighting the ways each of these cases shared commonalities (see Table 1), and fully illustrative quotes from the participants formatted into conventional paragraphs.

Table 1. Themes Across Cases

Themes	Quotes
Belonging and inclusion	<p data-bbox="467 310 1365 380">“When I walked into a classroom and only seeing myself as one of the few minority students.”- Anna</p> <p data-bbox="467 422 1305 491">“... faculty and staff with them paying more attention to my white counterparts.”- Anna</p> <p data-bbox="467 533 1377 564">“You know there weren’t many black people in my program.”- Charles</p> <p data-bbox="467 606 1406 716">“On one hand you knew every person you can relate to because they look like you so you can study together but at the same time there wasn’t a whole bunch of people willing to study with you.”- Charles</p> <p data-bbox="467 747 1398 816">“Some smaller schools have family feel vibes and that was definitely not the case.”- Charles</p> <p data-bbox="467 858 1354 928">“... very welcoming, friendly environment probably because of who I surrounded myself with.”- Patricia</p> <p data-bbox="467 970 1409 1079">“I never felt out of place because when I went to the dorm I saw black people. When I went to church I saw black people from the community.”- Patricia</p> <p data-bbox="467 1121 1149 1152">“I became more at home in my department.”- Abigail</p> <p data-bbox="467 1194 1373 1304">“The more you feel comfortable with people, the more you start seeing them all the time, you start working together, and start succeeding in classes.”- Abigail</p> <p data-bbox="467 1335 1179 1367">“... feeling more than just a face in the crowd.”- Abigail</p> <p data-bbox="467 1409 1162 1440">“We are learning together and I was special.”- Abigail</p> <p data-bbox="467 1482 1403 1591">“The environment in grad school is very different than undergrad. There’s a lot less minorities... I feel more aware myself just because all I see is white, white, white everywhere.”- Abigail</p> <p data-bbox="467 1623 1268 1692">“Research lab gave me an outlet. I wanted to stay in a positive environment.”-Bethany</p> <p data-bbox="467 1734 1414 1766">“They took me under their wings. They really took care of me.”- Bethany</p> <p data-bbox="467 1808 1162 1839">“If I had any questions I could ask anybody”- Bethany</p>

(table cont’d.)

Themes	Quotes
Belonging and inclusion	<p data-bbox="467 310 987 344">“I was accepted with open arms.”- Anna</p> <p data-bbox="467 380 1049 413">“I felt welcomed as soon as I joined.”- Lenny</p> <p data-bbox="467 449 1167 483">“My adviser told me to make myself at home.”- Lenny</p> <p data-bbox="467 518 1390 594">“Everybody from when I started to the time I finished, I was so nurtured and gave all the help I needed.”- Abigail</p> <p data-bbox="467 630 1390 705">“In the beginning it was very full of general very large classes with 200-300 people. Didn’t feel very personal at first.” - Brandon</p> <p data-bbox="467 741 1390 888">“There was nothing incredibly shocking for me but definitely moments I could see being the only person of color in a classroom or lab or organization. There was no glaring negativity I experienced but I did notice the lack of diversity. It was heavily a white male area.”- Brandon</p> <p data-bbox="467 924 1360 999">“The labs were very positive and open. Some really took an interest in seeing students learn and improve. Those were fantastic.” - Brandon</p> <p data-bbox="467 1035 1341 1110">“My friends in general were lab mates. They created a more relaxed environment.”- Brandon</p> <p data-bbox="467 1146 1373 1222">“The environment wasn’t bad but coming from a small school, it was a hard transition.”- Ryan</p> <p data-bbox="467 1257 1409 1333">“But in these programs you see other students of color and you know they have the same struggles.”- Jeremiah</p> <p data-bbox="467 1369 1062 1402">“On campus, I felt like a minority.”- Elizabeth</p> <p data-bbox="467 1438 1390 1514">“The lab was very diverse with grad students from different countries. I never felt out of place.”- Elizabeth</p> <p data-bbox="467 1549 919 1583">“I stayed in my bubble.”- Elizabeth</p>
Near peer mentoring	<p data-bbox="467 1591 1390 1667">“I was surrounded by a community of mentors...my graduate student in the lab showed me the ins and outs of graduate school.” - Anna</p> <p data-bbox="467 1703 1273 1736">“...the grad students I worked with encouraged me...”- Patricia</p> <p data-bbox="467 1772 1390 1848">“I was surrounded by a community of mentors...my graduate student in the lab showed me the ins and outs of graduate school.” - Anna</p>

(table cont’d.)

Themes	Quotes
Near peer mentoring	<p data-bbox="467 310 1271 344">“...the grad students I worked with encouraged me...”- Patricia</p> <p data-bbox="467 380 1349 449">“I interacted directly with my mentor as well as her Ph.D. students.”- Bethany</p> <p data-bbox="467 489 1386 596">“As I became a more advanced student I started discussing life with the grad students, you know, with navigating grad school and what I should look into.”- Abigail</p> <p data-bbox="467 636 1409 779">“A lot of people helped me and kind of introduced me to research, mentored me all along the way from freshman year, you know, and all way until I left. And you know, that really impacted me in a positive way because I was like I want to be like y’all.”- Abigail</p> <p data-bbox="467 819 1414 888">“I didn’t interact much with the PI of the lab. It was the graduate students I spent most of my time with.”- Ryan</p> <p data-bbox="467 928 1313 997">“The lab was very diverse with graduate students from different countries...everyone was supportive and encouraging.”- Elizabeth</p> <p data-bbox="467 1037 1398 1144">“After a while I started collaborating with the graduate students, you know, and got my project off the ground. We worked together as a team supporting each other.”- Lenny</p> <p data-bbox="467 1184 1398 1291">“They like push you forward and giving you personalized advice and incentives and they’re kind of pushing you along to realize that dream of becoming a scientist.”- Jeremiah</p>
Confidence in science	<p data-bbox="467 1297 1398 1440">“My scientific knowledge on the undergraduate level was very high compared to my counterparts because I would go into a class and understand what the teacher was talking about because I could see in real life.”- Anna</p> <p data-bbox="467 1480 1409 1587">“I got my project off the ground, went to a few conferences, and I felt pretty good... You kind of get to learn how to be a scientist in undergrad.” – Lenny</p> <p data-bbox="467 1627 1344 1696">“It prepared me very well, as far as like instrumentation and figuring things out and even working well with others.”- Lenny</p> <p data-bbox="467 1736 1373 1843">“Compared to those who didn’t, they didn’t get that experience so they just, you know, when they get a job or something else that’s their first time getting to be on their own figuring it out.”-Lenny</p>

(table cont’d.)

Themes	Quotes
Confidence in science	<p data-bbox="467 237 1404 268">“I never really knew anything until I started working in the lab.”- Abigail</p> <p data-bbox="467 310 1404 384">“Research experience gave me a hands on opportunity to learn processes and taken my scientific knowledge to a whole another level.”- Abigail</p> <p data-bbox="467 426 1193 457">“I felt very prepared for grad school and I was.”- Abigail</p> <p data-bbox="467 499 1258 531">“I think research doubled my knowledge in science.”- Charles</p> <p data-bbox="467 573 1372 646">“I thought with the large classrooms I would feel like a small fish but I always felt confident and sure of myself.”- Patricia</p> <p data-bbox="467 688 1356 762">“Being able to do the experiments and do them well and correctly and also write the paper was a good experience for me.”- Patricia</p> <p data-bbox="467 804 1047 835">“I can do this. This isn’t bad at all.”- Patricia</p> <p data-bbox="467 877 1421 951">“I see a huge, huge difference between me and people who haven’t had an extensive research background.”- Patricia</p> <p data-bbox="467 993 1388 1066">“If you have any research experience under your belt, you really have a leg up on other students. It puts you ahead of people who didn’t have research experience.”- Brandon</p> <p data-bbox="467 1108 1372 1224">“I felt I had more experience and knowledge in application than others. Translating knowledge from class and applying to real word applications.”- Brandon</p> <p data-bbox="467 1266 1356 1371">“Doing research teaches you how to follow protocols better than a lab class. You learn the small struggles and an opportunity to do it again correctly.”-Ryan</p> <p data-bbox="467 1413 1404 1507">“Doing UG research changes the way you approach things and absorb information. It makes you want more valid information. Made me think more in depth.”- Elizabeth</p>
Family influence	<p data-bbox="467 1518 1372 1591">“The decision to go to college for me, uhm, ... was not an option. My parents wanted me to go to college.” - Anna</p> <p data-bbox="467 1633 1388 1707">“My parents they, you know, kind of laid down the law. They said that there was no option for me other than to go to college.”- Jeremiah</p> <p data-bbox="467 1749 1388 1799">“My parents instilled in us education is important. They pushed that we would go to college.”- Bethany</p>

(table cont'd.)

Themes	Quotes
Family influence	<p data-bbox="467 233 1393 306">“My family, especially my parents, were supportive of me going to grad school.”- Abigail</p> <p data-bbox="467 342 1325 415">“Whenever I talk about anything or scientific to them I can see the excitement in their eyes.”- Abigail</p> <p data-bbox="467 451 1078 489">“I know they want this for me so bad.”- Abigail</p> <p data-bbox="467 525 1403 598">“They (parents) wanted it just as bad if not more than I did so they had a really big influence on me, you know.”- Abigail</p> <p data-bbox="467 634 1414 707">“My mom had been a big influence and motivator and keep pressing on.”- Brandon</p> <p data-bbox="467 743 1401 854">“In my household there wasn’t a choice to go to college. Everyone in my family are engineers. It was, ‘It’s the next step after high school, go to college, get a degree no matter in what’.”- Ryan</p> <p data-bbox="467 890 1414 1001">“It wasn’t an option in my house. My mother was always like, ‘You need an education and it’s good for you. It gives you more opportunities in life’.”- Elizabeth</p> <p data-bbox="467 1037 1406 1108">“Science was not a shock to me. Science itself was never like ‘this is really cool’ because we were always exposed to it in childhood”- Patricia</p>

5.1. Theme One: Belonging and Inclusion

During the interviews, every participant discussed feelings and events pertaining to their sense of belonging when they first arrived on campus and throughout their college experience. Some of the students expressed feelings of “shock” and isolation when transitioning from a smaller or more diverse high school to the campus. For example, Ryan explained how going from a high school graduating class of 45 students to a biology course with 900 students was “pure culture shock” and a “very difficult transition”. Anna, who described her high school as rich in diversity with individuals from different cultures, ethnicities, and religions, did not witness the diversity she was exposed to in high school and at times felt isolated. Charles shared, “On one hand you knew every person you can relate to because they look like you so you

can study together but at the same time there wasn't a whole bunch of people willing to study with you." Anna expressed similar feelings of isolation, "Sometimes I thought of it as a great way to defy the odds but then I really had no one that can relate to me."

In addition to feelings of isolation from fellow students, some of the alumni experienced incidents of racial micro aggressions from various faculty. Anna described incidents where faculty would pay more attention to the white students in class. Anna shared, "I did experience issues with faculty and staff paying more attention to my white counterparts. It was frustrating and discouraging at times." Elizabeth shared details of being treated differently and questioned by two different faculty members. Elizabeth stated, "I don't know why he was questioning my priorities. I had an A in the class but he probably didn't bother to check and just made assumptions".

Although some participants expressed initial feelings of isolation, the majority of the participants discussed a positive sense of belonging and inclusion after participation in undergraduate research. In contrast to the classroom and general campus climate, numerous participants spoke of the research laboratory as a welcoming and friendly environment. Lenny stated, "I was accepted with open arms" and "I felt welcomed as soon as I joined." Bethany explained, "Research lab gave me an outlet ... They took me under their wings. They really took care of me." Anna expressed, "I was accepted with open arms." Unlike the general campus and classroom environment, the research laboratory provided a welcoming environment with a sense of inclusion. Elizabeth described her laboratory environment as her "bubble" and explained, "On campus, I felt like a minority... but the laboratory was very diverse with students from different countries...I never felt out of place and everyone was supportive and encouraging." Brandon also described his preference for the social interactions with fellow peers in the

laboratory. He stated, “My friends in general were lab mates. They created a more relaxed environment.”

5.2. Theme Two: Near Peer Mentoring

All of the participants discussed the influence of mentoring on their academic training. Anna described her support network as a “community of mentors” ranging from program staff, faculty, and peers. Some of the participants specifically mentioned the support and guidance from program staff affiliated with the MRT program. Jeremiah stated, “They like push you forward and giving you personalized advice and incentives and they’re kind of pushing you along to realize that dream of becoming a scientist.” Abigail also shared mentorship from various faculty and staff related to undergraduate intervention programs. Abigail claimed the undergraduate programs “introduced me to research” and “mentored me all along the way.”

The majority of the participants, including Anna, Patricia, Bethany, Abigail, Ryan, Elizabeth and Lenny, described the interactions with fellow graduate students from the laboratory as a major source of encouragement, guidance, and socialization. For instance, Abigail stated, “Everybody [graduate students] from when I started to the time I finished I was so nurtured and gave all the help I needed” and “As I became a more advanced student, I started discussing life with the grad students, you know, with navigating grad school and what I should look into.” Ryan described limited interactions with the principal investigator of the laboratory and stated, “It was the graduate students I spent most of my time with. They taught me the instrumentation.” Elizabeth shared, “The lab was very diverse with grad students from different countries...everyone was supportive and encouraging.”

5.3. Theme Two: Confidence in Science

Many of the participants discussed a growth of confidence in science during their experience in the MRT program. In the initial years of college, Anna often felt hesitant of her personal capabilities. She stated, “You know there were times along the way I felt like I could not do it.” However, Anna described how undergraduate research training strengthened her sense of confidence in the classroom. Anna explained, “I would go into a class and understand what the teacher was talking about because I could see in real life.” She stated, “I never really knew anything until I started working in the lab ... gave me a hands on opportunity to learn processes and taken my scientific knowledge to a whole another level.” Unlike regular science laboratory courses, Ryan stated, “Doing research teaches you how to follow protocols better than a lab class. You learn the small struggles and an opportunity to do it again correctly.” Lenny explained how undergraduate research taught him “how to be a scientist and feel like a scientist in undergrad.” Patricia described how learning the experiments and doing them correctly changed her perception of science to “I can do this. This isn’t bad at all.” Through exposure to undergraduate research, Jeremiah claimed he “gained a skill set to work on an independent project and know the rigor to embark on doing a Ph.D.” Brandon explained how undergraduate research game him a “leg up”, an academic advantage, over other students. Many of the participants described their undergraduate research experience as a supplemental form of instruction that enhanced their scientific knowledge and success in the classroom. They gained confidence in their ability to conduct science, which influenced their persistence into graduate school.

5.4. Family Influence

The majority of the participants discussed the influence their family, particularly their parents, had on their educational development and motivation to attend college and graduate school. Many participants shared personal interest in science and a desire to attend college from a young age. They shared memories of receiving their first science related gift from their parents as a child and described a stimulating learning environment at home. Patricia stated, “Science itself was never like ‘this is really cool’ because we were always exposed to it in childhood.”

When it came time to go to college, eight participants expressed a sense of parental pressure for them to achieve academic success and attend college. These participants described college as “not an option” in their homes. Jeremiah shared, “My parents they, you know, kind of laid down the law. They said that there was no option for me other than to go to college.” Similarly, Elizabeth stated, “It wasn’t an option in my house. My mother was always like you need an education and it’s good for you.” Anna also expressed, “The decision to go to college for me, uhm, ... was not an option. My parents wanted me to go to college.” The family influence continued through out their undergraduate studies. Participants described supportive attitudes and motivation from in their parents when they were thinking about graduate school. Abigail shared, “My family, especially my parents, were supportive of me going to grad school. Whenever I talk about anything or scientific to them I can see the excitement in their eyes.” Brandon stated, “My mom had been a big influence and motivator and keep pressing on.”

CHAPTER SIX: DISCUSSION, IMPLICATIONS, AND CONCLUSION

The results of this study contribute to the current body of knowledge examining undergraduate research and training programs and gauge its influence on advanced science degree attainment. Participants expressed their perceptions and experiences starting with their decision to attend college, continuing throughout their undergraduate studies and their path to graduate school. The conversation style interviews explored past experiences, the core of their scientific interest, their confidence in science, their sense of belonging, influential individuals, and future aspirations. The interviews examined student stories and factors that influenced the career and academic paths they chose. This chapter addresses relevant research for each theme, presents implications for practice, future work, weaknesses of the study, and final conclusions.

6.1. Discussion

Bolstering science, technology, engineering, and mathematics (STEM) education and increasing the number of students graduating with a degree in a STEM field became a national incentive of various federal agencies. As the STEM job market increases, so does the desire to diversify the workforce. To close the educational achievement gap and build undergraduate pathways to generate a highly skilled and diverse STEM pool, the implementation of minority research and training programs has grown as a method across U.S. colleges and universities to patch the leaking science ‘pipeline’ (Shultz et al., 2011; Maton & Hrabowski, 2004, Barlow & Villarejo, 2004). These federally funded MRT programs provide a broad spectrum of educational activities, training opportunities, and professional experiences.

Studies on program effectiveness have relied on self-reported gains through surveys utilizing simple descriptive statistics (Laurensen et al., 2010; Hunter et al., 2007; Lopatto, 2004; Seymour et al., 2004). However, quantitative methods can be ineffective when researching

contemporary and complex issues (Webster & Mertova, 2007). Student voices and stories are lost with quantitative based surveys. A narrative inquiry embraces a culturally responsive approach that explores the social context in which the experience took place and the knowledge constructed (Webster & Mertova, 2007) and opens a space for researchers to analyze participant experiences related to social issues, such as social inequalities and gender relations (Esin et al., 2014). Thus, to fully explore the college experiences of alumni of a minority research and training program and possible cognitive and contextual factors influencing continuance into advanced degree programs, this study utilized a qualitative, narrative rich approach.

Ten former participants of a minority research and training program were selected for the study. Data collection included in-depth, conversational style interviews to promote storied responses. Unlike structured interviews, nondirective interviews gather information with limited researcher control and prevent skewness towards interest of the interviewer (Gray, 2009). The data was initially presented with individual vignettes allowing the researcher to focus on individual cases and provide a detailed portrait of each participant. A brief examination of archived documents provided additional information regarding student participation, research activity, and academic achievements of each participant. Then, data was analyzed by cross case analysis to identify common themes and variations. The cross case analysis identified four common themes that addressed the following research question: What are the experiences of students who participated in an undergraduate minority research program? Which experiences were most critical to their persistence into graduate school?

6.1.1. Theme One: Belonging and Inclusion

All but one participant expressed feelings of exclusion during their initial undergraduate experience. Some participants even shared instances of racial micro aggressions from various

faculty. In a study by Hurtado and Ruiz (2012), 55% of African American students experience feelings of exclusion from peer environments among institutions lacking diversity. Brown, Morning, and Watkins (2005) found African American engineering students' with favorable perceptions of campus climate had greater institutional commitment and higher graduation rates. Garcia (2013) found URM students from minority serving institutions were more likely to persist and graduate than those attending predominantly white institutions. The campus racial climate influences student persistence, sense of belonging, and academic and social involvement (Muses et al., 2008). In addition to the diversity structure of an institution, the institutions' efforts to help URM students persist and succeed also plays a pivotal role in URM student persistence (Hurtado & Ruiz, 2012; Reason, 2009).

All participants of the MRT program shared a sense of belonging once they joined a research laboratory. As shown in Table 1, participants emphasized the laboratory as a welcoming environment and a source of guidance and support. This common theme affirms that the experience of a supportive and welcoming environment in the laboratory indicates an influential factor in student persistence into an advanced level of education. Researchers argue underrepresented students lack mentoring, peer support, and encounter unwelcoming classroom climates, particularly African American students (Carnevale et al., 2011; Sasso, 2008). However, participation in research projects diminishes ethnic isolation (Villarejo et al., 2008; Gasiewsk, Garcia, Herrera, Tran, & Newman, 2010). Bauer and Bennett (2003) found undergraduate research provides students with a rewarding learning environment promoting self-discovery, self-expression, and appreciation of artistic, cultural, and creative differences. The participants in this study expressed similar feelings of ethnic isolation but developed a sense of belonging within the research laboratory.

6.1.2. Theme Two: Near Peer Mentoring

Numerous studies indicated students who develop an informal mentorship relationship with faculty through undergraduate research experiences have significantly higher degree aspirations (Carter, 2002; McGee & Keller, 2007, Craney et al., 2011). Close mentoring relationships with faculty also positively impact academic performance, attendance, and satisfaction among student participants (Linnehan, 2001; Tenenbaum et al., 2001; Kim & Sax, 2009). However, in this study, the majority of participants spoke of the mentoring and caring relationships they experienced in the laboratory with fellow graduate students, not faculty. In fact, some students discussed that they had limited to no interactions with their research advisors. The student narratives indicated the practice of near peer mentoring was an influential factor for student success and graduate school matriculation. Unlike peer mentoring where students collaborate with those of similar age, educational background, or laboratory experience, near peer mentoring involves the collaboration between individuals with slightly different parameters (Edgcomb et al., 2010). The use of near peer mentoring between graduate and undergraduate students to compliment faculty mentoring optimizes the research experience and establishes a more accessible collaboration and support system for MRT program participants.

6.1.3. Theme Three: Confidence in Science

According to Bandura (1986), self-confidence, a perception of one's ability, is a strong motivator and regulator of behaviors, including achievement strivings. All of the participants expressed increased confidence in science knowledge and skills after participating in undergraduate research. Participants discussed enhanced knowledge in instrumentation, connection of classroom concepts to real world application, and independent thinking and the ability to handle barriers. Participants also shared how undergraduate research provided the

opportunity for them to apply classroom knowledge to real world experiments and vice versa. Furthermore, they believed undergraduate research enhanced their research skills and facilitated a smoother transition into graduate school. Literature suggests the positive effects of undergraduate research on the development of attitudes and level of competence in the STEM disciplines. Studies found undergraduate research strengthens cognitive factors, including confidence and self-efficacy (Craney et al., 2011). Parham and Austin (1994) suggested individuals are more likely to pursue careers based on how well they can adapt and be successful in a career. Subsequently, increased students' confidence for STEM careers increases the probability that students will persist in a STEM major, reach degree completion, and continue into graduate programs.

An initial contradiction emerged with this theme, however. Unlike disconfirming evidence, a systematic process often utilized in data validation, inconsistencies in narratives can transform ambiguity into meaning (Watson, 2006). In this study, all participants shared feelings of confidence in science; half of the participants, however, shared behaviors of comparing themselves to gain self-evaluation of their abilities. Patricia stated, "I see a huge, huge difference between me and people who haven't had an extensive research background." Brandon claimed, "If you have any research experience under your belt, you really have a leg up on other students. It puts you ahead of people who didn't have research experience." He further explained, "I felt I had more experience and knowledge in application than others." Anna shared, "My scientific knowledge on the undergraduate level was very high compared to my counterparts because I would go into a class and understand what the teacher was talking about because I could see in real life." The participants' behavior of comparison may not necessary be a contradiction of self-confidence but rather a practice of competition often prescribed in

educational settings. According to Noddings (2013), capitalism in a social system occurs when there are limited resources and individuals compete for those resources by surpassing others to improve one's self as a means of social mobility. As with a capitalist economic system, America's college and public school systems is embedded with competition (Noddings, 2013). The participants may indeed feel confident in their scientific knowledge and skills but exhibit learned behaviors in a highly competitive environment.

6.1.4. Theme Four: Family Influence

STEM educational programs serve as environmental factors supporting a student's career development, but other external factors have shown to provide a supportive effect on student career decisions. For this study, the majority of the participants expressed a strong support system and high expectations from parents starting at a young age. Literature shows the value of family involvement and support in a student's college persistence (Cleaves, 2005; Russell & Atwater 2005). Stake and Mares (2005) found participants of a summer science program with encouragement from family, teachers, and peers was linked to a student's attitude towards science and their scientific abilities. Thus, Stake and Mares (2005) argued that the absence of support and involvement from significant people, such as family, can reduce a student's feeling of self-efficacy and the student will be less likely to pursue a STEM career. Mattanah, Brand, and Hancock (2004) found students, particularly among first generation students, who enjoy a secure relationship with parents who are supportive of their pursuit of higher education, demonstrate higher levels of satisfaction during their college experience. Slovacek, Jacob and Flenoury (2015) found academic interventions, such as research experiences and academic support, paired with parental outreach, facilitated successful college transition and degree attainment for underrepresented populations.

6.2. Implications for Theory

Theories addressing persistence in degree attainment already exist. The emerged themes from the cross case analysis support Lent's (1994) social cognitive career theory (SCCT) and campus racial climate model (Hurtado et al., 1998). Lent's SCCT explained the roles of cognitive factors and their interaction with environmental factors influencing the course of a student's career development. Since SCCT provides a broad conceptualization of persistence, exploring a theory that captures the unique experiences of URM students is imperative. Campus racial climate model discusses how structural and psychological dimensions of a campus influences students' persistence in college, specifically among underrepresented racial and ethnic groups.

6.2.1. Social Cognitive Career Theory

SCCT, based on Bandura's (1986) social cognitive theory and Hackett and Betz's (1981) career self-efficacy model, suggested that the three personal tenets of self-efficacy, outcome expectations, and interests, interact with external factors and shape a person's career goals and actions (Lent et al., 1994). Social cognitive career theory explores how career and academic interests mature, how career choices are developed, and how these choices are turned into action (Lent et al., 1994). In SCCT, career interests are shaped by self-efficacy, a measure of how successful a person believes he or she will be at completing a particular task or meeting a goal, and outcome expectations, defined as beliefs related to the consequences of performing a specific behavior (Lent et al., 1994). Self-efficacy and outcome expectations influence an individuals' personal agency for self-directed learning, motivation, and goal setting in guiding personal behavior. For example, the more confident college students are in their ability to perform well academically and believe that the outcomes associated with achieving a college degree are

worthwhile, the more likely they are to pursue their degree and set goals to reach their desired outcome. SCCT also focuses on how cognitive variables, such as self-efficacy, outcome expectations, and goals, interact with factors present in a student's environment, including gender, ethnicity, social supports, and barriers (Lent et al., 2000). Interaction between cognitive variables and environmental factors influence the course of a student's career development.

Self-efficacy, the key component within social cognitive career theory, focuses on the internal beliefs and experiences of students and its influence on their ideas and expectations about their own capabilities (Lent et al., 2005). To persist in STEM, students must believe that they are capable of successfully completing the required education and training and implementing the related skills once in the field. Outcome expectations, the beliefs related to the consequences of performing a specific behavior, are formed through past experiences and the perceived results of the experiences (Lent et al., 2005). Outcome expectations are the consequences and reward a student links with a course of action. A student's feeling of self-efficacy and outcome expectations influences their personal agency for goal setting. According to SCCT, personal goals play a vital role in behavior. A goal, defined as the decision to begin a particular activity or future plan, motivates academic performance and career choice behaviors and decision-making (Lent et al., 1994).

According to SCCT, career development is also influenced by objective and perceived environmental factors (Lent et al., 2000). Objective factors may include the quality of educational experiences and available financial support. According to Lent et al. (2000), "Such objective factors can potentially affect one's career development, whether or not one specifically apprehends their influence" (p. 37). Other contextual factors impacting a student's career decision may include perceptions of social supports, mentors, STEM educational programs,

family expectations, and barriers, including racism, exclusion, and gender role stereotyping (Brown & Lent, 1996). For example, supportive research mentors, classroom environments, family support, and socialization with peers all influence a student's level self-efficacy. On one hand, involvement of support systems by mentors, family, and peers may boost a student's feeling of self-efficacy while perceived barriers, such as socioeconomic status and poor campus climate, may create negative outcome expectations (Lent et al., 2000).

Lent et al. (2000) emphasized the importance of recognizing the individual differences students may have in response to similar environmental conditions. Lent et al. (2000) stated:

Many people have encountered persons who achieved great career and life successes despite the environmental odds against them; similarly, there are many stories of people who have failed in life's pursuits despite having every seeming environment advantage. If environmental conditions like material wealth were the only important consideration, all poor kids would fail and all rich ones would succeed (p. 37).

Thus, according to SCCT, researchers must consider multiple aspects of the objective environment as well as how students perceive and respond to surrounding environmental factors.

6.2.2. Campus Racial Climate Model

Although SCCT addresses the environment as an influential factor to student persistence, campus racial climate model (Hurtado et al., 1998) provides a multidimensional construct addressing the experiences of college students specifically from underrepresented racial and ethnic groups. Hurtado et al. (1998) defined a campus' racial climate with four interrelated dimensions: (a) structural diversity, (b) perceptions and attitudes between racial groups, (c) institution's history of inclusion or exclusion, and (c) the behavioral climate. According to Hurtado et al. (1998), the structural diversity, the numerical representation of racial and ethnic

groups on a campus, impacts the social adjustment and academic success of URM students. Greater diversity on a college campus creates more opportunities for interracial interactions and enhances college learning for all students (Hurtado et al., 2008).

However, structural diversity alone is not the only factor colleges should consider in establishing a welcoming environment for URM students. Hurtado et al. (2008) also examined the psychological climate, defined as the perceptions and attitudes between racial groups and hostile behaviors students encounter, as influential factors impacting URM student persistence in college. Hurtado and Ponjuan (2005) found that Latino/a students who perceived a college campus climate as hostile reported a lower sense of belonging and college persistence. However, those who experienced stronger and larger numbers of interracial interactions reported a greater sense of belonging. Although none of the participants of this study shared hostile behavior, they did share incidents of racial macroaggressions and exclusion from peers and faculty on the general campus. Upon joining a research laboratory, however, participants defined their research laboratory as a welcoming environment involving graduate students from diverse backgrounds. A research laboratory provides a diverse, welcoming environment promoting self- discovery, self-expression, and appreciation of artistic, cultural, and creative differences (Bauer & Bennett, 2003).

6.3. Implications for Practice

This study suggests a number of changes necessary to the academic success of underrepresented students in the STEM disciplines and improvements to program components enhancing student persistence into graduate programs. First, there is a need for a holistic institutional change. Participants shared incidents of exclusion and microaggressions by fellow peers and faculty outside of the laboratory. MRT programs should implement more diversity

efforts, including sensitivity training, cultural competence programs and workshops, and recruitment of diverse students, faculty, and staff. Promoting systematic changes on how institutions respond and value diversity may encourage a welcoming and nurturing environment for the entire college community.

Secondly, student narratives revealed valued social and professional relationships with graduate students. Participants expressed that mentoring relationships provided guidance and encouragement as they progressed through undergraduate studies and applied to graduate programs. As principal investigators of laboratories are often busy with other faculty obligations, the use of near peer mentoring increases mentoring accessibility from diverse graduate students. Including a near peer mentoring component for undergraduate programs creates a larger network of mentors encouraging college persistence.

Finally, participant narratives revealed early exposure to science and parental influence as major motivations in college persistence and graduate school enrollment. Encouraging parental involvement in a student's academic journey may offer invaluable benefits for students at all levels. Implementing community outreach activities to local K-12 children may spark interest in science and encourage college enrollment. Furthermore, encouraging parental involvement during undergraduate studies through invitations to research presentations and laboratory tours creates an impactful supportive and motivational network for URM students.

6.4. Realities and Limitations

As with all methods of inquiry, this study had limitations. Qualitative interviews are a great way of collecting detailed information; however, the primary source of data for this study relied on participant openness and accuracy. Social desirability bias, the tendency of an

interviewee presenting him/herself in a favorable way rather than providing accurate answers, may alter validity of participant narratives (Fisher, 1993).

Another limitation involved personal bias and subjectivities of interviewers themselves. Preexisting subjectivities of the interviewer may cognitively filter the representation of data. To minimize participant social desirability and researcher bias during the interview process, the researcher utilized open-ended questions, allowing participants to freely express their experiences while minimizing the researcher's personal thoughts and previous findings (Creswell, 2014).

Finally, qualitative research often requires a lengthy amount of time in the field of study (Creswell, 2014). This study occurred over a brief period of time and consisted of single in-depth interviews. The researcher's experience as the program coordinator for over 13 years, however, allowed the researcher to gain extensive understanding of the programs' and campus' culture and to enlist participants as co-researchers for narrative rich data.

6.5. Future Work

The findings of this study call for further exploration of factors and MRT program components impacting URM student persistence into doctoral programs. First, exploration of experiences of students who did not continue into advanced degree programs may identify variations and common themes across groups. Secondly, this study was conducted at a predominantly white and research intensive university in the southern region. Exploring student experiences from a different geographical area and campus climate may produce variations in findings. Ongoing research in these areas will provide institutions of higher education and enrichment programs with strategies to foster and promote the success of URM students in the science pipeline.

6.6. Conclusion

The results from this study provide personal narratives regarding the influence of a research training program on the career path and persistence into graduate degree programs. Each case provided personal and unique experiences and shared some commonalities. The participants expressed a sense of belonging and inclusion in their undergraduate research laboratories, close and supportive relationships with graduate students, enhanced scientific knowledge and confidence from research experiences, and parental influence. Based on findings, the study suggests a number of changes necessary to the academic success of underrepresented students in the STEM disciplines and improvements to program components enhancing student persistence into graduate programs, including holistic institutional changes to improve campus climates, utilization of near peer mentoring, and sustaining family involvement. This study adds student voices to the current literature supporting MRT programs as effective intervention influencing positive outcomes for URM students pursuing and achieving doctoral degrees. With this information, institutions and education programs may provide or improve support and resources needed to better serve URM students with science majors and enrich minority representation in academic or industry research careers.

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APPENDIX: CONSENT FORM

Consent to Participate in a Non-Clinical Study

1. Study Title: A Multiple Case Study Examining Experiences Among Alumni of a Minority Research and Training Program
2. Performance Site: Louisiana State University and Agricultural and Mechanical College
3. Principal Investigator: The following investigator is available for questions about this study,
M-F, 8:00 a.m.- 4:30 p.m.
Gretchen Schneider Burton (225) 266-9821
4. Purpose of the Study: The purpose of this research project is to examine the experiences among alumni of a minority research training program that matriculated into advanced degree programs.
5. Subject Inclusion: Individuals between the ages of 21-35 who received a bachelor's degree from a research intensive institution in a science related discipline, participated in a minority research and training program for at least two consecutive semesters, from an underrepresented group in the sciences, including African American, Latina/Latino, and Pacific Islander, and enrolled into an advanced degree program.
6. Number of subjects: 10
7. Study Procedures: Participation involves one face-to-face interview with the investigator held in a private room at the research site or via video call, during regular hours that are convenient for both the participant and researcher. The interview will last approximately 45 minutes to one hour. With your permission, audiotape and take notes will occur during the interview. The recording is to accurately record the information you provide, and will be used for transcription purposes only. If you choose not to be audiotaped, I will take notes instead. If you agree to being audiotaped but feel uncomfortable at any time during the interview, I can turn off the recorder at your request. Or if you don't wish to continue, you can stop the interview at any time.
8. Benefits: There is no direct benefit to you from taking part in this study. It is hoped that the research will yield valuable information about undergraduate research.
9. Risks: There are no anticipated risks to you if you participate in this study, beyond those encountered in everyday life. As with all research, there is a chance that confidentiality could be compromised; however, precautions will be taken to minimize this risk.
10. Right to Refuse: Subjects may choose not to participate or to withdraw from the study at any time without penalty or loss of any benefit to which they might otherwise be entitled.
11. Privacy: Results of the study may be published, but no names or identifying information will be included in the publication. Subject identity will remain confidential unless disclosure is required by law.
12. Signatures: The study has been discussed with me and all my questions have been answered. I may direct additional questions regarding study specifics to the investigator. If I have questions about subjects' rights or other concerns, I can contact Dennis Landin, Institutional Review Board, (225) 578-8692, irb@lsu.edu, www.lsu.edu/irb. I agree to participate in the study described above and acknowledge the investigator's obligation to provide me with a signed copy of this consent form.

Participant Signature

Date

VITA

Gretchen Schneider Burton was born in Slidell, Louisiana, to Joseph Frederick Schneider, Jr. and Rose Schneider in 1980. She attended primary school in Slidell, Louisiana, and graduated from Slidell High School in 1998. Gretchen received her Bachelor of Science degree in psychology with a minor in English from University of Louisiana at Lafayette in May 2002. With growing interest in counseling, she pursued and completed a Master of Education in counselor education with a concentration in school counseling in May 2004. Gretchen pursued a career as a counselor and grant coordinator at Louisiana State University and earned her state licensure for mental health counseling. In 2014, Gretchen enrolled into graduate school at Louisiana State University to pursue her doctorate degree in the School of Education. During her graduate studies, Gretchen obtained her Certificate of Education Specialist in educational leadership in May 2017. Gretchen plans to graduate with her Doctor of Philosophy degree in educational leadership and research with a concentration in higher education administration December 2017.