THE ROLE OF UNDERRGRADUATE RESEARCH PROGRAMS IN INFLUENCING ASPIRATIONS TO PURSUE GRADUATE EDUCATION AND FACULTY CAREERS AMONG UNDERREPRESENTED STUDENTS

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Introduction

Western education is ever-changing and educational attainment is more important to economic and societal success than ever before. As the years go by, the struggle to meet the needs of the increasing population has become more challenging (Bowen, Chingos, & McPherson, 2009; Collins & Kritsonis, 2006). One of the challenges of higher education is to ensure that all students have a "reasonable chance" to succeed (Raines, 2012). Although access to higher education has increased markedly over the past 40 years (Kezar, 2000), ethnic and racial involvement, attainment and achievement gaps are still a persistent in the United States (Carter, 2006; Curto, Fryer, & Howard, 2011). Numerous studies have documented continuous gaps between the educational attainment of Black, Hispanic, American Indian/Alaska Native, and Native Hawaiian/Pacific Islander students (e.g., Carter, 2006; Ross et al., 2012).

We have learned a lot about the challenges endured by underrepresented populations (Carter, 2006). Scholars place much of the importance on research suggests that (a) ethnic and racial context of the students impact on students' career motivations and aspirations (Herrera & Hurtado, 2011), (b) underrepresented students encounter social barriers as they navigate their education (Barlow & Villarejo, 2004; Fleming, Moore, Williams, Bliss, & Smith Chivon, 2013), and that (c) the likelihood of enrolling in a post-baccalaureate educational program varies by race and ethnicity (Perna, 2004). Accordingly, a significant body of research examining variables that inhibit and enhance success of underrepresented students has shown that some of the barriers for these include: (a) lack of self-confidence, (b) inappropriate expectations or information about the college environment and college preparation, and (c) lack of connection to the college community (Gasiewski, Garcia, Herrara, Tran, & Newman, 2010; Terenzini et al., 1994). Underrepresented students also face financial difficulties and an absence of role models who have gone to college (Bayer, 2010; Ntiri, 2001). Consequently, many students, mostly from first-

generation and low-income backgrounds, self-select themselves out of the college pipeline and postgraduate college "because they either do not feel they are prepared for it, or worse, simply feel they do not belong there" (Swail, 2014).

While many underrepresented students drop out of higher education because of finances and cultural barriers, others drop out because they do not possess the academic-related skill-sets to succeed (Swail, 2014). Along with others, these apprehensions may influence underrepresented students' persistence in the academic environment. However, development in college is important because college experiences influence student identity and can also influence students' post-college plans, including graduate school (Williams, George-Jackson, Baber, & Trent, 2011).

Much work has been done developing learning strategies that support the academic and professional identity development of learners from underrepresented groups. In order to determine variables that significantly influence persistence among underrepresented students extensive research has been conducted. The results showed that academic characteristics of underrepresented students, such as students' degree expectations, choice of major, and classroom performance, and family background predict whether an individual would apply to graduate school (Carter, 2006; Mullen, Goyete, & Soares, 2003; Zhang, 2005). Essentially, Mullen et al. (2003), Heller (2013), and Ross et al. (2012) suggested that parents' educational backgrounds and their participation continued to influence students' educational attainment through parents' educational expectations: students of well-educated parents had higher educational expectations, which translated into a greater propensity to enroll in graduate programs.

As economic and social changes have placed greater emphasis upon the college degrees as a medium of social mobility, educational initiatives provided by postsecondary education have become even more important over the recent decades. Accordingly, support initiatives as

undergraduate research programs have been created to help generate a pool of prospective graduate students from underrepresented populations, and to help these students make the transition to graduate school (Kweli, 2011). According to Hu, Kuh and Gayles (2007), student engagement in research-related activities increased from the mid-1990s in all types of institutions and in all major fields.

The literature suggests that participation in undergraduate research programs hold enormous potential in increasing underrepresented students' learning, retention, and their entrance into graduate school (Raines, 2012). Although these programs appear promising especially for underrepresented students, population statistics on ethnic and racial diversity among graduate students show slow progress in increasing representation of diverse students in graduate schools. A decade ago, despite small incremental progress, the proportion of underrepresented students receiving graduate degrees continued to remain “woefully” low (Booker & Frierson, 2002). Consequently, there is still a lack of representation of diverse population within the faculty in higher education.

Indeed, it is important that researchers continue to assess interventions that affect targeted populations (Carter, 2006). More research is needed to identify what makes undergraduate research programs effective, and more precisely, what features of the programs are critical for underrepresented students to pursue graduate education and faculty careers. Understanding the critical features of successful initiatives toward inclusion can result in even greater success in future interventions (DePass & Chubin, 2008).

Purpose of Study

Since, diversity is “an asset we cannot afford to waste” (National Academy of Sciences, 2011, p. 3), this study sought to determine whether participation in undergraduate research program increases underrepresented students' interest in pursuing graduate degrees and faculty

careers. This study focused on social-cognitive outcomes associated with participation in undergraduate research programs, students' aspirations to pursue graduate education and faculty careers. Specifically, this study compared students' perspectives towards graduate school and faculty career at the beginning and at the near end of program participation. Furthermore, this study examined students' reasons to enter undergraduate research program and students' perceptions of social interaction related to the program.

This study aimed to provide evidence of the benefits of undergraduate research participation on subsequent intentions to enroll in graduate school and pursue faculty careers. I explored the ways in which undergraduate research programs were able to assist underrepresented students in supporting them in pursuing graduate degrees and faculty careers.

The study used data from University of North Carolina at Chapel Hill's Summer Pre-Graduate Research Experience (SPGRE) program, established to facilitate the entrance of students from underrepresented students into graduate school. This report was designed to assess student outcomes of the SPGRE program from the year 1997. Analyzing and comparing students' perspectives at the beginning and the end of their participation in the undergraduate research program, this study aims at assessing short-term outcomes of the SPGRE program as "what are the participants going to know, feel, or do differently after participation in the program" (Barkman, 2012).

Significance of Study

This study gives attention to student outcomes of undergraduate research initiatives for underrepresented students. Specifically, this study focuses on examining the role of social interaction in undergraduate research programs in influencing aspirations to pursue both, graduate education and faculty careers. Moreover, this study seeks to determine which practices and approaches of social interaction in undergraduate research programs appear to contribute to

increasing underrepresented students' interest in graduate school and faculty careers.

Results of this investigation can serve as a useful information source for both policymaking and program management. Specifically, data analyzed from this type of research can be shared with program stakeholders and funders to show the impact of the program. Moreover, findings from this study can provide valuable information about whether the program achieved its targeted outcomes. Finally, results of this study can enhance the accessibility of evidence-based approaches to creating programs and strategies and increase effectiveness of undergraduate research initiatives for underrepresented students. In addition, understanding underrepresented student retention and persistence is not only important for college leaders, educators, and researchers, but it also has long-term influences on community (Carter, 2006).

In this study, “historically underrepresented students” and “underrepresented students” all refer to the following ethnic and racial groups: African Americans or people of African descent, Pacific Islanders, Hispanics or Latino/Latina persons, and Native Americans and Alaskan Natives.

In this investigation, "outcome(s)" and "program outcome(s)" were defined as the "change(s)" we would expect to notice as a result of participation in an undergraduate research program.

Undergraduate Research Programs for Underrepresented Students

This section reviews the literature on definition, characteristics, and student outcomes of undergraduate research programs. A concerted effort has been made to analyze prior studies examining the outcomes of undergraduate research programs for underrepresented students. In order to present a broader context of the role of undergraduate research programs in society and illustrate a rationale for assessing the outcomes of these programs, I highlight some of the key issues related to diversity among higher education faculty.

Definition and Characteristics

One of the strategies implemented to increase underrepresented students' participation in graduate school education and their aspirations to pursue faculty careers is engagement and participation of diverse students in undergraduate research programs. There are several definitions of and perspectives towards undergraduate research programs, all of which support the idea that undergraduate research is a vehicle for encouraging student success. For instance, Kuh (2008) determined undergraduate research programs to be high-impact educational practice because of their potential to deepen student learning, strengthen self-awareness and confidence, and broaden perspective-taking abilities.

Involvement in undergraduate research experience is explained as an undergraduate engagement in faculty-mentored, authentic research undertaken outside of class work (Seymour, Hunter, Laursen, & DeAntoni, 2004). In order to determine how to encourage and "celebrate" undergraduate research programs, Undergraduate Research Task Force (2012) organization provided detailed definition for undergraduate research experience and "creative endeavors":

> Undergraduate research and creative endeavors are defined as scholarly, collaborative, authentic, original work or an assessment from new point of view conducted by a student or group of students within a mentored environment for the purpose of publicly disseminating the information through a university seminar, poster/oral conference presentation, performance, exhibition, and/or publication. (p. 1)

From a society development and socioeconomic growth perspective, undergraduate research programs are also identified as "wise investments for governmental agencies and institutions that strive to contribute to the larger goal of sustaining our nation's capacity to flourish in the areas of science and technology." (Eagan et al., 2010, p. 28)

Reasons for Participation in Undergraduate Research Programs

Definitely, participation in undergraduate research programs exposes students to ways they can connect their motivation to research experience in preparation for graduate programs. Still, determining student outcomes of undergraduate research programs, Seymour et al. (2004) posited that discussion on the benefits of undergraduate research programs should distinguish between claims that the undergraduate research experience can prompt students to *choose* a graduate school path, and more qualified claims that the undergraduate research experience can *clarify*, *refine*, and *reinforce* such a choice. In addition, discussing the role of undergraduate research programs in influencing student aspirations to pursue graduate education, it is important to consider that not all students have aspirations to pursue graduate education before participating in undergraduate research program.

Research that examined factors that students cited for engaging in undergraduate research programs showed that students entered undergraduate research program for various reasons. Luchini-Colbry et al. (2013) found that the most common reasons students reported for choosing undergraduate research engagement were: (a) to enhance their resumes, (b) to gain practical experiences and skills for a future career, and (c) because it was a paid position. Furthermore, 75% of students reported that they wanted to develop mentoring relationship with a faculty member, and another 71% believed the research experience would help prepare them for graduate school.

Conversely, Mabrouk and Peters (2000) found that a majority (74%) of undergraduate students in biology and chemistry fields reported participating in undergraduate research primarily to learn "on their own." In the study, the majority of students (58%), who were mostly Caucasian (87%), became involved in research through the active effort of faculty. However, there was no information whether and to what extent participants' intentions to enter

undergraduate research program were correlated with participants' aspirations to pursue graduate education after the program participation.

Gains and Benefits of Participation in Undergraduate Research Programs

Scholars place a great amount of emphasis on examining the widespread beliefs that students who access undergraduate research opportunities derive a number of immediate and long-term benefits from their participation (Hurtado et al., 2014). For instance, undergraduate research programs can have a strong impact on student retention (Raines, 2012). Therefore, undergraduate research experiences have been specifically designed as graduate school preparation programs with a common goal: to increase underrepresented student participation in providing research experiences, mentoring, and intensive program advising (Lewis, 2007; Jones, 2014). All of these activities have been created to provide underrepresented students "an equal footing" with other students (Kezar, 2000).

There are few studies that examined gains and benefits of participation in undergraduate research programs among underrepresented students. Findings of these studies revealed that engaging underrepresented students in research played a significant role in students' educational trajectories. For example, Hathaway et al. (2002) investigated impacts of The Undergraduate Research Opportunity Program (UROP) at the University of Michigan on graduate education pursuit among underrepresented students who participated in the UROP program. The findings revealed that 76% of the participants in the UROP went to graduate school, and that UROP underrepresented students were significantly more likely to pursue graduate education than were underrepresented students without the experience in undergraduate research.

Using longitudinal research approach, Foertsch et al. (2000) tracked 4,585 (90%) underrepresented students participating in the Summer Research Opportunity Programs (SROP) during the 10-year period (1986-1996). He found that students described their participation in the

SROP program as a necessary step in allowing them to make an informed choice about attending graduate school; even when participants of the program did not enroll in postsecondary institutions for advanced degrees, the SROP program encouraged and prepared participants for graduate education.

Some studies have focused on the characteristics of undergraduate research experience that can foster students' interest in pursuing graduate education. For example, using qualitative methods only, Pedersen-Gallegos (2007) explored the extent to which participation in undergraduate research programs influenced students' aspirations to pursue graduate school. Although none of the participants said that the Smith College Summer Research program inspired them to pursue graduate school, participation in the program helped to shape graduate school plans that the students already had; 53% of the participants said that they learned more about specific career options in their disciplines of study, which informed their graduate school plans. Moreover, the students reported the following benefits of their research experience: (a) collegial work with mentor, (b) learning gains, such as research and lab skills, (c) involvement in authentic research, and (d) clarification of career aspirations.

Similarly, McGee and Keller (2007) sought to determine characteristics among 26 college undergraduates from underrepresented groups that predicted persistence in graduate education at the Mayo Clinic College of Medicine. After conducting interviews at the start, near the end, and 8-12 months after participants' research experience the following characteristics that predicted those students who pursued graduate studies evoked: (a) curiosity to discover the unknown, (b) enjoyment of problem solving, (c) high level of independence, and (d) desire to help others through research. The findings also revealed that a great majority of the students talked about individuals who played critical roles in shaping and guiding their interests in their career directions. However, no patterns emerged that revealed differences between participants who

continued with research and those who chose other career options after graduating from college.

Furthermore, Alexander, Foertsch, Daffinrud, and Tapia (2000) sought to uncover key strategies of undergraduate research initiatives for successfully recruiting underrepresented students in graduate education. After collecting data from 52 students who participated in the Summer with a Scientist program (SaS) at the Rice University between the years 1991 and 1997, the findings showed that the program succeeded in recruiting underrepresented undergraduates into graduate school. Specifically, the likelihood that underrepresented students went to graduate school was related with an open-ended and authentic nature of the research process in the program. Similarly, Strayhorn (2010) found that students who were engaged in authentic research environment and collected or analyzed data were more likely to have higher degree aspirations at the end of the program than students who mostly review prior literature.

According to these findings, undergraduate research programs have been shown to enhance the educational experience and retention of underrepresented students in graduate education. Still, many challenges still exist for creating and improving programs for underrepresented students navigating particular graduate programs. Evidently, the Science, Technology, Engineering and Mathematics (STEM) fields have traditionally been unsuccessful in attracting, retaining, and graduating acceptable numbers of underrepresented students (Blake & Liuo-Mark, 2014). Therefore, in order to increase participation of underrepresented students in STEM programs and careers, federal and private institutions have invested significantly in undergraduate research programs (Strayhorn, 2010).

Studies that focused on outcomes of undergraduate research programs among STEM students showed that participation in these programs may be one of the most potent means of retaining underrepresented students in STEM disciplines. For instance, Eagan et al. (2010) investigated the effects of participation in undergraduate research program on students' intention

to enroll in graduate school in a STEM fields. The findings revealed that initial STEM aspirants who gained research experience through the undergraduate research programs were significantly more likely to indicate intentions to pursue a graduate degree in a STEM-related discipline compared to students who did not participate in the program. However, the program attracted and admitted students who were already beginning to identify themselves as scientists. Yet, in another study, Carlone and Johnson (2007) found that participation of underrepresented students in undergraduate research program increased their identification with STEM disciplines, which helped to orient students toward graduate programs in science and engineering.

Lopatto (2004) also examined student aspirations to pursue graduate degrees after participation in undergraduate research program in STEM fields. He analyzed data that were gathered from a questionnaire that was created for research initiative called Survey of Undergraduate Research Experiences (SURE) on undergraduate students' perceptions and experiences with summer undergraduate research programs. The findings revealed that for 62.2% of the participants who had a plan for graduate education, participating in summer undergraduate research did not change this plan. Specifically, for 27.1% of the participants, undergraduate research experience confirmed their graduate education consideration. Importantly, Pender, Marcotte, Domingo, and Maton (2010) investigated longitudinal outcomes of the Meyerhoff Scholarship Program. They found that students in STEM fields who participated in the program were more likely to enroll in graduate schools in STEM disciplines.

There are a few studies that examined the influence of participation in undergraduate research programs for underrepresented students on both, graduate school enrollment and academic success. Among the studies conducted, Maton, Hrabowski, and Schmitt (2000) found that the Meyerhoff Scholarship Program increased the numbers of African American undergraduates who succeeded in science, mathematics, and engineering. Specifically, the

Meyerhoff African American students were more likely to graduate in STEM majors, earn competitive STEM grade point averages, and enter STEM graduate programs than multiple comparison samples.

In another study focused on examining student outcomes of undergraduate research programs, Hurtado, Cabrera, Lin, Arellano, and Espinosa (2009) examined how underrepresented students develop scientific research identity in undergraduate research programs. In the study, key themes that emerged from discussions in focus groups were (a) learning to become research scientists, (b) experiences with culture of science, and (c) views on racial and social stigma in scientific training. The majority of participants experienced the collaborative environment and exhibited strong science identities and high self-efficacy. Furthermore, the majority of participants developed oriented professional goals as a result of "doing science" in undergraduate research programs.

Hanauer, Frederick, Fotinakes, and Strobel (2012) identified the extents to which students developed a sense of ownership of the research projects they completed, and persistence in higher education. In the study, students with undergraduate research experience reported both a stronger sense of ownership of their research projects and higher levels of persistence in sciences, compared to students who participated in traditional research courses and research internships.

Certainly, there has been a lot of empirical work that attempts to assess the impact of undergraduate research programs on academic and professional development of students. Research on underrepresented students' academic development suggested that investment in the future of underrepresented students can be achieved by promoting measurable programs that promote graduate education in all fields of education (National Math and Science Initiative, n.d.). While colleges and universities celebrate the increasing original gains and contributions to

learning generated through undergraduate research programs, the external press for accountability focuses on different output and outcome measures. Consequently, studies of research-based evidence can help inform of how to achieve maximal effectiveness in increasing students' aspirations to pursue graduate education and faculty careers (Paul, 2012).

Undergraduate research programs have been criticized for ability to influence large-scale gains because they cater to a small, specific population of students and frequently are costly to operate (Barnett, Bork, Mayer, Pretlow, Washington, & Trimble, 2012). Moreover, according to DePass and Chubin (2008), many of these programs have not been created and implemented on conclusions drawn from research into how best to increase the participation of underrepresented students in the sciences. Instead, the programs have relied on intuitive approaches and 'best practices' that might not be applicable across student population. For example, a particular undergraduate research program might do more to reinforce the learning of those students already committed to a research or academic career path without also drawing students uninterested into graduate education (DePass & Chubin, 2008).

Benefits of Mentoring for Underrepresented Students

For underrepresented students, undergraduate research programs appear to facilitate relationships and connections with the faculty (Hathaway et al., 2002). In addition, social interactions in the program are powerful predictors of student commitment and persistence (Demaris & Kritsonis, 2006). In order to learn from their research experience, students participating in undergraduate research "require" a collegial yet professional relationship with their mentors (Guterman, 2007). Since retention of underrepresented students may largely hinge on issues such as financial aspect, supportive and positive faculty-student relationships are an imperative part of positive research and college experience (Kuh, Kinzie, Buckley, Bridges, & Hayek, 2006; Pillay, 2011).

For example, Strayhorn and Melvin Cleveland (2007) performed a secondary analysis of data from a national sample obtained from the College Student Experiences Questionnaire (CSEQ) Research Program from 554 Black college students. He assessed the role of faculty-student mentoring on student satisfaction with college. The results revealed that "establishing a meaningful, research-focused mentoring relationship with a faculty member had a positive relationship with Black students' satisfaction with college, whereas establishing a personal, informal mentoring relationship did not have a significant effect on satisfaction" (p. 69). Similarly, Lewis (2007) found that there were significant correlations between the faculty preceptor relationship and undergraduate research program satisfaction. The findings suggested that it was necessary to create and maintain a professional and supportive relationship between faculty mentors and program participants.

In another study, Smith and Frierson (2004) examined mentoring experiences among underrepresented graduates who participated in a research program, designed to support underrepresented populations in their efforts to attain PhD degrees at large, predominantly white institution in the Southeast. The results showed that the experiences of those students who reported positive mentoring relationships had similar themes. Of the themes emerged, students discussed: (a) comfortable and open relationship, (b) being able to openly discuss ideas with professors who respected their knowledge and insight, (c) encouragement, and (d) appropriate social skills of the mentors which was helpful in establishing the foundation for a "mentorship". However, Smith and Frierson (2004) did not explicitly discussed to what level mentoring experiences influenced students' perspectives towards graduate school.

Having a quality and positive research experience with faculty mentors, may increase both, confidence in research and interest in attending graduate school after undergraduate research experience (Aspray & Bernat, 2000). To demonstrate, Cambell and Skoog (2004) found

that the Texas Tech's HHMI program influenced both, students' self-efficacy in research and their aspirations to pursue graduate school. Similarly, Foertsch et al. (2000) and Szelenyi and Inkelas (2011) concluded that students' positive academic and research identity development and increased interest in graduate education were related with professional guidance and supportive relationship between the students and their mentors.

Early and Repeated Engagement in Undergraduate Research Programs

Undergraduate research experiences provide clarity for academic trajectories. Findings of the prior studies revealed that earlier experiences (e.g., freshman or sophomore year) had a stronger relationship with graduate school aspiration and subsequent persistence in educational environment than undergraduate research experiences that occured later in a student's undergraduate career (Hurtado, Eagan, Figuera, & Hughes, 2014; Pender et al., 2010).

The research showed that undergraduates make the most intellectual gains and have the greatest opportunity to become research partners and co-authors of peer-reviewed publications if they are involved in faculty-supervised research activities early and repeatedly in their academic careers (Lopatto, 2009). Early engagement in research helped students acquire multiple research experiences during their undergraduate years, and this helped them define their interest in graduate education (Rowlett, Blockus, & Larson, 2012). In addition, the first year of college was the most critical in ensuring underrepresented student success (Demaris & Kritsonis, 2006).

Characteristics and Type of Institution versus Graduate School Aspirations

Determining variables that influence graduate school aspirations among undergraduate students, findings of the prior studies suggested that graduate school attendance was linked with characteristics and type of institution. For example, Carter (1999) found that cultural dimension of institutional characteristics had an influence on interest in a graduate school; African-

American students who attended institutions with a higher percentage of African-American population had higher degree expectations.

Similarly, Eagan and Newman (2010) found that undergraduate students at Historically Black Colleges and Universities were more likely to have graduate plans compared to students from Hispanic-Serving Institutions and Predominately-White Institutions. Moreover, undergraduates from privately funded and elite institutions with extensive research experience were more likely to have graduate plans compared to undergraduates from public institutions without extensive research experiences (Hu et al., 2007; Mullen et al., 2003; Zhang, 2005).

Community-based Benefits of Undergraduate Research Programs

Exploring professional and academic gains of students with undergraduate research experience has an important role in broader community (Crowe & Brakke, 2008). Undergraduate research activities helped underrepresented students to reduce a sense of marginalization and isolation, and promoted integration of underrepresented students into academic community (e.g., Gasiewski et al., 2010; Hunter et al., 2007). Similarly, using a qualitative multiple-case study design, Jones (2014) examined the role of three undergraduate research programs in STEM fields on the greater campus community. The findings revealed that each program contributed in increasing diversity in graduate schools, inclusion, and community collaboration. Moreover, the undergraduate research programs had a significant impact on perceptions of diversity and inclusion among faculty and staff within a greater campus community, and consequently, worked as "advocates for change."

According to these findings, undergraduate research programs have served as important components of college missions, especially in terms of inclusion, commitment, and persistence of students with diverse cultural backgrounds (Marwick, 2012; Swail, Redd, & Perna, 2003). This group of students faces many obstacles in their educational environment, such as

sociocultural and academic isolation, negative stereotypes, prejudice, and low expectations, all of which contribute to the lower levels of motivation and performance (Hurtado, Eagan, Figueroa, & Hughes, 2014).

Research also showed that the effects of participating in undergraduate research programs appeared promising especially for underrepresented students who tended to benefit more from engaging in educational purposeful activities than majority students. Underrepresented students benefited more in increase of self-confidence in research and feelings of belongings to the academic environment than White and Asian students (Brownell & Swaner, 2010; Kezar, 2000; Russell, Hancock, & McCullough, 2007).

Diversifying Higher Education Faculty

Research has shown that there is continued underrepresentation of ethnic and racial populations not only in graduate programs, but in academic professions as well, mostly African American, Hispanics, Native American, and Alaskan Natives (Crowley et al., 2004; Perna, 2001). Although affirmative action has been portrayed as a way to increase the number of faculty of color in higher education and several efforts in the practice have been done, faculty diversity remains "more of a dream than a reality" (DePass & Chubin, 2008; Kosoko-Lasaki, Sonnino, & Voytko, 2006; Swail et al., 2003; Umbach, 2006). Evidently, interest in faculty careers decreases as training progresses (Gibbs & Griffin, 2013; Mervis, 2006).

For instance, Moreno, Smith, Clayton-Pedersen, Parker, and Teraguchi (2006) found that the status of faculty ethnic and racial diversity at 27 colleges in California continues in its slow progress; a large portion of underrepresented faculty hired between 2000 and 2005 replaced underrepresented faculty who had recently left. Of nearly 1500 hires on the campuses within the five years, only 157 of these hires were American Indian/Alaska Native, African American, or Hispanic (Moreno et al., 2006). Among the barriers to recruit and retain faculty with culturally

diverse backgrounds, a review of the research revealed two primary themes: isolation and lack of mentoring (Campbell et al., 2014; Williams & Kirk, 2008).

The persistent deficit of underrepresented population in graduate schools and among faculty validates the continued need for structured evaluation of undergraduate research programs. Accordingly, given the slow progress in diversifying the workforce thus far, it is clear that "the current architecture and format of these programs is not sufficient for addressing the problem" (Campbell, Skvirsky, Wortis, Thomas, Kawachi, & Hohmann, 2014). A lack of representation of culturally diverse populations in academic professions should be taken more strategically, especially because we are facing a critical moment in postsecondary education: if college education does not succeed in enhancing interest in academic careers among underrepresented students, and in "diversifying the group of faculty and currently entering the academy, an entire generation's worth of opportunity will be lost" (Moreno et al., 2006, p. 16).

If those in higher education want truly to move beyond symbolic diversity and inclusion of underrepresented students toward "institutional change", institutional leaders and the competent organizations that encourage diversity initiatives must begin to take the role of undergraduate research experience more seriously (Jones, 2014). Underrepresented students need to be introduced both to graduate schools and to the idea of graduate school. They also need to show that faculty positions may offer an opportunity to give back to their broader communities, which is a goal for many of these students (DePass & Chubin, 2008). As possible strategies are viewed to increase the number of underrepresented students in graduate schools and within a faculty, we must keep in mind that in the relationship between the faculty and student, each one influences the other (Antonio, 2003).

Indeed, among others reasons, the importance of undergraduate research programs in facilitating underrepresented students' interest in graduate school and faculty careers is also

reflected in the role of ethnic and racial diversity within a mentor faculty, who "make or break" undergraduate research experience (Foertsch, Alexander, & Penberthy, 2000). Scholars posit that there are several reasons to hire a diverse faculty, especially because a diverse faculty population and diverse learning environments lead to great benefits for all students and their communities (Collins & Kritsonis, 2006).

Specifically, Montvale (2003) conducted a survey among 1,094 undergraduate and graduate students at U.S. colleges and universities. Among the respondents, 46% were White, 31% African American, with the remaining 23% consisting of Hispanic, Asian Americans, American Indians or "other." In the study, 96% of underrepresented students and 83% of non-underrepresented students reported that professors with culturally diverse backgrounds had a positive impact on their education. Moreover, in the study, 88 % of all respondents felt that professors with diverse backgrounds positively impacted their career decisions of underrepresented students, and 69% of all respondents believed that professors with culturally diverse backgrounds had a positive influence on career decisions of non-underrepresented students. Similarly, Russell et al. (2007) found that having a mix of mentors in terms of their race and ethnicity is likely to have a beneficial effect for all students.

Student body diversity and faculty diversity are mutually reinforcing, because they call for collaboration, new approaches in education, and broader outreach (Springer, 2006). Accordingly, understanding more about how underrepresented students experience undergraduate research programs, and which experiences and characteristics of social interaction in these programs may influence student persistence provides insights into the complexities of underrepresented faculty in higher education and into diversifying a faculty workforce.

Summary of the Literature Review

The literature analyzed in this paper has shown that undergraduate research programs

appear promising at providing a host of benefits related to academic and professional development. Students who are involved in undergraduate research (a) become more self-confident in self-directed information gathering, (b) establish a collegial, working relationship with faculty mentors and with peers, (c) enhance career or graduate school preparation, (d) gain personal and professional skills, such as leadership, communication, research, and critical-thinking skills, (e) increase their completion rate and grade point average (GPA), (f) increase their understanding and tolerance, independence, and awareness in educational environment, and (g) enhance their sense of science identity (Barlow & Villarejo, 2004; Carlone & Johnson, 2007; Craney et al., 2009; Eagan et al., 2013; Haave & Audet, 2013; Hunter, Laursen, & Seymour, 2007; Lewis, 2007; Lopatto, 2004; Luchini-Colbry, Wawrzynski, & Shannahan, 2013; Russell et al., 2007; Seymour et al., 2004; Shaw & Kennepohl, 2013).

The studies highlighted in previous sections have also revealed a great deal about the impacts of particular undergraduate research program on underrepresented students' interest in entering graduate education. The findings showed that underrepresented students with undergraduate research experience had a greater interest in research and were more likely to pursue graduate degrees (e.g., Eagan et al., 2010; Hathaway et al., 2002; McGee & Keller, 2007; Lopatto, 2004; Russel et al., 2007; Seymour et al., 2004). Positive aspirations to pursue graduate education were related to research skills and research experience (Hathaway et al., 2002; Lopatto, 2004). Moreover, the results revealed that experience gathered from undergraduate research programs increased enrollment among underrepresented students (e.g., Bauer & Bennet, 2003; Herrera & Hurtado, 2011; Lewis, 2007). Importantly, the positive effects of undergraduate research experience extend beyond retention and persistence; underrepresented students involved in undergraduate research also tended to have higher intellectual gains in college (Mabrouk & Peters, 2000; Seymour et al., 2004).

Examining the role of mentoring in undergraduate research programs, findings of the studies showed that professional support by mentors and peers fostered underrepresented students' resilience and their ability to navigate their academic and professional development (e.g., Corwin Auchincloss et al., 2014; Gasiewski et al., 2010). Cooperative and supportive mentoring and peers relationships in the program connected underrepresented students to networks that fostered their positive academic and professional identity, including defining their role within the broader academic or scientific community (e.g., Alexander et al., 2000; Carlone & Johnson, 2007; Corwin Auchincloss et al., 2014; Jones, 2014; Pedersen-Gallegos, 2007). Students reported that working collaboratively with mentors and peers in a "hands-on" research environment contributed in increasing their self-efficacy and confidence in doing research (Bauer & Bennett, 2003; Szteinberg & Weaver, 2013).

Because "conducting research with a faculty member can be a life changing experience" (Kuh, Kinzie, Cruce, Shoup, & Gonyea, 2007, p. 38), supportive and understanding faculty-student relationships were emphasized over learning gains and benefits by students participating in research (e.g., Falconer & Holcomb, 2008; Hunter et al., 2007; Russell et al., 2007). Lundberg & Schreine (2004) suggested that the quality of the student-mentor interaction mattered: for undergraduate students from a variety institutions and ethnic groups, the quality of the student-faculty relationship was determined as a stronger predictor of learning outcomes than student background characteristics. Accordingly, research on gains for underrepresented students with undergraduate research experience showed that participation in undergraduate research programs provided a pathway to a research career regardless of ethnicity (Hathaway et al., 2002; Lopatto, 2004; Russel et al., 2007; McGee & Keller, 2007). However, since undergraduate research experience can markedly differ from that of majority white students, cultural background characteristics still has tended to be a significant predictor of the outcomes of program

participation and/or graduate school attendance (Rendon, Jalomo, & Nora, 2000; Zhang, 2005).

Despite several positive outcomes of participation in an undergraduate research program for underrepresented students, students' experiences with the program varied in structure, intensity, and the frequency or duration of the experience (Balster, Pfund, Rediske, & Branchaw, 2010). All of these influenced the level of gains student make as a result of being involved in research (Carter, Mandell, & Maton, 2009). In turn, this might affect student's decision to apply for a graduate school and pursue a faculty career.

Student satisfaction with undergraduate research experience is one of the building blocks of the retention process among underrepresented students (Demaris & Kritsonis, 2006). The literature review has shown that for undergraduate research experience to be effective in creating positive experience among students and consequently, increasing their interest in graduate education, faculty mentors must give undergraduate researchers a significant role in all phases of the research process (Bauer & Bennett, 2003). Undergraduate research programs should also provide students with socioemotional and academic support (Barlow & Villarejo, 2004). Moreover, undergraduate research programs should be implemented in authentic and open-ended research environment (Foertsch et al., 2000; Rowlett et al., 2012); goals and expectations of the research should be clearly defined, including assessment of student learning outcomes of undergraduate research program (Blake & Liou-Mark, 2014; Lopatto, 2009). Institutions that strive for excellence should recognize and embrace opportunities to combine undergraduate research programs with other engaging experiences when undergraduates have achieved a level of research competence and self-efficacy (Rowlett et al., 2012).

Critique of the Prior Studies and Suggestions for Further Research

Although there have been several studies on the outcomes of undergraduate research programs conducted, the number of comprehensive and rigorous analyses of programs designed

to increase the participation of underrepresented students remains small (BEST, 2004).While extant literature on undergraduate research programs reported positive outcomes and provided comprehensive strategies for the programs to be effective, it is equally important to determine empirical correlations between outcomes and program participation. "(E)fforts to increase our understanding of how and why the program succeed are as important as the programs themselves." (Lewis, 2007, p. 87)

The cumulative academic benefits of participating in undergraduate research programs are varied, interwoven, complex, and, in some cases, not easily measured (Bauer & Bennett, 2003; Perna, 2004). Even if a positive outcome is realized, there is a lack of understanding what characteristics and experiences of the programs influence underrepresented students' interest in entering graduate school, especially among the students who enter undergraduate research programs with negative or neutral interest in graduate school. Moreover, although there is empirical evidence that underrepresented students who participate in undergraduate research benefit in many ways, it remains unclear why and how some students benefit more from program participation, and/or have different perspectives and aspirations to pursue graduate school at the end of the program.

Assessing the outcomes of undergraduate research, very few studies have attempted to systematically investigate outcomes of undergraduate research programs for underrepresented students across various majors and from different institutions (e.g., Historically Black Colleges and Predominately-White Institutions). In addition, the majority of studies that examined the outcomes of undergraduate research programs for underrepresented students analyzed a single institution and/or major. Such analytic approach limits a generalization of the findings to other institutions and majors.

Research on student-derived benefits from undergraduate research participation also tend

to be retrospective in nature by asking alumni and participants with undergraduate research experience to discuss their experiences or to identify the key undergraduate opportunities that helped them to pursue graduate school (e.g., Barlow & Villarejo, 2004; Bauer & Bennet, 2003; Hathaway et al., 2002, Pedersen-Gallegos, 2007). Research that employs student data gathered at the beginning and at the end of students' participation in undergraduate research program is needed to overcome validity issues and to understand the links between the students' aspirations and program outcomes. In that case, participants are able to accurately report their academic and career aspirations.

This study seeks to contribute to the existing literature by examining the student outcomes from program participation and the variables that were related to these outcomes. Essentially, this investigation focuses on the process of uncovering the significance of the program contexts on students' perspectives and intentions to pursue graduate education and faculty careers. Importantly, this study is driven by acknowledgment that as with other promising educational practices, just because students have undergraduate research experiences does not necessarily mean that this experiences will increase their interest in graduate education and faculty careers, or automatically enrich their learning and development (Hu et al., 2007). In addition, the presence of program staff, peers, and faculty preceptors can have a significant impact on their experience and program output (Jay et al., 2005).

Theoretical Framework

This section presents and analyzes theoretical framework used in this study. Applicability and appropriateness of theories employed in this study to determine student outcomes of undergraduate research program are suggested and explained.

Role of Social Interaction in Undergraduate Research Programs

Related to the role of supportive research environment, mostly by mentors, Vygotsky

(1978) introduced a developmental, social constructivist theoretical approach to learning and development. According to Vygostky (1978), the learning process involves collaboration between learners and teachers, or more knowledgeable others. In this case, both students and faculty mentors are expected to be actively engaged in authentic activities. Vygotsky's (1978) concept of The Zone of Proximal Development (ZPD) provides an understanding of interaction with mentors and advanced peers from a cognitive approach to learning.

The concept of ZPD can be applied on examining student outcomes of undergraduate research programs. Specifically, goals of undergraduate research programs, such as student persistence in higher education, may be enhanced when students work in collaboration with more capable and experienced others in research environment, such as faculty mentors and near peers (peers with more academic experiences; in this study, graduate students). In undergraduate research programs, the more knowledgeable others tend to serve as sources of knowledge and skills about the research process and research methods to undergraduate students. They also assist undergraduates to master their research skills and become (more) self-confident in research. Still, the knowledge and skills that students gain through participation in undergraduate research program *might* influence and/or increase their interest in graduate school and faculty careers. In addition, academic and professional identity development is interdependent with the social context and the situations of others, and influenced by past experiences and sociocultural background as well (Trede, 2012).

Undergraduate Research Programs as Communities of Practice

Because mentoring is one of the focal components of undergraduate research programs, student participation in mentored activities can be also explained and conceptualized as an apprenticeship model of community of practice (Lave & Wenger, 1991). Lave and Wenger's (1991) described communities of practice within informal learning environments, for example

communities of tailors, highlighting the importance of learning and development being situated in authentic learning contexts or fields. Undergraduate research programs, then, must help embed underrepresented students in supportive authentic contexts in which they can 'do' and acquire the knowledge that is desired (Jones et al., 2010; Pender et al. 2010; Summers & Hrabowski, 2006).

Lave and Wenger (1991) emphasized the importance of the learner's participation in a community of practitioners with social interactions, critically defined by a constant process of legitimate peripheral participation. In this process, newcomers participate to the community in several, increasingly complex but shared and collaborative learning practices with an eventual goal of participation near the center of the community.

Because learning experiences and learning outcomes in communities of practice are in constant interaction and mutually constitutive, students' academic and professional identity could be influenced by the quality of social interactions in undergraduate research program (e.g., Alexander et al., 2000; Bayer, 2010; Pedersen-Gallegos, 2007). Therefore, the characteristics and types of social interaction in the program are expected to change or modify perspectives of participants and their locations: from peripheral to more centered participation. Considering that mentor-student interaction promotes underrepresented students interest and self-confidence in research (Alexander et al., 2000; Lopatto, 2010; Smith & Frierson, 2004), and encourages underrepresented students to aspire to graduate degrees (Bayer, 2010; Foertsch et al., 2000; Hathaway et al., 2002; Kuh, 2008; Lewis, 2007; Strayhorn, 2010), further investigation of the undergraduate experience will provide better understanding of the role of social interaction in influencing students' aspirations to pursue both, graduate education and faculty careers.

Importantly, Lave and Wenger's (1991) model of communities of practice suggests that students participate in undergraduate research programs not only under the guidance and

modeling of a single faculty member. Instead, students engaging in community of practice in undergraduate research programs have the opportunity to develop social interactions and relationships with additional faculty and students participating in the program. Undergraduate students who collaborate with their mentors and other students, tend to form collective academic and professional identities through the social learning process of engaging in undergraduate research activities (Aspray & Bernat, 2000).

In order to create caring and professional research environment, it is crucial for participants in undergraduate research programs, especially those who are more centrally located (the more knowledgeable others), provide support and guidance to undergraduate students. Accordingly, undergraduate research programs should strive at creating positive and caring relationships in communities of practice, where students can develop feelings of belonging and appreciation in the academic environment (e.g., Alexander et al., 2000; Lopatto, 2004; Terenzini et al., 1994). Undergraduate students as "newcomers" in research environment should feel valued and motivated to observe their mentors as "old-timers" and "more knowledgeable others." By reflection on their observation, students can contribute to research practice with new knowledge, or experience (e.g., Pedersen-Gallegos, 2007).

The Summer Pre-Graduate Research Experience (SPGRE) Program

The study gives attention to underrepresented students at the undergraduate level participating in the Summer Pre-Graduate Research Experience (SPGRE) Program at the University of North Carolina at Chapel Hill (UNC-CH). The SPGRE program, established in the summer of 1988, is a component of the larger Research Education Support (RES) Program at the UNC-CH which enhances, strengthens, and supports the university's long-term and ongoing commitment to addressing the underrepresentation of students with diverse backgrounds in graduate programs at the UNC-CH (Jay, Eatmon, & Frierson, 2005).

As the summer undergraduate component of the RES program, the SPGRE program aimed at increasing the number of underrepresented students acquiring the skills, knowledge, and experience preparing them for graduate school. Accordingly, the program is designed for underrepresented students who are interested in pursuing graduate studies, particularly for underrepresented groups of African American, Native American, and Puerto Rican students. The participants of the program come from colleges across the country: many attended Historically Black Colleges and Universities, while others attended Predominantly White Institutions. The students are largely African American; however, they include Native American and Hispanic students as well, and majority of the participants were women (Jay et al., 2005).

The SPGRE ran continuously since its inception and served more than 700 students by 2007. Over the last 20 years, 45-60 students participated in the program each year. The purpose of the 10-week program was to reinforce interest in the pursuit of graduate study through participation in directed or on-going faculty research projects. Accordingly, the SPGRE program attempted to engage promising underrepresented students in not only fruitful mentoring experience, but also in a realistic graduate-level research experience. The SPGRE afforded an opportunity for students to closely interact and cooperate with UNC-CH Graduate School programs and work one-on-one with a faculty member who serves as student's research preceptor (Booker & Frierson, 2002). The research projects covered a broad range of disciplines, including the physical and natural sciences, social sciences, and the humanities (Lewis, 2007).

There are some studies that assessed student outcomes of the SPGRE program and determined the extent to which student background characteristics influenced students' experience with the program. The findings suggested that race, gender, and type of school affected the students' interest in graduate school at the end of the program (Frierson, Hargrove, & Lewis, 1992; 1993; Hargrove & Frierson, 1994). However, no known studies have been

conducted that compared students' aspirations to pursue graduate education and a faculty career before and after the undergraduate research experience.

According to Lewis (2007), the SPGRE program was relatively successful in achieving its goals of reinforcing and increasing participants' interest in graduate study. To demonstrate, Frierson (2006; as cited in Lewis, 2007) found that of over 600 students who participated in SPGRE by 2004, approximately 70% enrolled in graduate study. However, there is a lack of understanding concerning relationship between students' aspirations to pursue graduate education and faculty careers, primary reasons to enter the program, and their perceptions of interaction with their mentor and others in the program, such as peers and near-peers.

Research Questions of the Study

This study was guided by the following research questions:

1. To what extent did students' aspirations to pursue graduate education change from the beginning to the end of their program participation?
2. To what extent did students' aspirations to pursue faculty careers change from the beginning to the end of their program participation?
3. What primary reasons did students report as influential to enter the SPGRE program, and what is the relation between those reasons identified on the "pre"-test and "post"-test aspirations to pursue graduate education and faculty careers?
4. Of the students, whose aspirations to pursue graduate school and/or faculty careers increased from the beginning to the end of the program, what experience of interaction with mentor and others in the program did those students report?

This section reviewed, summarized, and critiqued existing literature on undergraduate research programs and proposed theoretical framework appropriate to use in this field. Additionally, the research questions guiding the current study were discussed. The next section

outlines the methods employed in this thesis.

Methods

This study examines the SPGRE outcomes that are associated with participants' experiences of the program and their interest in pursuing graduate education and faculty careers. The following section describes and explains the research methods used to conduct the study. First, the participants and research design are presented, then research procedures and results are explained, and finally, the discussion, recommendation for further research, and limitations of the study are discussed.

Participants

There are several benefits of using the SPGRE population for the investigation. Primarily, participants of the program have experienced college and, therefore, can better navigate their educational plans and desire to continue on to graduate study compared to underrepresented students without the college experiences. Secondly, the population consists of underrepresented students who have expressed various intentions for applying to the program (Lewis, 2007). Accordingly, academic and personal credentials make them different candidates for graduate admission and consequently, with interest in doing a faculty career. Hence, among other factors, the study may provide better understanding of how the program outcomes differ among groups of students with different intentions for participating in the program.

The program personnel continuously (annually) administrated “pre”- and “post”-program questionnaire to SPGRE participants, and therefore, student responses from the “pre”- and “post”-program questionnaire were available for more than one year. However, this study sought to determine student outcomes of the SPGRE program by using de-identified data. Since the data de-identified were available only for one SPGRE cohort (for the year 1997), participants in this study were students, who participated in the SPGRE program in the year 1997.

In 1997, 47 students participated in the SPGRE program. Data for this study were taken from the interview data that was obtained from 21 students in the 1997 cohort of one summer research program, representing 45% of the student population in the SPGRE program in 1997.

In the year 1997, two sets of interviews as "pre"-test and "post"-test were conducted, one at the near beginning and other at the near end of the program. For the year 1997, data from the near beginning of the program were available for 25 students and data from the near end of the program were available for 34 students. Students that lacked the data from the near beginning or the near end of the program were discussed with limited attention.

The students were largely African American and majority of participants were women; there were no detailed data available about participants' ethnicity and race and gender background. The participants of the program came from colleges across the country: many attended Historically Black Colleges and Universities (HBCU), while others attended Predominantly White Institutions (PWI). Participants that attended HBCU presented 86% (18) and participants that attended PWI presented 14% (3) of all participants in this study (see Appendix 2). Regarding the type of undergraduate major characteristics of the participants in this study, participants in STEM fields presented 57% (12) and participants in non-STEM fields presented 43% (9) of all participants in this study (see Appendix 1).

For participating in the program, participants were pre-screened based on grade point average (GPA) with minimum requirement 3.5, letters of recommendation from faculty, academic classification, and their statement of statement of purpose. Faculty preceptors, who collaborated with the program review applications of students, selected students with whom they would like to work in the program. The faculty aimed at matching students according to their research interests and academic background and the research of prospective preceptors. Participants worked one-on-one with faculty mentors and were involved in a full-time research

with a number of social activities as well as special seminars and sessions related to research and student major. Regarding the costs for attending the program, the participants resided on-campus and at no cost. Participants also received stipend, food allowance, and a full use of university resources (Frierson, 1996; Lewis, 2007).

Research Design

Assessing outcomes of undergraduate research program is of interest of faculty, administrators, funders, and policymakers (Laursen, 2015). However, whether a program meets or exceeds its goals is subject to examination (NAS, 2011). Self-report is an appropriate and necessary approach to probe student gains that are personal, internal, and not easily tested, such as changes in students' educational and career plans (Laursen, 2015).

This study employed the data taken from the students' responses at the beginning (in Week 1 or 2 of the program) and at the end of the program (in the last two weeks of the program). The interview conducted at the near beginning of the program asked participants about their demographic characteristics, academic backgrounds, their perceptions of various components of the program, and their interest in graduate school and faculty career. The interview conducted at the near end of the program asked the same questions, however, employing only questions related to students' perceptions of the program components and students' interest in graduate school and faculty careers. There were 30 questions on the survey from the near beginning of the program and 25 questions on the survey from the near end of the program. A majority of questions were open-ended type so participants had an opportunity to freely express their opinion.

Variables

Variables of interest in this study were (a) the extent to which the SPGRE program influenced participants' interest in pursuing a graduate education, (b) the extent to which the

SPGRE program influenced participants' interest in a faculty career, (c) students' primary reasons for entering the SPGRE program, and (d) perceptions of students' interactions with mentor and students' social interactions during the program. In this study, "(a)" and "(b)" variables are defined as the outcome indicators - the observable and measurable characteristic or a change that indicates whether the participants have achieved the targeted outcomes of the program (Barkman, 2012).

Procedures

The data for the study were taken from the SPGRE self-reported questionnaires that measured students' perceptions of the program and their aspirations to pursue graduate education and faculty or research careers. Data interviews conducted at the near start ("pre"-test) and at the near end ("post"-test) of the program participation were analyzed and compared in order to indicate whether there is a change in the participants' aspirations and perspectives. Advantages of analyzing the data from the interviews at the near start and near end of the program include the ability to obtain students' immediate feedback regarding their program experience and post-baccalaureate intentions. In addition, the content of the interview questions selected to conduct this study remained consistent from the beginning to the end of the program.

Personal data of the participants were de-identified to prevent participants' identity from being connected with the information.

In order to determine the extent to which students' aspirations to pursue graduate education and faculty careers changed from the beginning to end of the program, coding scheme was used to analyze participants' responses from the SPGRE interviews. Codes followed characteristics of selective coding as "the process of selecting the core category, systematically relating it to other categories, validating those relationships, and filling in categories that need further refinement and development" (Strauss & Corbin, 1990, p. 116). Two raters independently

coded the same data. One rater was me and the other rater was a person with master's degree in MEd Educational Administration from the University of Hawaii at Manoa, obtained in the Spring 2015. Data were collected through ratings provided by trained raters. Before subjects from the real study were coded, a considerable amount of training with practice subjects was conducted. I decided that the students' responses were coded as: -1 = negative/no aspirations, 0 = neutral aspirations/undecided, 1= positive aspirations. Through conversation both raters gave examples of responses for negative (-1), neutral (0), and (1) positive aspirations to pursue graduate education and faculty careers.

In this study, research question 1 aimed at determining the extent to which students' aspirations to pursue graduate education changed from the beginning to the end of their program participation. Aspirations to pursue graduate education were identified through students' responses/answers to the interview questions on the "pre"- and "post"-program questionnaire:

#15: "Do you intend to go to graduate school?"

Aspirations to pursue graduate education were coded as negative, neutral, or positive for the following examples of responses: negative aspirations (-1) = (none of the responses was coded as negative aspirations), neutral aspirations (0) = "I'm not sure yet if I'll attend though," and positive aspirations (1) = "Yes", or "If everything goes as planned, I intend to go to grad school immediately after graduation, in the fall."

In this study, research question 2 aimed at determining the extent to which students' aspirations to pursue faculty careers changed from the beginning to the end of their program participation. Aspirations to pursue faculty careers were identified through students' responses/answers to the interview question on the "pre"- and "post"-program questionnaire:

#19: "What are your thoughts about an academic/faculty career at a college or university?"

Aspirations to pursue graduate education were coded as negative, neutral, or positive for the

following examples of responses: negative aspirations (-1) = “I’m not interested”, or “No, it seems too much to teach, do research, and publish,” neutral aspirations (0) = “I really can’t say because that’s not something that I want to do, but I know a lot of things that I missed in my education that I could give to someone … It’s an option,” or “Something I might not do immediately, maybe might do later on,” and positive aspirations (1) = “I’d like a career at a college because I have always wanted to teach. And I think I’d really like the research I could do if I could do research and teach,” or “That’s the plan.”

Upon the coding process by two raters, two sets coded from the same data were produced and compared. The two sets coded differed. Revision of coding students’ aspirations to pursue graduate education and/or faculty careers was made for four students. After revision, the final code set was created (see Appendix 3, 4, 5, and 6).

Research design used in this study required the assessment of inter-rater reliability (IRR) to demonstrate consistency among observational ratings provided by the two raters. In this study, the extent to which these two categorizations coincided represents the level of inter-rater reliability (Gwet, 2014). In order to determine the level of inter-rater reliability, this study employed Cohen’s (1960) Kappa statistics, which measure the observed level of agreement between two coders for a set of nominal ratings, and corrects for agreement that would be expected by chance. Accordingly, in this study, the degree of observed agreement was determined by cross-tabulating ratings for the two coders, and the agreement excepted by chance was determined by the marginal frequencies of each coder’s ratings. Kappa coefficient was computed based on equation:

$$K = (P(a)-P(e))/(1-P(e)),$$

where $P(a)$ denotes to observed percentage of agreement, and $P(e)$ denotes the probability of expected agreement due to chance. Possible values for kappa statistics range from −1 to 1, with 1

indicating perfect agreement, 0 indicating completely random agreement, and −1 indicating 'perfect' disagreement (Hallgren, 2012). In this study, the degree of inter-rater reliability was 0.90, indicating almost perfect agreement between the coders.

In this study, research question 3 sought to determine primary reasons that students reported as influential to enter the SPGRE program, and relation between the reasons identified and "pre"/"post"-test aspirations to pursue graduate education and faculty careers. Primary reasons to enter the program were determined through students' responses/answers to the interview question on the "pre"-program questionnaire:

#4: "What were the most critical reasons for you to participate in the SPGRE program?"

In this study, research question 4 sought to identify perceptions of interaction with mentor and others in the program among the students, whose aspirations to pursue graduate school and/or faculty careers increased from the beginning to the end of the program. Perceptions of interaction with mentor and others in the program were identified through students' responses/answers to the following interview questions on the "post"-program questionnaire:

#21: "Are you enjoying what you are doing so far in the program?"

#22: "Concerning what you are doing now in the program, how closely is it related to your initial interests?"

#25: "How do you get along with your preceptor?"

#26: "Are you working with others in addition to your preceptor?"

#26a: "If yes, how much time do you spend with those individuals in comparison to the time spent with your preceptor?"

#26b: "How do you feel about that?"

#27: "Are you comfortable with or within your particular research setting? Why?"

#28: "Are you comfortable with the relationship you have with your preceptor?"

#29a: “What expectations did you have before you started the program?”

#29b: “Are your expectations being met?”

#30: “What are your thoughts about your fellow SPGRE participants?”

Data Analysis

To analyze the outcomes of student participation in the SPGRE program, I proceeded in the following steps. First, based on descriptive statistics, coded responses from the interviews with participants were analyzed to take into the consideration their aspirations to pursue graduate education and faculty careers. For the data coded, mean, standard deviation, and t-test scores for aspirations to pursue graduate education and faculty careers at the near beginning and at the near end of the program were reported and compared. Missing data were presented and analyzed.

Second, students' responses about their primary reason(s) to enter the program were presented. For students who reported an increase or decrease in their interest in pursuing a graduate education and/or faculty careers at the near end of the program, primary reasons to enter the program were discussed.

Finally, this study aims to understand the role that students’ interaction with their mentor and others in the program had on students’ aspirations to pursue graduate education and faculty careers students, whose interest in graduate school and faculty careers increase after their participation in undergraduate research program. Therefore, I employed students’ experiences of social interaction during the program for those students, whose interest in a graduate school and faculty careers increased from the beginning to the end of the program.

Results

Results of this study are presented in this section. Descriptive statistics of the mean, standard deviation, and t-test scores for participants' aspirations to pursue graduate school and faculty careers that occurred from the beginning to the end of the program were generated and

explained. Following the descriptive statistics results, students' primary reasons to enter the program and experiences with students' interaction with mentor and others in the program are presented to identify some of the positive examples of the program. Scores from students, who lacked the data from the "pre"- or "post"-test were analyzed.

Aspirations to Pursue Graduate Education

Table 1 presents "pre"- and "post"-test difference in means of students' aspirations to pursue graduate education. The "pre"- and "post"-test mean scores range from -1 to 1. Students' responses were coded as: -1 = negative/no aspirations, 0 = neutral aspirations/undecided, 1 = positive aspirations. To explain the results from the Table 1, the "pre"-test mean score from the sample is lower than the "post"-test mean score. At the near beginning of the program, mean of participants' aspirations to pursue graduate education was 0.86, while, upon the "post"-test, mean from students' responses to attend a graduate school was 0.98. Accordingly, mean of participants' aspirations to pursue graduate education increased by 0.12 from the near beginning to the near end of the program.

To explain the additional meaning of the data and to provide indication of how far the individual responses to a question about the interest in graduate education vary or "deviate" from the mean, standard deviation (SD) statistics for "pre"- and "post"-test were calculated. Results from the Table 1 show that SDs of both, the "pre"-test (SD=0.22) and "post"-test (SD=0.11) for aspirations to pursue graduate education, were clustered closely around the mean. In addition, the majority of participants in the sample had plans and intentions to pursue graduate education at the near beginning and at the near end of the program. However, the higher SD from the "pre"-test shows that the students' aspirations to pursue graduate education were more polarized at the near beginning of the program.

To test for significant change in graduate education pursuit and to examine the

differences in means between “pre”- and “post”-test aspirations, the most direct method was to compare the “pre”- and “post”-test scores using a two-sample paired t-test. In a two-sample t-test with paired sample, a sample from population is chosen and two measurements for each element in the sample are taken. Following the usual convention for examining data for the presence of correlation between variables, differences below the 0.05 level were taken to be statistically correlated. In this study, the p-value (two-tail) = 0.02 < 0.05 = α showed that there was a statistically significant difference between the mean of students’ aspirations to pursue graduate education before and after participation in the program. Since the paired samples statistics revealed that the mean for aspirations to pursue graduate education at the near end of the program was greater than the mean for graduate education pursuit at the near beginning of the program, I can conclude that the SPGRE program had a significant positive influence on participants’ aspirations to pursue graduate education.

Table 1

Graduate School Mean (M) “Pre”- and “Post”-Test Responses

	"Pre"-Test M (SD)	"Post"-Test M (SD)	Difference in M	Sig (two-tail) p-value
Aspirations to Pursue Graduate Education	0.86 (0.22) 1 (0.0)*	0.98 (0.11) 1 (0.0)**	+0.12	0.02

Note. The “pre”-test and “post”-test mean scores range from 0 to 1. Students’ responses were coded as: -1 = negative/no aspirations, 0 = neutral aspirations/undecided, 1 = positive aspirations.

* Scores from students, whose data were available only from the “pre”-test.
** Scores from students, whose data were available only from the “post”-test.

To continue with the data analysis more in-depth (see Table 2), at the end of the SPGRE program in the year 1997, 5 participants from the sample (24%) reported increased interest in pursuing graduate education at the near end of the program. All participants that entered the program with neutral interest in applying for a graduate school reported an increase in their aspirations to pursue a graduate education at the near end of their program participation. At the end of the program, these students reported that they were going to pursue a graduate education.

For 16 students from the sample (76%), aspirations and plans to pursue graduation education remained the same throughout their program participation; 15 students (71%) reported that they were planning to pursue graduate education at both measurement points, the near beginning and near end of the program. At the near end of their program participation, aspirations to pursue graduate education also remained the same for one student, who reported neutral interest in graduate school at the near beginning and the near end of the program.

Table 2

Primary Reasons and "Pre"- and "Post"-Test Graduate School (GS) Aspirations

Student	Reason for Participation	Pre-Test GS Aspirations	Post-Test GS Aspirations
Sophie	Research Interest	1	1
Ryan*	Research Interest	0	1
Olivia	Research Interest	1	1
Christian	Research Interest	1	1
David	Research Interest	1	1
Julia	Research Interest	1	1
Lucy*	Research Interest	0	1
Daniel	Research Interest	1	1
James	Research Interest	1	1
Dylan*	Research Interest	0	1

Emma	Research Interest	0	0
Aaron	Grad School Preparation	1	1
Kim	Grad School Preparation	1	1
Frank	Grad School Preparation	1	1
Alexis*	Grad School Preparation	1	1
Brad*	Grad School Preparation	0	1
Justin	Grad School Preparation	0	1
Alicia	Grad School Preparation	1	1
Lisa	Stipend/Money	1	1
Christine	Stipend/Money	1	1
Anna	Recommendation from Others	1	1

* Students, whose aspirations to pursue graduate education increased after participating in the program.

The results show that at the near end of the SPGRE program, participants from the sample had either plans to pursue graduation education (20 students; 95%), or at least neutral aspirations about applying for a graduate school (1 student; 5%). None of the participants reported negative aspirations to pursue graduate school. Students' responses about their plans to pursue graduate education show that engagement in the SPGRE program had positive impact on participants' educational plans. In addition, responses about graduate plans from both tests show that at the near beginning of the program, positive aspirations to pursue graduate education were reported by 71% (15 participants), and at near end of the program, positive graduate education pursuit was reported by 95% (20 students) of all participants in the sample. Throughout the participation in the program, participants sustained or increased their interest in pursuing a graduate education and clarified or confirmed their intentions to attend a graduate school.

Missing Data

All students (4), whose data were available only from the near start of the program, entered the program with positive aspirations to pursue graduate education. Similarly, all students (13), whose data were available only from the near end of the program, reported positive graduate education pursuit after their program participation (see Appendix 3).

The mean score to pursue graduate education from participants, whose data were available only from the near start of the program was M = 1 with SD = 0.0. Accordingly, "pre"-test mean (M = 0.86) and standard deviation (SD = 0.22) scores from the sample of participants, whose data were available from both, "pre"- and "post"-test, were lower than the "pre"-test mean score from participants, who lacked data from the "post"-test (M = 1; SD = 0.0).

Similarly, the mean score to pursue graduate education from participants, whose data were available only from the near end of the program was M = 1 with SD = 0.0. Accordingly, "post"-test mean (M = 0.98) and standard deviation (SD = 0.11) scores from the sample of participants, whose data were available from both, "pre"- and "post"-test, were lower than the "post"-test mean score from participants, who lacked data from the "pre"-test (M = 1, SD = 0.0).

Aspirations to Pursue Faculty Careers

Table 3 presents the "pre"- and "post"-test difference in means of students' aspirations to pursue faculty careers. The "pre"- and "post"-test mean scores range from -1 to 1. Students' responses were coded as: -1 = negative/no aspirations, 0 = neutral aspirations/undecided, 1 = positive aspirations.

The results from the Table 3 show that the "pre"-test mean score from the sample is lower than the "post"-test mean score. At the near beginning of the program, mean of participants' aspirations to pursue faculty careers was 0.55, while at the near end of the program mean from responses to pursue a faculty career was 0.69. Accordingly, from the near beginning to the near

end of the program, the sample mean of interest in faculty careers increased by 0.14.

To further explain the meaning of the data and to provide indication of how far the individual responses to the question about the interest in faculty careers vary or "deviate" from the mean, standard deviation (SD) statistics for "pre"- and "post"-test were calculated. Data from Table 3 indicate that the "pre"-test (SD=0.42) and "post"-test (SD=0.30) SD of the sample, based on participants' aspirations to pursue faculty were not clustered so closely around the mean as participants' aspirations to pursue graduate education. In addition, the majority of students in the sample reported a variety of their aspirations, such as positive, neutral, and negative of pursing a faculty career at both measurement points, the near beginning and the near end of the program. However, the higher SD from the "pre"-test shows that the students' aspirations to pursue faculty careers were more polarized at the near beginning of the program. Upon the "post"-test, for some students not only their intentions to pursue a faculty career increased, but also students' interest in faculty careers varied less than at the beginning of the program.

To test for significant change in faculty career pursuit in the sample and to examine the differences in means between "pre"- and "post"-test scores, I compared the "pre"- and "post"-test scores using a two-sample paired t-test. Following the usual convention for examining data for the presence of correlation between variables, differences below the 0.05 level were taken to be statistically correlated. In this study, the p-value (two-tail) = $0.02 < 0.05 = \alpha$ showed that the SPGRE program had a significant influence on participants' aspirations to pursue faculty careers (see Table 3). Since the paired samples statistics revealed that the mean for aspirations to pursue faculty careers at the near end of the program was greater than the mean for faculty career pursuit at the near beginning of the program, I can conclude that the SPGRE program had a significant and positive influence on participants' aspirations to pursue faculty careers.

Table 3

Faculty Career Mean "Pre"- and "Post"-Test Responses

	"Pre"-Test M (SD)	"Post"-Test M (SD)	Difference in M	Sig (two-tail) p-value
Aspirations to Pursue Faculty Careers	0.55 (0.42) 0.50 (0.33)*	0.69 (0.30) 0.54 (0.55)**	+0.14	0.02

Note. The "pre"-test and "post"-test mean scores range from 0 to 1. Students' responses were coded as: -1 = negative/no aspirations, 0 = neutral aspirations/undecided, 1 = positive aspirations.

* Scores from students, whose data were available only from the "pre"-test.
** Scores from students, whose data were available only from the "post"-test.

Table 4 explains participants' intentions to pursue faculty careers more in-depth. At the near end of the program, 5 participants of the sample (24%) reported increased interest in pursuing faculty careers at the near end of the program. Amongst the students whose aspirations to pursue faculty careers increased from the beginning to the end of their program participation, 4 (67%) entered the program with negative aspirations to pursue faculty careers. At the near end of the program, these students reported neutral interest in faculty careers. Furthermore, upon the "post"-test, one student who entered the program with neutral aspirations to pursue a faculty career reported having positive aspirations to pursue a faculty career at the end of the program.

Throughout the program participation, positive aspirations to pursue faculty careers remained the same for 16 students (76% of the sample). In addition, 8 participants (38%) reported positive aspirations to pursue a faculty career at the both measurement points, the near beginning and the near end of the program. At the near end of their program participation,

aspirations to pursue faculty careers reported in “pre”- and “post”-test also remained the same for 6 students (29% of the sample), who expressed neutral interest and for 2 students (10%) with negative aspirations to pursue faculty careers.

Table 4

Primary Reasons and “Pre”- and “Post”-Test Faculty Career (FC) Aspirations

Student	Reason for Participation	Pre-Test FC Aspirations	Post-Test FC Aspirations
Sophie	Research Interest	1	1
Ryan*	Research Interest	-1	0
Olivia	Research Interest	0	0
Christian	Research Interest	0	0
David	Research Interest	1	1
Julia	Research Interest	1	1
Lucy	Research Interest	1	1
Daniel	Research Interest	1	1
James*	Research Interest	0	1
Dylan	Research Interest	1	1
Emma	Research Interest	1	1
Aaron	Grad School Preparation	1	1
Kim	Grad School Preparation	0	0
Frank	Grad School Preparation	-1	-1
Alexis*	Grad School Preparation	-1	0
Chloe*	Grad School Preparation	-1	0
Justin*	Grad School Preparation	-1	0
Alicia	Grad School Preparation	0	0
Lisa	Stipend/Money	-1	-1
Christine	Stipend/Money	0	0
Anna	Recommendation from Others	0	0

* Students, whose aspirations to pursue faculty careers increased after program participation.

The data show that the program had positive influence on aspirations to pursue faculty careers among the students in the sample, who entered the program with negative or neutral aspirations. However, the program impact varied: of the 7 (33%) participants, who entered the program with neutral aspirations, one participant reported increased interest in faculty careers at the near end of the program; of the 6 participants (29%), who entered the program with negative aspirations to pursue a faculty career, 4 participants reported increased interest in faculty careers.

The results show that throughout their participation in the SPGRE program, majority of the participants sustained their interest in pursuing faculty careers and clarified or confirmed their intentions to seek for a faculty career (8 students; 38%), or reported neutral aspirations in pursuing faculty careers (6 students; 29%) at both, the "pre-" and "post"-test.

Missing Data

Amongst the students whose data were available only from the "pre"-test, two students (50%) reported positive and two students (50%) reported neutral faculty career aspirations before participating in the program. Amongst the students whose data were available only from the "post"-test, 8 (62%) students reported positive, 3 (23%) students neutral, and two (15%) students expressed negative faculty career aspirations after their program participation (see Appendix 4).

The mean score to pursue faculty careers from participants whose data were available only from the near start of the program was M = 0.50 with SD = 0.33. Accordingly, "pre"-test mean score from the sample of participants (M = 0.55) whose data were available from both, "pre"- and "post"-test, was similar to the "pre"-test mean score from participants who lacked data from the "post"-test (M = 0.50). However, aspirations to pursue faculty careers of the participants whose data were available only from the "pre"-test (SD = 0.33), varied less than

faculty career aspirations of the sample (SD = 0.42) (see Table 3).

The mean score to pursue graduate education from participants, whose data were available only from the near end of the program was M = 0.54 with SD = 0.55. Accordingly, "post"-test mean (M = 0.69) score from the sample of participants, whose data were available from both, "pre"- and "post"-test, was higher than the "post"-test mean score from participants, who lacked data from the "pre"-test (M = 0.54) (see Table 1). Moreover, aspirations to pursue faculty careers varied less among the sample of students, whose data were available from the both tests (see Table 3).

Primary Reason for Participation in the SPGRE Program

Table 5 presents the primary reasons that participants of this study reported as influential for their participation in the SPGRE program. 52% (11 students) of the participants entered the program because of their interest in mastering research skills and conducting a research. Other participants reported that they entered the program either to prepare themselves for graduate school (7 students; 33%), to get the stipend and/or money (2 students; 10%), or due to the recommendation from the peers based on the benefits of the program (1 student; 5%).

Table 5

Primary Reasons for Participation in the Program

Primary Reason	Number (%) of Participants
Research Interest	11 (52%), 1 (25%)*, 7 (54%)**
Graduate School Preparation	7 (33%), 3 (75%)*, 5 (38%)**
Stipend/Money	2 (10%), 1 (8%)**
Recommendation from Peers	1 (5%)

* Scores from students, whose data were available only from the "pre"-test.
** Scores from students, whose data were available only from the "post"-test.

Aspirations to Pursue Graduate Education

Table 6 presents frequency characteristics for primary reasons that students reported as influential to enter the SPGRE program and students' “post”-test responses about pursuing a graduate education. On the "post"-test, all of the participants that entered the program because of their interest in research, reported that they were going to pursue a graduate education. Similarly, all participants who participated in the program to prepare themselves for a graduate school or because of the recommendation from their peers reported graduate school plans at the near end of the program. Amongst the 3 students, who entered the program because of the financial benefits and opportunities, 2 reported that they were going to pursue a graduate school.

Table 6

Primary Reasons and "Pre"- and “Post”-Test Aspirations to Pursue Graduate Education

Primary Reason	Graduate School Aspirations	"Pre"-Test Number (%) of Participants	"Post"-Test Number (%) of Participants
Research Interest	Positive (1)	7 (64%), 1 (100%)*	10 (91%), 7 (100%)**
	Neutral (0)	4 (36%)	1 (9%)
	Negative (-1)		
Graduate School Preparation	Positive (1)	5 (72%), 3 (100%)*	7 (100%), 5 (100%)**
	Neutral (0)	2 (28%)	
	Negative (-1)		
Stipend/Money	Positive (1)	2 (100%)	2 (100%)
	Neutral (0)		
	Negative (-1)		
Recommendation from Peers	Positive (1)	1 (100%)	1 (100%), 1 (100%)**
	Neutral (0)		
	Negative (-1)		

Note. The “Aspiration” presents intention to apply for graduate school. Responses were coded as: -1 = negative aspirations, 0 = neutral aspirations, 1 = positive aspirations.

* Scores from students, whose data were available only from the “pre”-test.
** Scores from students, whose data were available only from the “post”-test.

Results from the Table 6 show that although the students entered the SPGRE program for different reasons, 95% of the participants reported having graduate school plans at the near end of the program. Moreover, participation in the program positively influenced graduate education aspirations among 5 (24%) participants who entered the program because of their interest in research or to prepare for a graduate education.

Still, results from the Table 6 indicate that majority of the participants who entered the program because of their research interest or preparation for graduate school, were already decided to apply for a graduate school at the beginning of the program. Specifically (see Table 2), amongst the participants who entered the program because of their interest in research, 7 participants (70%) reported having graduate school plans on both, the “pre”- and “post”-test. Similar results were found amongst the participants who entered the program because of the graduate school preparation. On both test, students who entered the program because of the financial benefits, reported having graduate school plans at the near end of the program.

At the end of the program, none of the participants reported negative aspirations of pursuing a graduate education. Moreover, all participants either had a plan to pursue a graduate education or were considering about applying for graduate school.

Aspirations to Pursue Faculty Careers

Table 7 presents frequency characteristics for primary reasons that students reported as influential to enter the SPGRE program, and students' responses about pursuing faculty careers at near beginning ("pre"-test) and at the near end ("post"-test) of the program. On the "post"-test,

participants with different primary reasons to enter the program reported different aspirations of pursuing a faculty career. At the near end of the program, among the participants who entered the program because of their research interest, 73% (8 students) reported that they were going to pursue a faculty career. On the other hand, at the near end of the program, majority (72%) of the participants who entered the program to prepare themselves for graduate school, reported neutral aspirations of pursuing a faculty career.

After the participation in the program, none of the participants reported a decrease or negative changes in student aspirations to pursue faculty careers were reported.

Table 7

Primary Reasons and "Pre"- and "Post"-Test Aspirations to Pursue Faculty Careers

Primary Reason	Faculty Career Aspirations	"Pre"-Test Number (%) of Participants	"Post"-Test Number (%) of Participants
Research Interest	Positive (1)	7 (63%), 1 (100%)*	8 (73%), 3 (43%)**
	Neutral (0)	3 (27%)	3 (27%), 3 (43%)**
	Negative (-1)	1 (10%)	1 (14%)**
Graduate School Preparation	Positive (1)	1 (14%), 1 (33%)*	1 (14%), 4 (80%)**
	Neutral (0)	2 (29%), 2 (67%)*	5 (72%)
	Negative (-1)	4 (57%)	1 (14%), 1 (20%)**
Stipend/Money	Positive (1)		1(100%)**
	Neutral (0)	1 (50%)	1 (50%)
	Negative (-1)	1 (50%)	1 (50%)
Recommendation from Peers	Positive (1)		
	Neutral (0)	1 (100%)	1 (100%)
	Negative (-1)		

Note. The “Aspiration” presents student's intentions to pursue a faculty career. Students’ responses were coded as: -1 = negative/no aspirations, 0 = neutral aspirations/undecided, 1 = positive aspirations.

* Scores from students, whose data were available only from the “pre”-test.
** Scores from students, whose data were available only from the “post”-test.

Table 7 compares primary reasons to enter the program and faculty career aspirations from the "pre"- and "post"-test. Results show that for 38% (8) of participants, the program experience confirmed or clarified their intentions to pursue faculty careers: 7 participants entered the program because of their interest in research, and one student entered to prepare for a graduate school. The program did not influence and/or increase aspirations to pursue faculty careers among three students: two students who entered the program because of the stipend or money and one student who entered the program because of the recommendation from peers.

Missing Data

Of the students whose responses were available only from the near start of the program, 3 students (75%) entered the program because of the graduate school preparation, and one student because of their interest in research. At the “pre”-test, they all reported positive graduate education aspirations. However, of those students, two students who entered the program because of the graduate school preparation reported neutral aspirations to pursue faculty careers. At the “pre”-test, the other two students with data available only from the near start of the program reported positive faculty career pursuit.

Of the 13 students, whose responses were available only from the near end of the program, 7 (54%) students entered the program because of their interest in research, 5 (38%) students because they wanted to prepare themselves for graduate school, and one student because of the money/stipend reasons. Although they reported different primary reasons to enter the

program, all of the students whose data were available only from the “post”-test, had positive aspirations to pursue graduate education. However, of the students who entered the program because of their research interest, 3 (43%) students reported positive, 3 (43%) students neutral, and one student negative aspirations to pursue faculty careers. Of the students who entered the program to prepare themselves for graduate school, 4 (80%) students reported positive and one student reported negative faculty career pursuit. At the near end of the program, the student who entered the program because of financial benefits, reported positive aspiration to pursue faculty careers (see Table 5, 6, and 7, and/or Appendix 3 and 4).

Data show that the frequencies of primary reasons to enter the program of the students, who lacked the data from the “pre-” or “post-” test were similar to the frequencies of primary reasons of students in the sample. However, none of the students with missing data entered the program because of the recommendation from peers.

Similarly, frequencies of aspirations to pursue graduate education and faculty careers of the students with missing data were similar to the frequencies of aspirations of the sample. However, of the 5 students whose data were available only from the “post”-test and who entered the program to preparation themselves for graduate school, 4 (80%) students reported positive faculty career pursuit. Differently, upon the “post”-test, the majority of students in the sample who similarly entered the program because of the graduate school preparation reported neutral aspirations to pursue faculty careers (see Table 7).

Perceptions of Interaction with Mentor and Others in the Program

In order to better understand the outcomes of student aspirations to pursue graduate education and/or faculty careers discussed above, this section focuses on participants' perceptions and satisfaction with interactions with their mentor and others in the 1997 SPGRE program. However, undergraduate research programs for underrepresented students aim at

fostering student academic and professional development. Therefore, feedback about student satisfaction with interaction with their mentor and others in the program is analyzed and discussed for these participants, whose aspirations to pursue graduate education and/or faculty careers had positively changed (increased) from the near beginning to the near end of the program.

Positive changes in participants' aspirations to pursue graduate education were identified among 5 participants, coded as Dylan, Ryan, Lucy, Justin, and Chloe (see Table 2). All of those students entered the program with neutral aspirations to pursue graduate education and finished the program with positive aspirations to apply for a graduate school. Positive changes in participants' aspirations to pursue faculty careers were identified among 5 participants, coded as Isabella, Brad, Justin, Ryan, and James (see Table 4).

Increase of Aspirations to Pursue Graduate Education and Faculty Careers. Results from the Table 2 and Table 4 show that from the near beginning to the near end of the program, three (14%) participants, coded as Justin, Chloe, and Ryan, reported changes in their aspirations of pursuing both, graduate education and faculty careers. Their aspirations to pursue graduate education and faculty careers increased from the near beginning to the near end of the program. Justin and Chloe entered the program because they wanted to prepare themselves for graduate school, while Ryan participated in the program because of the interest in research.

Regarding their perceptions and satisfaction with social interaction in the program, Justin and Chloe reported similar type of support they received from social interaction in the program and were both satisfied with the support and guidance they received from their mentor and others in the program. Specifically, at the end of the program, Justin expressed satisfaction with interaction with his mentor because they were both interested in a topic of his project in the program. Working on a research project that is in interest of both, the student and the mentor,

may greatly influenced student outcomes of undergraduate research program. In addition, Justin highlighted that "(i)f it's something that interests you, you can learn a lot from it."

In addition to working with the mentor, Justin reported satisfaction with interaction and experience with others in the program. The student discussed project cooperation and collaboration with others in the program, which included sharing the project with two others in the program where they were all working on different parts of the project.

Similarly, at the end of the program, Chloe was satisfied with her mentor in the program because of the cooperation on "meaningful" research experience and interaction and communication with her mentor on a daily basis. The student also reported collaboration with graduate students in the program. Specifically, Chloe highlighted positive experience connected with the discussions about "getting into graduate school" with others in the program as well as the satisfaction with getting a research experience in different fields. Similarly, Ryan, who worked with the mentor as well as with three others in the program, reported that collaboration with more people in the program helped "to fill gaps" between him and the mentor. Ryan also found the program as a motivating environment that fostered student identity development; he reported that it was "(G)ood to see black students at this level...people that will achieve their goals."

Although Justin and Chloe reported increased aspirations in pursuing a graduate education and faculty careers on the "post"-test and were both satisfied with social interaction in the program, they expected that their project was going to be more closely related to their initial interests. For example, Justin's project was related to an education, which was also his major. Still, he "wanted to do something more hands on with children, to do research and actually see children."

Increase of Student Aspirations to Pursue Graduate Education. Two participants reported

positive changes in their aspirations to pursue graduate education only (see Table 2 and Table 4). Participants, coded as Dylan and Lucy, both entered the program because of their interest in research. From the near beginning to the near end of the program, the students' interest in pursuing graduate education increased from neutral to positive.

Regarding the perceptions and satisfaction with social interaction in the program, both Dylan and Lucy reported positive experience with interaction with their mentor. Specifically, the students highlighted common research interests between them and their mentor and reported that their project was closely related to their initial interest. Students reported that positive undergraduate research experience with an ongoing communication and collaboration with their mentors influenced gathering of "a lot of research experience" (Lucy), and "inspired me(him) to go to grad school." (Dylan)

Although Dylan and Lucy cooperated only with their mentors when doing their research project, they were both satisfied with their social interaction with others in the program. For example, Lucy said that:

(T)here is a lot of diversity as far as interest - not respect to the different fields, but also just people in general. I got a chance to meet different people, experience different things... (p)eople have different aspirations, going to graduate school, coming up to senior year.

Increase of Student Aspirations to Pursue Faculty Careers. Two participants reported positive changes in their aspirations to pursue faculty careers only (see Table 2 and Table 4). Among these two participants, one student, coded as Alexis, participated in the program to prepare for a graduate school, and the other student, coded as James, participated in the program because of the interest in research. From the near beginning to the near end of the program, these two students' interest in pursuing faculty careers increased from negative to neutral (Alexis) and from neutral to positive (James).

Regarding their perceptions and satisfaction with social interaction in the program, Alexis and James reported that they were satisfied with interactions with their mentors. At the near end of the program, James discussed the relationship with their mentor and said that "(i)t has been a pretty good relationship. I am not afraid to ask her a question or feel intimidated by her in anyway." He also discussed quality feedback and support that they received from their mentors.

Similarly, Alexis reported that her mentor "goes 120%" and that "(s)he (her mentor) loves what she is doing." In addition to working with her mentor, Alexis had extremely positive experience with others in the program, especially with support and help needed for the project. She said:

> There are others in the room. They are on the project . . . One person might say this is how you make a code book, another might help me with coding the demographics . . . Everyone around gives me 100% all the time and they are on task and everyone has their own way of doing things. (Alexis)

Cooperative social interaction with the mentor and others in the program helped Alexis to get research skills and knowledge of the research process. At the end of the program, the student reported having knowledge on how to do an independent research.

Regarding the role of research project on student outcomes, James expressed the importance of the research project being closely related to the initial interests of students and mentors. Working on the project that was closely related to the research interest, the student said that "(i)t is interesting if you do research you really like." Accordingly, James reported high satisfaction with the performance in the program and learned "how to do an extensive research."

Discussion

This study aimed to examine the role of undergraduate research programs in influencing aspirations to pursue graduate education and faculty careers among underrepresented students.

This research employed secondary data from “pre”- and “post”-test of 21 underrepresented students who participated in the SPGRE program in the year 1997.

This study has investigated to what extent did students' aspirations to pursue graduate school and faculty careers change after participation in the SPGRE program. Moreover, this study has also sought to discover what were the primary reasons that students report as being influential in their decision to enter the program. Finally, this study has examined experiences of students’ interaction with mentor and others in the program. Perceptions of social interaction in the program were reported by those students whose aspirations to pursue graduate education and/or faculty careers increased after participation in the program.

The results that emerged provide further explanation about the influence of the SPGRE program on students' aspirations to pursue graduate education and faculty careers. Better understanding of students' primary reason to enter the program and their experiences with social interaction in the program enabled to identify to what extent the SPGRE program fostered students' aspirations to pursue graduate education and faculty careers.

Findings of the previous studies showed that underrepresented students with undergraduate research experience were more likely to pursue graduate degrees (e.g., Eagan et al., 2010; Hathaway et al., 2002; McGee & Keller, 2007; Lewis, 2007; Lopatto, 2004; Russel et al., 2007; Seymour et al., 2004). Findings of this study show that after their participation in the program, the majority of participants clarified or confirmed their intentions to pursue a graduate school and/or faculty careers. At the near end of the program in the year 1997, 2 (9%) participants reported increased aspirations to pursue graduate education, 2 participants (9%) intention to pursue faculty careers, and 3 (14%) participants confirmed to pursue both, graduate education and faculty careers. Moreover, after their program participation, 20 participants (95%) reported that they were going to apply for a graduate school, and 19 students (90%) reported that

were going to pursue or were considering faculty careers. In this study, t-test statistics scores showed significant correlation between participation in the SPGRE program and participants' aspirations to pursue graduate education and faculty careers.

Regarding their reasons to participate in the program, participants reported four primary reasons to enter the SPGRE program: (a) research interest (52%), (b) graduate school preparation (33%), (c) stipend/money (10%), and (d) recommendation from peers (5%). These results offered additional insight into the outcomes of the program. The findings indicate that students who entered the program because of their research interest or graduate school preparation, were already decided to pursue graduate education before participating in the program and their graduate school aspirations remained the same after participating in the program. An assumption can be made that those students participated in the program to master additional research skills and knowledge about the research, which are two of the main aspects of the graduate education. This suggests that the program met their expectations regarding participation in an undergraduate research experience.

However, at both tests, faculty career pursuits of the students, who engaged in the program because of the research interest or graduate school preparation reasons, varied more than their graduate education pursuits. In general, those students reported lower aspirations to pursue faculty careers than graduate education. Still, the program appeared to be effective in increasing faculty career aspirations among students who entered the program to prepare themselves for graduate school and with negative interest in faculty careers. Upon the “post”-test, the majority of those students reported neutral aspirations to pursue faculty careers.

Student interest in graduate education and professional career is interrelated to the extent to which certain environmental context meets students' expectations and provides students with opportunities to explore and develop their academic and professional identities (Murphy, Steele,

& Gross, 2007; Trede, 2012). In this study, students whose aspirations to pursue graduate education and/or faculty careers increased over the SPGRE program, reported positive experience of student-mentor and student-peer interaction. Those students reported similar perceptions and levels of satisfaction with interaction with their mentor and others in the program. The findings suggest that increases in their interest in graduate education and/or faculty careers were formed through the supportive and ongoing social and "research" relationships between students and mentors as well as between students and peers and near-peers. Regarding the positive relationship between students and mentors, the findings could be connected to the previous studies which showed positive correlation between student interest in graduate education and the quality of student-mentor interaction in undergraduate research programs (e.g., Corwin Auchincloss et al., 2014; Gasiewski et al., 2010; Lundberg & Schreine, 2004; McGee & Keller, 2007).

As the development of research skills through authentic activities is seen as an underlying principle in the entire education system, undergraduate research experience can be pivotal to academic and professional development (Imafuku, Saiki, Kawakami, & Suzuki, 2015). Findings of the previous studies showed that working collaboratively with mentors in "hands-on" research environment contributed to increasing students' self-efficacy and confidence in doing research (Bauer & Bennett, 2003; Szteinberg & Weaver, 2013). Similarly, in this study, the SPGRE program, "a community of practice" one, provided students with opportunity to develop confidence in research. Students who benefited from the research activity in increasing their interest in pursuing graduate education or faculty careers, discussed improvement in their research skills and being more confident in the research area that were result of social interaction. Those students also reported building supportive relationships with mentor and others in the program.

Results of the prior studies showed that cooperative and supportive mentoring relationships in undergraduate research programs enabled underrepresented students to join networks that fostered their positive academic and professional identity (e.g., Alexander et al., 2000; Carlone & Johnson, 2007; Corwin Auchincloss et al., 2014; Jones, 2014; Pedersen-Gallegos, 2007). However, results of this study suggest that the experiences that students received upon the research collaboration with their mentors and others in the program enhanced their sense of collective identity and feelings of belongingness. Therefore, this program facilitated their graduate school and faculty career aspirations. This suggests that not only collaborative interaction with mentor is important for students to benefit from undergraduate research programs, but also cooperative and supportive "research and diverse relationships" with peers as well.

Next, the results indicate that mentors as well as others in the program, mostly near-peers, served as more knowledgeable others to the program participants, informing undergraduates about insights in information of graduate school and helping them to master research skills, and enhancing their self-efficacy in research. Consequently, working with others might foster students' identification with graduate education and faculty careers and increase their educational and faculty career pursuit.

The findings also revealed that the linkage between student interest in pursuing a graduate school or faculty career and satisfaction with the research project may be one of the significant outcomes of the undergraduate research experience. In addition, students whose aspirations to pursue graduate education and/or faculty careers increased from the beginning to the end of the program, remarked about the importance of the research project in being authentic and closely related to their initial interests. The results indicate that hands-on research experience, structured around students' initial interest might foster student curiosity and

motivation for research and facilitate positive identification with graduate education and faculty careers.

Finally, the results suggest that establishing network “research” relationships with mentors and others in the program might foster mastering research skills and increasing self-confidence in research. This means that for some students the program appeared to encourage positive identification with the research environment. Furthermore, working on the project that was closely related to students' initial interests and that was in common interest of students and mentors, might influence positive experience with interaction with mentor and others in the program.

Recommendations for Further Research

Although findings of this study and prior research on the topic showed that participation in similar programs appears to be promising in increasing student interest in pursuing graduate education, graduate education pursuits and consequently, faculty careers pursuits, are multidimensional. More research is needed to identify other variables that motivate and influence underrepresented students' perceptions of graduate education and faculty careers. This section explains the importance of the further research that will allow for a more in-depth look at a variety of factors.

First, further research on underrepresentation of diverse students in graduate schools and among the faculty in higher education could focus on exploring social and psychological barriers that many underrepresented students face when navigating through their education and career, such as financial concerns, lack of self-efficacy, lack of knowledge and information about graduate school and faculty careers, concerns about employment, and lack of role models with master's and doctoral degrees (Brazziel & Brazziel, 2001). Predictably, along with participation in undergraduate research programs, these factors may also influence students' aspirations to

pursue graduate education and faculty careers.

Second, in addition to the analysis of students' responses from the questionnaire discussed above, further research could employ student-initiated and student-led discussions, such as on-line discussions, or conversations in a focus group, conducted among the previous program participants with master's and/or doctoral degrees, especially those with faculty careers. Open discussions without or with limited input of the coordinator would enable participants to express and share their experience and interests. Open-ended information about the perceptions of social interaction in the program and the experiences through social interaction might help to identify other themes and topics related to social relationships in the program, and therefore, provide a better understanding of program outcomes related to students' aspirations to pursue graduate education and faculty careers.

Moreover, this study aimed to explore to what extent participation in an undergraduate research program influenced underrepresented students' aspirations to pursue graduate education or faculty careers and students' perspectives on mentoring and social relationships in undergraduate research program. More needs to be learned about the variety of activities occurring in the undergraduate research programs. Accordingly, future research needs to examine which characteristics and approaches of mentoring and social interaction in undergraduate research programs appear promising in shaping students' personal, academic, and professional development. To further explain, it would be necessary to examine to what extent do certain research activities in the program, such as collecting data or working in the laboratory, significantly influence students' aspirations of graduate school and faculty careers and their experience with interaction in undergraduate research program.

Next, this study did not investigate direct causal impact of undergraduate research participation on the actual enrollment in the graduate programs and educational attainment of the

participants. However, based on the results of this study it is essential to determine the long-term impact that SPGRE program had on participants' educational attainment and career development. Information about the actual enrollment in graduate school, educational attainment, and the latest participants' careers, may provide better understanding of the student outcomes of the SPGRE program. Longitudinal research is needed to identify long-term outcomes of the program across different cohorts. The rigorous study of undergraduate research programs for underrepresented students can determine the best approaches that should be brought into a long-term practice. In addition, inclusive engagement of underrepresented students has tremendous potential (a) to enhance student and faculty mentor learning, (b) to deepen research initiatives, and (c) to help redress the exclusionary practices that too often occur in higher education (Felten et al., 2013).

Finally, I propose that students' ability to understand themselves as graduate students and researchers and/or faculty members is largely shaped by the way in which they negotiate between personal and professional identities. In the process of exploring and shaping their academic and professional identity, findings of this study suggest that the quality of social interaction in undergraduate research programs matters. However, I would suggest that some of the mentors and others in the program might not be aware of the challenges that students from underrepresented populations face when negotiating personal and professional identities. Therefore, an outcome of the future research could be to develop resources for faculty mentors and other stakeholders in undergraduate research programs that would prepare them to effectively and successfully work with underrepresented students.

Limitations

Findings of this study indicate that participation in undergraduate research programs, such as the SPGRE, can have a positive impact on pursuing a graduate education and faculty careers among underrepresented students. Although this study shows beneficial findings, there

are three limitations of this study that need to be addressed since they influence the generalization of the findings.

First, since this study relies on the analysis of the secondary data, the results are limited by the variables and their definitions on the interviews. Additionally, the measurements related to students' primary reason to enter the program and their perspectives of interaction with their mentor and others on the program do not provide detailed information to what extent student outcomes (aspirations to pursue graduate education and faculty careers) are significantly correlated with program participation. The change in scores for participants' plans to attend graduate school and to pursue a faculty career could be influenced by other factors, such as other programs the participants might attended, other social activities the participants might engaged in, or the media. A similar comparison group of underrepresented students that answered questions before the start and at the end of the program during the same period but did not participate in the program should be tested to strengthen the rigor of methodology in this study.

Second, since this study uses data from the interview questionnaires, where participants self-report experience from their participation in the SPGRE program, like other such instruments, questionnaire is a subject to concern about the validity of self-report of outcomes (Corwin Auchincloss et al., 2014). The self-reported outcomes can result in poor questionnaire design, questions being interpreted differently by different participants, or unclear perception of what they are assessing (Bowman & Hill, 2011; Kuh, 2001; Porter, Rumann, & Pontius, 2011). Students might also report more positively feedback because they are either implicitly or explicitly aware of the desired outcomes of the program.

Finally, in this study, the coding scheme was used to analyze participants' responses from the SPGRE interviews. Two raters coded the same data independently. Two sets coded, compared, and then, transformed into one code set, established the inter-rater reliability of the

study. Students' aspirations to pursue graduate education and faculty careers varied within each category of aspirations (e.g., negative, neutral, and positive aspirations). Therefore, the code set used in this study might not reflect the exact extent of participants' aspirations to pursue graduate education and faculty careers. Moreover, coding the data about students' aspirations by others might result in different code sets and, consequently, influence findings of this study.

This section outlined the methods guiding the current study. The research design with limitations, participants, research procedures, and data analysis were provided. The data for the study were taken from the SPGRE interviews that were obtained in the year 1997 from the students. The interviews were conducted at two different points in time, at the near start of the program and at the near end of the program.

Conclusions

This study, an investigation of the role of undergraduate research program in influencing aspirations to pursue graduate education and faculty careers among underrepresented students, affirms the positive value of underrepresented student participation in undergraduate research programs. As found in this study, such involvement has positive influence on fostering and clarifying or confirming pursuit of graduate education and faculty career plans.

The results and discussion imply that undergraduate research programs for underrepresented students can increase their influence by acknowledging and establishing two components: (a) creating authentic (hands-on) research experiences that are more closely related to students' initial interests, especially for those who enter the program because of their interest in research and preparation for graduate school and are undecided about their educational and career plans, and (b) developing supportive and professional relationships between students and mentors as well as between students and others in these programs, such as peers and near-peers.

The quality of student-mentor and student-"others in the program" relationships appeared

to have influenced not only student satisfaction with research experience, but also graduate education aspirations and pursuits of faculty careers. This suggests that undergraduate research programs can increase their contribution to diversifying graduate education and faculty populations by creating and promoting collaborative, supportive, and "diverse" social interaction. This "socioresearch" interaction, structured around or within research activities and among diverse groups of people, who share their experiences and knowledge from different fields, appears to encourage students' academic and professional identification and consequently, fosters their educational and career identity development.

Although measuring the outcomes of only one student cohort in the SPGRE program, the findings can provide insights into the significance of the undergraduate research programs in increasing or confirming aspirations to pursue graduate education and faculty careers among underrepresented students. In the long term, undergraduate research experiences, structured around students' initial interest and collaborative and supportive relationships with others, including peers and near-peers, can also increase the representation of diverse population within the higher education faculty, which can become “more of a reality than a dream.”

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Appendix 1: *Undergraduate Majors of the Participants*

STEM Field	Non-STEM Field
Applied Math; Biochemistry; Biology; Chemical Engineering; Chemistry; Computer Science; Industrial Technology; Math/Computer Science; Mathematics;	African & Afro-American Studies; Anthropology; Communication; Communications and Broadcast Religion; Economics; Education; Elementary Philosophy; English; Greek & Latin; History Education; History; Journalism; Political Science; Psychology; Secondary Math Education; Social Work; Spanish; Special Education; Women's Studies;

Appendix 2: *Institutions of the Participants*

HBCU	PWI
Agricultural and Technical State University; Alabama State University; Bethune-Cookman University; Bowie State University; Clark Atlanta University; Florida Agricultural & Mechanical University; Howard University; Morehouse College; North Carolina Central University; North Carolina Elizabeth City State University; Norfolk State University; Oakwood University; Shaw University; Spelman College	La Salle University; University of Maryland, Baltimore County; University of North Carolina at Chapel Hill

Appendix 3: *Missing Data - Primary Reasons and Graduate School (GS) Aspirations*

Student	Reason for Participation	Pre-Test GS Aspirations	Post-Test GS Aspirations
Mary	Preparation for grad school	1	
Joanna	Preparation for grad school	1	
Linda	Preparation for grad school	1	
Elizabeth	Preparation for grad school		1
Carl	Preparation for grad school		1
Alex	Preparation for grad school		1
John	Preparation for grad school		1
Patricia	Preparation for grad school		1
Ivan	Research Interest	1	
Devin	Research Interest		1
Iris	Research Interest		1
Nick	Research Interest		1
Travis	Research Interest		1
Miranda	Research Interest		1
Tom	Research Interest		1
Rita	Research Interest		1
Ben	Stipend/Money		1

Appendix 4: *Missing Data - Primary Reasons and Faculty Career (FC) Aspirations*

Student	Reason for Participation	Pre-Test FC Aspirations	Post-Test FC Aspirations
Mary	Preparation for grad school	0	
Joanna	Preparation for grad school	1	
Linda	Preparation for grad school	0	
Elizabeth	Preparation for grad school		1
Carl	Preparation for grad school		1
Alex	Preparation for grad school		1
John	Preparation for grad school		1
Patricia	Preparation for grad school		-1
Ivan	Research Interest	1	
Devin	Research Interest		0
Iris	Research Interest		1
Nick	Research Interest		1
Travis	Research Interest		1
Miranda	Research Interest		0
Tom	Research Interest		-1
Rita	Research Interest		0
Ben	Stipend/Money		1