Attracting and retaining Latina women in an undergraduate biology program: Benefits of NSF S-STEM Support

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Many efforts are being made to enroll more women and other underrepresented groups in science, technology, engineering, and mathematics (STEM) fields. Despite this, representation by women, particularly Latinas, remains low in STEM fields. Women make up half of the total U.S. college-education workforce, but only 29% of the science and engineering workforce (NSF, Science & Engineering Indicators, 2016). In the past 10 years, the number of Latinas receiving STEM degrees has nearly doubled. Yet, representation remains low with less than 6% of STEM degrees awarded to Latinas in 2014 (NSF, 2017). Latina students have been shown to express interest in STEM at the same level as white students (Chen, 2009), but leave STEM majors at higher rates (Lindsey et al., 2015). Many attribute this to familial attitudes toward science and male-oriented college environments that may not feel welcoming to women (Anaya & Cole, 2001; Cole & Espinoza, 2008; Hurtado et al., 2007). Thus, attracting underrepresented individuals to STEM fields must be followed with practices that welcome Latinas and lead to retention.

The National Science Foundation (NSF) Scholarships in Science, Technology, Engineering and Mathematics (S-STEM) program is one effort to increase the STEM workforce pipeline through increased access and retention by welcoming underrepresented students and providing support for success. S-STEM is an innovative response targeting the needs of first-generation college students who demonstrate a potential for success by providing financial assistance to reduce the burden of college attendance and to allow students to focus on their studies in order to complete degrees in a timely manner.

As a women's college and a Hispanic serving institution (HSI), STEM faculty at the authors' university received an NSF S-STEM grant (#1564677) to attract women and improve retention in these majors. The program provides financial assistance to reduce the burden of college attendance and to allow students to focus on their studies and complete their degree in a timely manner. Students receiving this S-STEM (S-4: Supporting Scholars to Succeed in STEM) scholarship are supported by student programming and activities including a summer "transition to University" program, the development of a learning community, academic support and resources, seminars on STEM graduate programs and careers, and student support (soft-skill) workshops. The program also provides the faculty and peer mentorship shown to positively affect retention (e.g. Arellano & Padilla, 1996; Cole & Espinoza, 2008; Gasiewski et al., 2012; Martin et al., 2013) and encourages participation in undergraduate research opportunities, which have been noted to increase persistence in STEM by building confidence and increasing one's science identity (e.g. Carter et al., 2009; Hurtado et al., 2009; Lopatto, 2003).

In the design of the S-4 program to support science majors, the Principle Investigators (S-4 co-leads) considered what research has shown to positively affect retention in STEM for those from underrepresented groups. For example, self-confidence and perceived ability has been linked to persistence (Bandura, 1997; Beasley & Fischer, 2012). Women need to be able to see their future selves as scientists in order to choose a STEM major. Women have also reported a strong desire for generativity or to "give back" in their career choices. Thus, to attract women to science, STEM fields must demonstrate relevance to students' daily lives and appeal to their desire for generativity. Latinas, in particular, wanted careers where they could help their families or communities, both through financial successes, contributing through needed fields, such as medicine, and through serving as positive role models (e.g.Blackburn, 2017; Trenor et al, 2008). Attracting women into STEM majors may require appealing to these desires.

Persistence in science majors is also tied to a student's sense of belonging in the STEM field and was also considered in the design of the S-4 program. Barriers to this sense of belonging may be attributed to stereotyping. For example, female college students report more discrimination in the form of negative attitudes and comments related to their place in a STEM major (Bevan & Learmonth, 2013, Carlone & Johnson, 2007). This sense of belonging is needed for developing a science identity, described by Lave and Wenger (1991) as being socially constructed within communities of practice. Thus, active participation in the scientific community is critical for developing a science identity. Carlone (1994) defined the imagination of oneself as a scientist as an important aspect of developing a science identity, which was further defined as a "demonstrated competent performance in relevant scientific practices with deep meaningful knowledge and understanding of science". Carlone acknowledged that one must recognize oneself and be recognized by others for these traits to be considered a science person. More recent study results support the positive relationship between science identity and retention in STEM college programs (e.g. Hurtado et al., 2009; Perez et al., 2014). While having a science identity may lead to persistence in science, lack of self-identification may also deter some students from even entering STEM fields. For example, Farland-Smith (2015) found that girls were often discouraged from science fields because they were unable to identify with those they see as scientists and engineers. Farland-Smith further noted the impact on women from their mother's education level and career. Brickhouse & Potter (2001) caution, however, that having a science identity does not guarantee success in sciences at school; one must consider the impact of stereotype threat, or the fear of becoming the stereotype related to women and science, on a girl's feeling of belonging in a science program that could potentially stop them from even enrolling.

Women often perceive themselves as less proficient even if they receive higher grades than men (Bandura, 1997; Beasley & Fischer, 2012). Workshops were thus designed into the S-4 program to help build self-esteem. Leyva (2016) further discussed how role models could affect confidence: At times when strong efforts did not translate into higher grades, or students felt disconnected to a professor's style, having a mentor eased what could easily have led to a loss of confidence. While having a role model, such as a family member in the sciences to influence persistence, could not be controlled, it was posited that faculty role models could help students to achieve the same benefits. This assumption is supported by the findings from Martin, et al. (2013) that a lack of available family social capital could be supplemented by school personnel.

In addition to identity, collaborative learning environments (i.e., support groups, study partners, peer tutoring) may contribute to a sense of belonging for many, particularly in introductory courses for STEM. The ability to maintain self-confidence in these courses can be the key indicator for later success. Females and other under-

Student *Pseudonyms used	Ethnic Identity	Status	Reason for STEM major/Career Interest
Gabriela	Latina	First year scholar-freshman	Physician
Bonnie	Latina	First year scholar-freshman	Loves Science
Patti	Latina	First year scholar-freshman	Forensic Anthropologist
Vivian	Latina	Transfer student scholar-freshman in major	Biologist/Human Life
Zelda	Latina	Transfer student scholar-freshman in major	Opens doors
Sandra	Latina	Sophomore student scholar	Pediatrician
Ani	Latina	Sophomore student scholar	Pediatrician

Table 1. Overview of student S-4 participants

represented groups have often noted the "weed out" nature of science classes and find that off-putting (e.g., Cole & Espinoza, 2008; Beasley & Fischer, 2012). However, support from female groups in STEM and "study buddies" helped to build persistence (Martin et al., 2013). Leyva (2016), in her study of the gendered cultural pressures of being young mothers and/or wives pursuing higher education, further described the successes of women of color "sticking together" and supporting one another. Support groups were thus, critically important to their success.

The purpose of this study was to identify, from the perspective of first-generation, Latina, university women, the reasons for choosing a STEM field, and the essential pieces of the S-4 program that positively impacted retention in their early years. Participants were continually asked about their science identity and their confidence levels to better understand how their views affected their decisions to not leave challenging majors at the end of the first or second year when other classmates often choose to change their majors. Specifically, research questions asked:

- What are successful ways to attract and meet the needs of Latinas in STEM? What can faculty and support staff do to increase the numbers seeking scholarships from an already small STEM pool?
- What can be learned about the science identities of Latinas entering STEM fields and how does the S-4 program impact these identities? Do the impacts of the S-4 program in the first year contribute to an early development of a science identity?

Methods

This study tracked students' science identity over the first year in the S-4 program to learn about the types of support that contributed to a science identity and persistence. Nine students in their first or second year in a STEM major were selected as S-STEM scholars based on their GPA and interview with the program directors. Each scholar completed surveys and interviews at the end of the summer transition to university program in the first year of the grant, and again at the end of their first year of coursework. Participants included four freshman scholars, two transfer-student scholars, and three sophomore student scholars (also serving as student mentors). Two non-scholars, serving as mentors and faculty mentors were also interviewed.

Seven students (see Table 1), all biology and/or biochemistry majors, met the criteria of identifying as Latina, being an S-STEM scholar, and having completed all sets of interviews and surveys. This paper analyzes the data from these seven students. The survey included a self-efficacy portion, adapted from the surveys included in "Self-efficacy: The exercise of control," (Bandura, 1997) and a science identity survey adapted from Changes in Attitudes about the Relevance of Science (CARS) Questionnaire (Siegel & Ranney, 2003). Semi-formal interviews (see Appendix A) lasted between 12 and 30 minutes and focused on decisions for choosing their baccalaureate degree and major and perceived influences on their decisions to persist.

In addition, the faculty Principal Investigators (S-4 program leads) were also interviewed to be able to compare what they deemed essential for the program to the views of the students. Interviews were semi-structured and lasted about one hour, each. Questions for these interviews are included in appendix B.

Primarily employing a qualitative approach allowed exploration of the influence of chosen research factors, but also other factors that emerged from the data (Bogdan and Bilen, 1982). Transcribed interviews were coded using the six themes identified in the literature: identity, collaboration, self-confidence and perceived ability, role models, altruism, and resources. Upon completing the first round of coding, the following additional themes emerged: family influences (e.g. the role of family in supporting or influencing students; this theme was later merged with role models) and mistrust, which aligned with the concept of stereotype threat (e.g., Beasley & Fischer, 2012) and was thus merged with identity. Two of the authors coded the transcripts separately, and then met to compare notes, which led to a few changes in the coding categories and noted themes. The transcripts were then recoded using the eight themes and coding was compared between the researchers. Comparisons were then made between each category of student interviews and the survey results based on each category. (Surveys did not include student names, but identified them as freshman scholar, transfer scholar, sophomore scholar, or non-scholar.) A matrix was then created for each of the students and each of the themes to aid the analysis.

The overall changes in self-confidence and science identity were also tracked quantitatively, comparing responses on a Likert scale as the students began the program and at the end of their first year of study. Due to the small sample size, these data are reported in terms of the numbers reporting a rating. Retention in a STEM field was also tracked, in addition to changes of major within those disciplines.

Results

Overall, results of this study were organized into two overarching themes: how students chose a STEM major and what factors influenced their retention in STEM.

Choosing a STEM Field

Recruitment to STEM and S-4: University admissions staff were responsible for recruitment of the incoming freshman students to STEM programs and communicated with high school counselors to build awareness of programs offered at the university and the availability of the S-4 supports. Parents were not part of the recruitment efforts unless they had accompanied their student to recruitment events. S-4 scholars were made aware of the S-4 program through invitations distributed with their letters of admission to the university. Interviews were then held to determine the scholarship awards.

Despite efforts to reach potential scholars upon admissions, or even before, program directors needed ad-

ditional strategies to fill the first cohort of scholars. This particular year had unusually low numbers of biology/biochemistry majors, only six of whom qualified for S-4. These six were thus, strongly encouraged to interview. Selected students, included those admitted as sophomores due to the small freshman class, specifically mentioned some degree of hesitation when they first learned of the program. The box below displays quotes from the interviews that support the hesitancy to seek out scholarships. It took multiple times hearing of the opportunity from faculty they had grown to trust and/or from peers involved before they applied. Another student described her feelings of disbelief when she opened the letter of acceptance.

"My counselor, when I was in high school, did push me to apply for scholarships. I just… I didn't take it seriously when I was in high school. Like, I'll figure it out. My parents will help me. … And my roomie also has encouraged me to apply for this scholarship" (Vivian, initial interview).

"When I was first admitted and got a letter in the mail [that included] the president's award. At first, I thought 'it's not really for me'. … It's fake and they were just playing me. … Like I didn't believe it at first. Like when you get a scam letter in the mail or applying to a job [that doesn't really exist]. And then when I got an e-mail from Dr. [A] on this program I didn't even know [what it was] and wondered, 'why would you pick me?'" (Sandra, initial interview).

This mirrored what we had read in the "campus read" of Justice Sotomayor's 2014 autobiography, "My Beloved World", in which Sotomayor described throwing away invitations from prestigious honor societies, thinking that they were just solicitations to get her money. For first-generation college students the lack of family members who have been to college, and successfully navigated the resources in the higher education system can also be a contributing factor. Resources, such as grants and scholarships, have been part of higher education for some time but can be useful only to those who are aware of them and apply. It is also possible that a lack of trust contributed to why more of the students did not choose to live in the dormitory, despite the cost coverage being available in the grant.

Role Models (Including Family Influences). Families played an important role in helping students to choose a STEM degree. For example, Gabriela's parents were dentists, and she chose to be a physician because she "didn't like working with the mouth" (Gabriela, initial interview). Three of the seven in the study were interested in pursuing a medical degree. Sandra, whose mother was a nurse in Mexico, was encouraged to become a doctor. The others cited a family member with an illness that had prompted them to want to become a doctor in order to learn better to prevent disease and to help those afflicted. All seven answered that they strongly agreed to the statement: "My parents encourage me to continue with my STEM studies." Six of the seven answered that they agreed with the statement: "I have had strong role models in science", and two answered "strongly agree."

In the initial interviews, students reported that their families were their primary source for emotional support and mentoring prior to entering the University and continued to be strong influences, despite six of the seven being first-generation college students. Six mentioned their parents as very influential on their choice of school and major. They also credited their parents for their resilience and ability to be prepared for college, even when the parents themselves had little experience about college and did not know specifically how to help. Families influenced the choice of university, as it was important that students attended a university close to them, with five participants choosing to still live at home and commute. The quotes below are examples of parental influence on resilience.

"My parents like to keep me going and don't let me give up" (Vivian, initial interview).

"My family, most importantly, have supported me in my ups and downs academically…. encouraging me to seek the help of tutors and teachers/professors" (Ariana, initial interview).

Retention in STEM

Of the seven students tracked in this study, six were retained in the S-4 program. The additional four who did not meet all criteria to be included in this study, were also retained. This indicates a retention rate greater than 90%. Patti, whose interest had always been in forensic science, switched majors when she realized that she could reach her goals with a degree in criminology, but remained at the university. Overall, this indicates a strong retention of students. Comparable data from earlier cohorts of biology/biochemistry majors that were not part of S-4 showed retention rates between 73% and 75% for the previous three years (*Our University* Report, 2015, 2016, 2017).

Self-Confidence and Identity. Survey results indicated that, initially, students held high expectations for success, rating themselves with a 90% or higher likelihood that they would complete their biology and/or biochemistry degrees. This remained very high at the end of the first year (all remaining at 90% or higher, but with only three of six who had responded initially at 100%, remained at that level of confidence). Three did express some concerns for being able to handle the pressures of student life. Four mentioned concerns about being able to get adults to help them with any social problems that arose, such as issues with roommates. Three expressed concerns about using the library effectively and arranging a place to study without distractions. Three had fears of living up to what their parents expected of them, and three had the same fears regarding their peer's expectations. Students viewed science as collaborative and agreed that emotions could play a role in science. All felt strongly that science would help prepare them for their desired careers. There was a wider range of agreement when looking at the relevancy of science in their everyday lives, with three believing that science was very relevant to their daily lives, and four seeing it only relevant to their goals of working in the medical field. Survey responses showed little change between the beginning and the end of their first year as S-4 scholars.

When initially asked to describe how they see themselves, none directly referred to seeing themselves as scientists, although many mentioned qualities often attributed to scientists—curiosity, perseverance, hard-working, open-minded. When asked directly if they saw themselves as scientists, several said yes, while others qualified their answers as "not yet". For example, "After I have more lab experience" (Zelda, end of year interview), or "when I'm wearing my lab coat" (Gabriela, end of year interview). Five were already involved in undergraduate research and/or planning experiences for the upcoming summer.

Mentoring. Recognizing that having family role models in STEM was not common in this student population, the S-4 program was designed to include intensive faculty mentoring. "Students cannot distinguish between a 'bump in the road' and disaster and failure" (faculty lead, 1st interview). There were two official faculty mentors for the S-4 Scholars, but research project leaders, course instructors, and department advisors also provided mentorship. The styles of these mentors varied and focused on a balance between allowing students to take control and make mistakes and pushing them to excel. The co-faculty lead summarized the differences as "when there is an issue, [Dr. A would have a] more hands-on approach to anticipate the issue, a little bit more at an earlier stage versus seeing the students figure it out on their own a little bit. And then if you're [a student] having trouble, having [that student] come to somebody, because we all know the goal is eventually to build that self-sufficiency into students. And that self- agency" (faculty co-lead, 1st interview).

Frequent communications with faculty mentors and academic supports through university systems were seen as important, including the additional sessions with student success staff. "In my experience, it takes at least one semester for students to learn to engage with course materials, with faculty, and thus, with the content. Mentoring helps students to understand that they are here for a purpose, and then they get more involved" (faculty lead, 1st interview). The faculty mentor further noted that students in the S-4 program engaged in the content more quickly and were able to build their self-confidence at a faster pace.

When the scholars were asked what aspects of the S-4 program were most critical in helping them to be successful, the soft-skills workshops were frequently mentioned, six of seven citing the group counseling session as highly valuable. In this session, a counselor from the

University Counseling and Psychological Services (CPS) led a STEM relevant workshop getting students to open up about their own experiences in their major. Many students expressed how this activity helped them to realize that they were not alone in their struggles, reinforcing what they had heard from their professors and mentors. These workshops enabled students to see that their major was difficult for everyone, and that they, too, could succeed if they put in the effort. Although Patti was the only one who did not credit the group counseling session as an important factor in learning to reduce the stresses of being a student, Patti did mention that she liked the "no judgement" listening that she received from faculty and peers.

Meeting with peers was seen as very important, but also a challenge. This was further revealed when the directors of the program asked students to show their availability on calendars. No time meshed for all students, although directors were able to find a slot available to all freshmen, and another for all sophomores. Many of the students lamented not being able to all meet as one group, as they did see the value in these peer connections.

"It was hard that the freshmen were in different sessions. I would like to have kept more connected" (Sandra, end of year interview).

"I wanted more group sessions—and they need to be in person" (Zelda, end of year interview).

"I felt a strong support from my peers and faculty mentors" (Vivian, end of year interview).

"I need to communicate and network. Scientists don't just work alone" (Bonnie, end of year interview).

Research Experiences. Research experiences played a strong role in retention, as well. S-4 students involved with research also had opportunities to be leaders and peer mentors to the newer students to the research teams. "Being involved in research and being part of a scholarly community helps students to feel more confident about whatever it is they are doing. When they start, they have a lot of self-doubt because they haven't really been tested or challenged" (Faculty lead, 1st interview).

Students mentioned the honors biology lab as being critical to staying motivated to study biology, citing the importance of being able to design their own investigations, rather than reproducing experiments as was done in their earlier chemistry labs. "The honors biology lab was less boring than before. Instead of moving through one topic each week, we had time to follow up on our ideas" (Zelda, end of year interview). Research was often mentioned when describing their passion for biology.

Challenges to Pursuit of a STEM degree

In the second set of interviews, students spoke of the challenges in getting through their first year (or second, as some became scholars as sophomores) in biology, and how they had overcome obstacles. The authors categorized the challenges in their first year as S-4 students into four emerging themes from these interviews: academically challenging courses, family and life issues, lengthy commutes, and underdeveloped time-management skills.

Difficult Courses. STEM courses are difficult, with unfamiliar vocabulary and concepts that are challenging to novices to the field. An overwhelming theme in the second set of interviews after the S-4 scholars had completed their first year was that it was hard, but they had the support from peers, faculty, and others to help them reach their goals. Students mentioned that the first year was very difficult, but that they were pleased to make it through. Students embraced the idea that hard work and use of resources could help them to persist. The overall impression from many was that the messages they were receiving is that yes, a biology major is difficult, but if you are willing to put in the work, one can succeed.

"I love learning biology. It is my passion." (Zelda, end of year interview).

"Science has never come easily for me, but I don't give up" (Vivian, initial interview).

Family/Life Issues. Faculty leads noted that families were often a strong network of support, but that students often needed advice beyond what their parents could provide. "[Parents] love their children and do whatever they can to be supportive, but the kinds of support many need is more than the emotional. Students needing support about how to improve their GPA, discuss progress in a class, apply for graduate school." (Faculty lead, 1st interview). Sometimes, well-meaning comments from the families were not helpful. The faculty lead further described a conversation with a student who was concerned about her being too stressed with all of the work required for success. "She is in her room and studying all of the time, so her parents were worried. They loved the fact that she was going to be a doctor, but at the same time, [the student] felt that her parents didn't understand that she was not just putting pressure on herself, but that she had a goal and wanted to achieve it. This is what it takes, and it is temporary." (Faculty lead, 1st interview).

Patti, Zelda, and Ani all mentioned the challenges from outside issues with families, along with long commutes as their main sources of stress. These issues were not only related to families not understanding what they needed to do, but the students also felt family pressures to contribute financially and to be available for helping with siblings and elderly family members.

Commuting. Recognizing that belonging to a community on campus provided access to the activities linked to success, the S-4 program was designed to be able to support the financial obligations of being a resident student. Even so, many students chose to live at home and commute, often at the request of their family members, unaware of the benefits of the campus environment. Being able to live on campus made it easier to make use of resources, including receiving peer support. For example, Sandra credited her roommate (in the same major, but a year ahead), as helping her to stay motivated. She further described what she learned from her peers in the dormitory, "Defeat doesn't define me. There are little battles not won, but the final outcome is what matters. Being hard on myself isn't healthy" (Sandra, end of year interview).

Time Management. For commuters and non-commuters, learning to better manage their time (a workshop topic) was key to success. "The first semester was really hard. I learned to manage my time in the workshop" (Gabriela, end of year interview). Vivian took a slightly different path in learning to be a better student. "I needed to change my study habits. . ..I used YouTube to learn "active reading" (Vivian, end of year interview).

Time management was also an issue discussed with the faculty mentors. In describing common reasons that students would drop in for advice, Dr. A discussed teaching students to develop better study skills. "I would see them because they were just falling apart because the calculus test was too difficult and they felt like they studied for it. . .I would help them to organize their studies and tell them the steps that you take for learning" (faculty lead, 1st interview).

Discussion

Previous studies have shown that a science identity is needed for success in science (e.g., Hurtado et al., 2009). The S-4 scholars entered with high perceived abilities, expectations for success and strong science identities, consistent with those with a "high science capital", as described by Archer et al., (2015). While not all students perceived themselves currently as scientists, they were pursuing the higher-level coursework and research experiences that they believed important to this identity. Identities were not tied only to being a scientist. Students saw themselves as patient, caring, and curious. Family expectations and the voices of their peers were important. This aligns well with Carlone's (1994) concept of identity being connected to how others see them.

Students must navigate many other identities that may shift over time or even context. For example, undergraduate science students may not identify with being a scientist because they have not experienced advanced research or degrees associated with that identity. Yet, this may also be dependent on context, as amongst friends, there may be a strong science identity, but in a room of research scientists, that student might feel as an outsider to that group. Allowing students to explore their feelings through peer meetings and counselor-led workshops has contributed to persistence by building their relationships and helping them to learn more about themselves. Faculty mentorship, peer meetings, and workshops were viewed as positively contributing to retention.

Parental roles are important, even if parents are not role models for STEM. However, a lack of STEM role models prior to college experiences limited students' breadth of knowledge about what opportunities were available to them. Relationships with faculty and peer mentors builds success and encouragement to do research. Mentoring also allows students to explore additional career options.

Strengths and Limitations

One strength of this program may also represent its limitations. As a women's college, many supports have been designed specifically for the needs of women in STEM. It is unknown whether the type of supports shown to have positive influences on retention in this study would be as effective in a coeducational setting, or even in a student population with fewer number of Latinas. However, it is believed that modifications to the themes for the group meetings could lead to similar results. Another limitation of this study is a result of shifting numbers in the incoming classes for biology majors. Prior to the S-4 grant, biology majors at the freshman level numbered over 100. At the start of the grant, these numbers had shrunk to 30, creating challenges for recruitment of students into the program. In addition, the resulting class sizes may have also allowed for more personal attention and support. Although using data from the first year only was chosen to be able to highlight the reasons for choosing a STEM major and persistence through what is typically a "weed-out" year in STEM majors, another limitation of this study may have been its short timeframe. However, these students are continuing to be interviewed each year until graduation and will be reported in future studies.

Conclusion

The high retention of students after their first year is indicative of the success of the interventions put into place to help students maintain confidence and build a science identity. Recruitment hinges on building early interest in STEM majors to increase the numbers of students seeking these majors. In addition, high school counselors and students need to be aware of the many opportunities for scholarships and grants to build trust and the confidence to apply. S-4 students exhibited a strong desire to have close, supportive relationships with peers and professors. Peer collaboration was important to the success of the S-4 students. While there were many challenges for finding the time for in-person meetings, efforts to create these spaces paid off. Workshops offering support along with opportunities for peer connections are an integral part of retention, even at commuter campuses. These collaborations may also have contributed to building the science identities related to the success of students from underrepresented groups. Motivation and resilience were critical to retention in the program. Challenges related to finding time for face-to-face participation, particularly for commuting students, are expected to increase on university campuses. Thus, the financial supports offered through the S-4 scholarships, along with the ability to mandate participation in these collaborations as a requirement of the scholarship, is seen as an important factor in persistence in STEM majors. Finding ways to communicate about these opportunities, particularly in this digital age with many false promotions, is another need for the success of these programs and their ability to reach the students they desire. Building that trust, and perhaps doing more to promote living on campus, are important to the success of students.

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Appendix A

Scholar Interview Protocol

Initial Interview

1. Who or what most influenced your decision to be a STEM major?
2. How committed are you to your major? How likely do you think it is that you will receive your degree in this field?
3. What do you feel will be the most important resources for you to be able to successfully complete your major? Are there additional resources that you need that are not available, to your knowledge?
4. What invitations did you receive regarding scholarships, associations or societies?
5. What encouragement did you receive for applying to scholarships? Which individuals Sre most influential in your applications?
6. Were there any opportunities for which you did not follow through in applying? What were your reasons for giving up?
7. What is your biggest fear regarding being able to complete your STEM degree?

End of Year Interviews

1. Looking back at this year, what has been the most memorable experience related to school?
2. At this time, how likely do you think it is that you will receive a degree in your field of study?
3. In what activities did you participate? Which have been most influential on your interest and/or ability to remain in your STEM major? Why?
4. What have been the biggest challenges in continuing your studies? How did you overcome these obstacles?

Appendix B

Program Leads Interview Protocol

1. Looking back at the first year of the S-4 program, what do you view as the most important supports for students?
2. How important do you think it is that students develop a science identity? How did S-4 impact this?
3. How did students learn about these opportunities? Were you able to involve parents in any way?
4. In general, how often do you meet with S-4 students on a weekly basis? What are the most common reasons S-4 students seek your advice?