Female Participants' Reflection on the Impacts of *FIRST*® (For Inspiration and Recognition of Science and Technology)

Results from a Qualitative Interview Study

Ten Years after Program Participation

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Executive Summary

Ten years after participating in *FIRST®* (For Inspiration and Recognition of Science and Technology), the long-term impact on female participants surpassed the impact for male participants in the *FIRST* Longitudinal Study (Meschede et al, 2024, forthcoming). To better understand the consistently greater impact, a diverse group of 42 female participants was interviewed, responding to questions ranging from their experiences in *FIRST* to how they link these experiences with their current involvement in Science, Technology, Engineering and Math (STEM) and the experiences of women in a male dominated field. In this report, we present their insights in four overarching areas: memories and reflections of the *FIRST* experience, skill development, pathways through college and into employment, and family influence on *FIRST* participation and careers. To underscore the themes presented, we share quotes from the interviews.

Topics ranged widely, from detailed descriptions of the *FIRST* experience which are still carried along today to discussions of the role of women in STEM. These data point to the long-term impacts of *FIRST* participation on young women's college experiences and entry into the workforce, including

- The skill sets they developed in *FIRST* that they still draw on, ranging from technical skills, presentation and leadership skills, to social emotional learning through *FIRST*'s core approaches of Gracious Professionalism and Coopertition.
- The challenges of being female in a male dominated field, from participating in *FIRST* to the workplace, and the range of strategies women developed to address these challenges.
- The importance of good mentors, including serving as role models when successful or as negative examples when not.
- The influence of parental expectations on participating in *FIRST* and careers.

We end the report with a summary of the many positive impacts for female students in *FIRST* and suggestions for attending to the challenges that study participants shared.

Introduction

Girls are less likely to participate in science, technology, engineering, and math (STEM) throughout their education, limiting their access, preparation and opportunities to enter STEM fields as adults. Only about a third of the female workforce engages in STEM careers. Even fewer, about 25%, engage in computer science or math, and just 16% in engineering and architecture (Corbett and Hill, 2015). Creating and evaluating pathways towards more female participation in these critical STEM fields are important for creating a more gender-diverse workforce in the future.

The *FIRST* Longitudinal Study has tracked *FIRST* program participants and a matched comparison group over ten years. The ten years of follow-up data collected on STEM attitudes and STEM behavior consistently showed stronger impacts of *FIRST* on young women. While stronger outcomes were observed for all *FIRST* alumni, *FIRST* female alumni reported significantly higher interest in STEM, higher likelihood of engaging in STEM activities, higher scores on STEM identity, higher interest in STEM careers, and more knowledge in the application of STEM. In addition, the difference in the proportion of STEM course taking and Engineering and Computer Science majors among *FIRST* female participants and the comparison group was consistently higher than the difference observed among the male counterparts. The preliminary employment outcome analysis indicated these stronger outcomes for *FIRST* female participants positively impacted employment entry. These stronger outcomes for *FIRST* female participants were also observed in the preliminary employment outcome analysis.

In this qualitative interview study, our goal was to better understand these consistently stronger outcomes for *FIRST* female participants. We selected a diverse sample, inviting interview participants based on differences in race/ethnicity, parental income, and geography. In total, we spoke with 42 young women in interviews and very small focus groups (see more details on the study methodology in the Appendix). Despite this selection, this sample of women overall resembled the *FIRST* Longitudinal Study sample with one notable exception: they were more likely to be involved with STEM, when compared to the Year 10 sample of *FIRST* women. Interview questions ranged from experience in *FIRST* as seen 10 years after participation, skills learned and maintained, to STEM experience in college and in employment.

The data presented in this report focuses on themes most often discussed in the interviews and is divided into four overarching sections: *FIRST* female participants' memories and reflections of their *FIRST* experience 10 years after participation, skill development, pathways through college and into employment, and family influence on *FIRST* participation and careers. We end with a discussion and recommendation section.

I.   Experiences and Perspectives of *FIRST's* Program Design

Reflecting on their experience 10 years after participating in *FIRST*, female alumni shared a diversity of perspectives on the various elements comprising the program, ranging from outreach to activities, and ideas on how *FIRST* is and can continue to be inclusive to women. These included their experiences with teammates during robot-building activities and decision-making powers. Discussions also centered on how they got connected with *FIRST* and ways program sponsors conducted outreach specific to younger *FIRST* members, sometimes orienting this towards young females. In one case, an interviewee described how they enjoyed that their *FIRST* experience involved "build a robot day for kids" outreach from sponsors including IBM and Google. Others mentioned *FIRST* club fairs which specifically spoke to sessions dedicated to their program (for example, *FIRST* Lego League).

> *"One of the things I enjoyed the most was the fact that in the beginning, I was very student-led…It seemed like the Student Leadership Team definitely had a lot of decision-making power, like how the robot was built was mostly on students. And then the mentors would help, and I just thought that was so cool. We just had the freedom to explore ideas and try things out."*
> *– Asian, suburban, high-income participant*

> *"We had a club fair in the fall every year, the second or third week of school, and we'd always have a booth. We would drive around one of our old robots…And so the parents would seek us and ask what we are and what we're doing, and [we'd] explain it."*
> *– Asian, suburban, high-income participant*

Competitions were commonly talked about, either in response to interview questions or arising organically throughout conversations. Overall, participants shared how they enjoyed the "high-stakes" atmosphere of competitions, and being around like-minded students who enjoyed robotics as much as they did. A few study participants shared their experiences at competitions on girls-only teams. Others served as judges in later years and mentioned they felt excited seeing females involved on their teams at the competitions. The contagious energy, opportunity to learn from others, teamwork, and ability to represent their schools all were positive defining characteristics of females' time at competitions.

While the prospect of winning the competition served as a positive motivator for some, others felt they enjoyed the on-site experience overall and that winning was not important to them. Further, the women discussed how socializing and meeting new people, in addition to enjoying the time with their friends on their own team, made competitions a welcome environment.

However, challenges for women during competitions, mostly during FRC competitions, were also touched upon. Some felt as though the existing hierarchy within their team was furthered at competitions, sometimes along gendered lines with males dominating the robot-building portion. When discussing this exclusion, women described how their male peers took over nearly all tasks relating to their team robot, including making adjustments to technical details, driving the robot, and other smaller tasks. At times, these women felt as though they needed to prove their worthiness to be at competitions, simply due to their gender identity. Such dynamics contributed to conflicts within teams during competitions.

"Overall my favorite experience out of all of it: There's always a competition [and] they're just so full of energy. And you got to learn so much from other people."
– Hispanic and White, urban, high-income participant

"We did go to a girl's competition at Bloomfield Hills, Michigan, which was very exciting. And these girls, most of them had never ever been to a competition, as it was their rookie year too. And they got to learn and [be a part] and learn with the mentors. And they said it was the best experience they had. They were so glad they did it, because they got to learn new roles."
– White, suburban, high-income participant

"…there was a lot of pressure…We [girls] had a little unspoken rule that we were a minority of this team, and we needed to stick together and do whatever we needed to do to impress. We had to work way harder to get any recognition [at competitions]. I had that awareness coming in."
– White, suburban, high-income participant

The *FIRST* core elements of **Gracious Professionalism** and **Coopertition** were widely discussed in the conversations. The women often reflected on how these elements were taught to them and have since become a part of their academic and professional lives. Some spoke about how they felt *FIRST* taught them emotional maturity, citing instances where conflict resolution was something they had to push for to keep order in tense moments. For example, one focus group member discussed the need to "be polite with each other, [and] be kind with one another," which extended into their high school experience outside of *FIRST*.

In the context of competitions, women witnessed and engaged in teams helping one another despite being in a space where winning was a goal. While trying to "stay afloat ourselves," it was not uncommon for female *FIRST* participants to try to help other teams that were struggling.

"Our group was such a group of 'We're doing what's best for the group not best for the individual. How are we getting better as individuals to be better as a group'…It's how I interact with people around me [today] because you may not always like somebody, but you can always work with them. And be gracious while doing it. I use it every single day and live by it now."
– White, rural participant

"With coopertition, I will say FIRST does a great job in saying 'your opponent in one match might be your ally in the next match.' So you're taught to always have a good competitive spirit…There's no smack-talking. Everyone's cordial, and they work well."
– White, suburban, low-income participant

Study participants discussed the ways in which **their relationships with peers and mentors** in *FIRST* impacted their experience. Most were on primarily male teams, with a few on teams that were more evenly split, and very few had been on girls-only teams. Overall, the women who participated in the interviews reflected a mix of experiences as impacted by gender representation and dynamics on their team. Some spoke about how they saw team coaches attempting to recruit and form more female-centric teams, and how this led them to feel more comfortable. Others did not find the gender composition of their team to affect their experience, with some describing how they felt everyone they worked with had equal opportunity to engage however they chose to. Yet, some on primarily male teams found themselves being pushed into the "outskirts" of *FIRST* activities, where they were left working on more administrative, marketing, and organizational types of tasks, rather than engaging with the hands-on activities that they described as being "gatekept" by their male teammates.

"I also loved being in a community where people my age were so dedicated and had a vision in the same way that I did. You don't really get that in other places when you're in high school, or just walking around campus, anyone could be pretty much pursuing any goal. But then with FIRST, most of these students were very serious, very passionate about STEM."
– White and Hispanic, urban, high-income participant

Team mentors played a significant role in the experience of female participants. Team mentors included college students, current and retired professionals in STEM fields, parents, and school teachers. Some women spoke about the close relationships they developed with their mentors, having felt supported by those who provided guidance not only within *FIRST*, but outside of the program as well; one participant described how their mentor was willing to help her with physics and calculus homework as a summer tutor, which she feels has helped her "be where I am today" professionally. Study participants also described how their mentors demonstrated great patience with them and genuine passion for the program and STEM subjects taught through *FIRST*. Mentors encouraged creativity and facilitated democratic engagement across all team members.

"[My mentor had] a willingness to slow down and teach. That's a big one for me. Because oftentimes when it comes to a lot of these lessons, they go really quickly. And for me, I need to take some time to slow down and like, I want you to take me step by step, so I could fully process what's going on, and having teachers that are willing to slow down and take that time, was helpful."
– Black, suburban, low-income participant

"I do remember when I was on the programming team, I used to wear headbands in my hair. And I remember my formatting on my robot was kind of out of place…I hadn't put in consistent tabbing or something. And [my male coach] said something along the lines of 'If you're going to put an effort into your appearance, you should do that with your code.'"
– Multiracial, urban, high-income participant

While many women discussed positive interactions and impacts of their mentors, some also **described less favorable experiences**. Participation in *FIRST* competes with the wealth of after-school activities offered to most. Some participants shared anxiety about multitasking. Many engaged in extracurricular activities to relieve the stress from academics, but also mentioned how in some cases, they felt the over-commitment led to even more stress. For instance, one participant mentioned they at times felt exhausted in school due to frequent sleep deprivation.

"I didn't wanna spread myself too thin…In high school I was involved in a lot of things, [and] I guess I knew that science wasn't gonna be what I was pursuing so [FIRST] didn't really make sense for me. I would have barely have [had] time to sleep."
– Black, suburban, high-income participant not currently involved in STEM

Finally, focus group participants described how they **witnessed favoritism of males from their mentors**, some appearing to be "particularly biased towards the boys." Many spoke about unfair dress code violations, where they felt their mentors made unwarranted and unnecessary comments about the ways they wore their hair, clothing, or makeup. One participant explained how her team mentor gave her dress code violations for wearing clothing she saw others on her

team wear too – including male participants. In her example, she decided to "go to the system" and speak with the Assistant Principal, and as a result her mentor switched her from practicing robot building to marketing responsibilities. This study participant felt this was a punishment for outwardly acknowledging her mentor's sexist behavior. In addition to negative experiences with mentors who demonstrated perceived sexism, focus group participants also described how some of their advisors and coaches enabled toxic environments, overemphasized and prioritized winning competitions, and were not always attuned to practicing care, compassion, and attentiveness to students' needs. [1]

> *"…a lot of the time I was pushed away from [building and programming] and did more writing and later, safety stuff. I think that was one thing I wished I had more of an opportunity [to do more building and programming], because it seemed like a lot of upperclassmen and their dads ran the show."*
> *– White participant*

While female participants shared a wide range of rewards from their *FIRST* experience, some focused on the more **challenging aspects** of their participation, related to their involvement in the program as young girls. They spoke about the gendered roles they witnessed and experienced, where they felt male *FIRST* participants were receiving and engaging in certain tasks and responsibilities to a greater extent to what they as females were experiencing. In addition, female participants expressed that they were not listened to in the same way as their male counterparts, and not always included in all *FIRST* activities and competitions. This includes feeling excluded from tasks involving working on their team robot at meetings, similar to the exclusion females felt at competitions. Finally, a small number of study participants discussed the ways in which their confidence was negatively affected, as a result of many of the struggles they identified as pains during their *FIRST* experience:

> *"There were also just mentors who felt winning was their achievement, a lot of times. And that was the first priority for a lot of them. Why are you mentoring high schoolers if that's what you care about? You should be here to help them grow and become good adults and good people…It doesn't actually matter if they build the best robot."*
> *– Asian, urban, high-income participant*

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[1] Please note that we don't have complete demographic data for all interview participants. These data were drawn from the baseline surveys with information will be missing for anyone who didn't mention their geographical location, race, SES, etc.

"I definitely clashed heads with a lot of the male leadership. I ended up being a captain for the FTC team, but I didn't even get to lead the team I was originally part of...I was put on the last place team to be the captain for that one, and we ended up being the higher-ranking team by the end of the year. But I was pretty frustrated in that. I think a lot of people underestimate my skills. Maybe because I may have been the only female, pushing for change and things at the time. I know that's actually why I quit my first college robotics team. I didn't do robotics in college that much, because I didn't feel like I was being listened to at all."
– Asian, suburban, high-income participant

"[The larger society is] like, why do we have women groups? Why do we have a Society of Women Engineers? Why do we need that? Why can't we just work with men and just be like everyone, be engineers? Why do we have to make the distinction of women engineers?'"
– White, suburban, low-income participant

II.   Skill Development in *FIRST*

FIRST female alumni shared the ways in which their experiences in the program enabled them to grow and develop different skills including practical skills, such as hands-on experience in programming, designing, and teaching, general professional skills, socio-emotional skills, and skills pertaining to gaining a clearer sense of the direction of their future careers.

Much of the discussion focused on the professional skill development that characterized their experience in *FIRST*. Nearly all individuals spoke about how they felt *FIRST* enabled their growth in how to problem-solve and troubleshoot when issues arose, not only in the program but also in their day-to-day experiences. This extended to their school experiences, at home, and in social arenas as well. Furthermore, many focus group

"FIRST is where I got a lot of projects where we'd have to go through the cycle of [testing] out your design or your idea first and then put it into action, and then see how it goes."
– Asian, urban, low-income participant

"In a general sense, having that really basic knowledge [of STEM during FIRST] back in middle school has helped teach me how to think like a programmer."
– White, suburban, high-income participant

"I realize I was unintentionally teaching those values of just integrity and making sure that you have community, no matter where you go. Being able to talk to people, and ask for help...[my students I teach] got [these skills] from me, and where I got them from was FIRST."
– White, rural, high-income participant

participants discussed how they felt *FIRST* helped them improve their ability to collaborate, and feel better prepared to engage with others in situations that called for group work. Additional professional skills mentioned by interview participants included learning how to present detailed information, general organization skills, multitasking and time management, and how to think critically and ask questions.

"In high school, you're doing a lot of individualized work, and then you get to FIRST and you have to build a robot with 20 other people. And so that definitely takes a lot of my coordination delegation. And just, you know, working with other people in a technical sense."
– White, high-income participant

"I think the process of problem-solving has made the biggest difference for me, this idea of knowing that you have an end goal and needing to know the pieces that need to come together to reach that goal, but also being able to start with a first test, troubleshoot that and continue observing."
– Asian, suburban, high-income participant

Leadership skill development was commonly discussed. Women shared how they gained confidence specifically in regards to leading their teammates, some speaking to how they served as Safety Captain to their group. They also mentioned how they felt enabled to learn how to teach and share key information with others, and trust their knowledge to be valuable. Socioemotional skills specifically pertaining to leadership were also developed during women's time in *FIRST*, with participants describing how they learned how to be active listeners, develop and practice empathy with their team, work to help others feel included, and build team spirit. Women who served in leadership roles discussed how they learned to manage their teams, recognize the key strengths of others in order to determine how to organize their team most effectively, communicate clear expectations, and ensure important details and resource management was documented appropriately.

"Being in that leadership role at FIRST really helped me foster that collaborative and inclusive environment. And my current [professional] role is just to continue fostering a very educational, inclusive, collaborative digital robotics program within our company."
– Asian, suburban, low-income participant

"...but you're working with people, right? And people have, like, really valid feelings. And that's part of who you are. … It's not just what you say, it is really how you say it, and how you deliver information and how you make other people feel. So that's definitely a skill set I've gotten in FIRST."
—Asian, suburban, high-income participant

"…that was definitely a time where I felt, especially when I was a junior-senior, like I needed to start pulling these other young women into building the robot with me when I do it, because it was so important for me to do that when I was first starting out…[I thought] maybe this will help them be more excited. [And] one of my favorite parts of [FIRST] was trying to be like a mentor, because I always thought that was pretty cool."
– Asian, urban, low-income participant

Participants attributed their experiences in *FIRST* to helping them develop the **skills needed to work in male-dominant environments**, even though that was not an intention of the program. One spoke to how they felt *FIRST* helped them "learn how to deal with [rude little boys]," extending to their robotics classes in school and beyond. This signaled the ways in which *FIRST* taught transferable skills regarding working with others, in this case specifically regarding gendered dynamics within STEM topics. Study participants described how *FIRST* helped them not only feel included as females, but also motivated and empowered to encourage other young girls to join or help mentor them as a result of *FIRST's* impact on them.

"Personally, I felt like [having a woman-focused team] helped me develop skills. It helped me build confidence in myself, knowing that there were a bunch of other girls, women on this team."
– White, suburban, high-income participant

"[We'd say] all right, here's our first round of what works and what doesn't work, what we need to solve, and then [move] onto the next level, and be able to persevere and be persistent with that, until we get to a result. [FIRST] definitely taught me a lot of discipline [and] diligence."
– Asian, suburban, high-income participant

Some spoke to the ways in which they felt their experience in *FIRST* enabled their ability to practice perseverance, and sustain their engagement in activities or situations that were more challenging for them as women, for example when they felt they were delegated to more traditional female roles. Emotional intelligence was another domain that females felt *FIRST* helped them grow in; notably, this theme arose only in conversations with women of color. Lastly, many women discussed how they felt their skills regarding conflict resolution, standing up for oneself, and being courageous with teammates were improved as a result of their participation in *FIRST*.

"…the [male] coach tried to start yelling at [someone in the pit during a competition where we lost]. And I had to interfere because I was a senior, and it was a freshman [being yelled at]. And I felt responsible for not letting an adult man scream at a child. And I had to intervene. And I think I have a lot of resentment for the fact that as an older woman on the team, I had to do a lot of emotional regulation of the adult men who were mentors."
– White, suburban, high-income participant

"With your teammates, or even with the other teams that you're competing against, you're not allowed to be rude, right? But you always have to be polite with each other. Be kind with one another."
– Asian, urban, high-income participant

"…when you're 14 years old, being taught [in FIRST] how to not mess around …when you're having fun [and] to still be professional [taught me emotional intelligence.]"
– Asian, suburban, high-income participant

Additional social growth discussed by study participants included building community, learning to be comfortable with making mistakes, maintaining a positive outlook in the face of challenge, and building courage to speak out. Additionally, participants described how they experienced *FIRST* in ways that directly related to them as females. These included experiencing and providing support to one another as females, whether as participants or mentors.

"Now you kind of have to learn how to make mistakes when you're in FIRST. So the robot doesn't always work the first time, or like the first five times. You're gonna always have to go back and do that."
– Black, suburban, low-income participant

"I think the male mentors really have influenced me psychologically, to want to be the woman leading the change [at FIRST]."
– White, suburban, high-income participant

"…my high school team was really lucky because there was a very strong culture of women leadership in our robotics team, because it had been started by a girl."
– Asian, urban, high-income participant

"I don't want to [describe it as] a cult, but FIRST was like a cult…It's just such a welcoming community that I continue to volunteer and mentor."
– White, suburban, high-income participant

III.   STEM Pathways through School and Work

Specific interview questions asked about women's experiences with STEM during school, higher education, and their early careers, revealing trends relating to their pathways in these fields. While some enrolled in STEM courses during college and ultimately continued to pursue STEM professionally, others did the opposite. Females in STEM today exhibited diverse interests in areas including aerospace science, bioscience, anatomy, mathematics, engineering, programming and physics. However, most discussed how their experiences with STEM outside of *FIRST* is riddled with challenges. Participants openly discussed the hurdles they faced as women in STEM and the proactive measures they took to navigate and cope with these stressors.

> *"FIRST was really the introduction to the engineering field [for me]. I had thought for a couple of years before joining FIRST, that I wanted to be an engineer. But FIRST was the first example of, 'Okay. This is how we like to work on a multi-disciplinary team and work with people.' And it was a really strong foundation that carried me forward all through college and into my career."*
> *– White, suburban, high-income participant*

Availability of STEM resources outside of *FIRST* varied among participants, particularly regarding their schooling experiences. Some participants who grew up with fewer STEM resources expressed the insecurity of feeling left behind from the beginning of high school. For example, the ability to afford lab fees and necessary equipment reflected the tangible barriers faced by one focus group member. Some participants in fact changed their academic trajectories due to financial constraints. Females described how their parents grappled with financial challenges and as a result, exerted pressure on their daughters to pursue more lucrative careers.

> *"I feel I could do a lot more communication impact because civil engineers tend to work for the government in one way or another, and I can work big infrastructure items that will help better the livelihoods of the community I live in, but my parents or my dad specifically was like, 'Heck no, I'm not paying this much money for you to be a civil engineer.' Because they don't get paid very well."*
> *– Asian, urban, low-income participant currently involved in STEM (Engineering)*

Developing and maintaining **confidence in STEM** was a critical component for many. Notably, findings revealed more women of color in the study sample expressed issues with confidence in comparison to white women. For participants who came from STEM-focused high schools, the intense competition and the high academic expectations led to higher levels of anxiety. One participant who grew up in a community where many peers' parents were engineers described how she and others were "very, very encouraged to overreach." Women shared how subjects such as arts and humanities were ignored or prioritized less by their parents, who instead emphasized an investment in STEM education. Additionally, study participants discussed the

anxiety they felt about achieving high grades in their STEM classes. Many spoke to how they felt discouraged when receiving what felt like unsatisfying grades in STEM, and others also shared how this led to a decrease in confidence.

"You know I was a more prepared student in high school, it was very easy to get straight A's. That was my experience, and that just did not transition well into university…going from the experience of [getting A's] to not being able to do anything to help your grades [in science and math], was very degrading. I just felt there's so much value placed on our grades and that was very discouraging in pursuing STEM."
– White, Hispanic, high-income participant not currently involved in STEM

Another commonly shared stressor was the discomfort females felt from being the **gender minority in male-dominated fields**, including both at school and in the workplace. Some participants explicitly described their STEM classes and activities as "male-oriented". Females shared how they felt unable to fit into the environment due to discrimination, unfriendly behavior, and unequal treatment from male peers. Female participants also described how they at times feel as though they are not taken seriously by male colleagues at their workplace. One participant mentioned she noticed how higher-power positions at her workplace were held by white males primarily in their forties through their sixties. Another described the subtle, implicitly sexist attitudes she encountered, sharing how she felt it was at times difficult to identify such instances unless they were "blatantly saying something" that clearly underscored misogynistic beliefs. Some participants also shared how they witnessed males in their places of work exhibiting irritation in response to policies introduced to promote greater representation of women in STEM. Finally, in discussing how they internalized and shared these struggles with others in their life, several women mentioned the role of family, others in their community, and their male partners who were unable to relate to their experiences involving facing sexist experiences at work.

"I definitely think…the introductory classes [in STEM] might [have been] curved to a lower grade and a lot of women versus men are discouraged by that. And I think that actually applied to my reason for not pursuing STEM. I think I just did not want bad grades…the idea of not having something close to a four-point GPA was really unsettling to me. In my first-year general chemistry class, I got a B, [and] it was supposed to be one of the easier classes at my school for pre-med. If I'm not doing well, that's not a good sign."
– Asian, urban, low-income participant not currently involved in STEM

A number of approaches to **coping with these challenges** were shared. Some shared positive experiences of building study groups during their time in school and working with "study buddies." *FIRST* was described by many as a community where participants made friends and gained peer support. Females shared how they also connected with fellow women in STEM majors or joined organizations like "Women in Engineering" to build solidarity during their STEM education. Additionally, participants spoke about the impact of their teachers in moments where they faced challenges in STEM, with many noting it was in fact thanks to science teachers that they were introduced to *FIRST*. In terms of coping with barriers they faced in STEM classes, some participants described how their teachers' passion increased their own confidence. One woman shared how her high school teacher made efforts to "show how, even as a high schooler, you can do things that scientists and engineers are doing as well," and described how such support led her to feel like a "scientist-in-training." Others shared similar experiences where they felt their teacher's enthusiasm led them to feel less afraid to make mistakes, and more willing to take risks in the STEM learning process. One participant discussed how a female physics teacher inspired her to speak up and be more assertive in expressing her opinions in class. At the time, this participant was a new immigrant to the United States and had difficulty speaking fluent English, which she expressed impacted her confidence in participating in class. In reflecting upon this experience, she shared how her teacher encouraged her to overcome her fear of not speaking fluently and therefore not feeling she would be taken seriously in physics.

For those in STEM careers today, participants discussed how they work to **create woman-friendly** spaces to make themselves feel more comfortable through community. Some mentioned

they participate in their company's mentorship programs as both mentees or mentors, allowing them to connect with senior female colleagues who can provide support to them. Participants described how engaging in such a fashion has helped with feeling more welcome in their STEM workplace. Additionally, women acknowledged how having female leaders in their STEM workplaces increased their own confidence and belongingness.

> *"There was this woman engineer [at my job] who did a great job saying we need to promote more women in engineering, to create a safer entrance and ease of getting involved in STEM. It is important to make the distinction of women because it's a community, and women can support women in a very unique way."*
> *– White, suburban, low-income participant currently involved in STEM (Manufacturing Engineering)*

Women also shared how they direct their attention to **enhancing their confidence** as a coping mechanism. Participants described how in their STEM workplaces, they feel the need to continuously anticipate push-back from men, and work to maintain a positive attitude about their own skills and capabilities when such instances arise. Some spoke about how they hold themselves to a standard of firmly standing their ground when they feel their work abilities are questioned by male colleagues, speaking up and "shutting down negative behaviors" if they feel criticism is unwarranted or out of line, rather than being constructive.

> *"…in grad schools, when I was starting, somebody gave me all these warnings [of how] the statistics are awful: 50% of people quit their PhD and 30% in total leave during their first year. It was horrifying…But now that I've started, robotics gave me the feeling that no matter what research problem I was having, I would figure out a way to solve it…that's one thing I do feel really assured about. If I encounter a research problem, if I work at it for long enough, if I think about it for long enough, if I asked enough people for help, eventually I'll get to a solution. And that is a really good feeling.*
> *– Multi-racial, urban, high-income participant not currently involved in STEM*

Additionally, female *FIRST* alumni shared how they feel motivated to bring more women into STEM and **increase female representation** in order to combat anxieties rooted in gender-based discrimination across fields. On an individual level, some participants described their efforts to serve as role models themselves; one shared how she encourages her younger female family members to join STEM clubs, for example. Regarding increasing female presence in STEM careers, many participants who work directly with young people in their STEM careers shared the measures they take to facilitate this growth at the institutional level. Women described how

they feel the presence of accomplished women in leadership roles or as role models serve as an important "pull factor" that can help motivate young girls to feel secure and confident entering STEM. Some participants expressed they feel there is a need for early exposure to STEM; for example, several interviewees currently working as pediatric nurses and STEM educators discussed how they encourage youth and parents to consider looking into STEM pathways in their earlier school years.

"…as a society, we normalize men being in those [STEM] fields more than us, so I think it just has to do with shifting our mindset. And for little children, they're very impressionable, and a lot of times, it's not an explicit directive that you give them of like, pursue this field versus that one. It's more by example. And so I think women who are involved in these courses should try to reach out and let it be known, 'Hey, I pursued this career, and I'm very happy [and] passionate about it, maybe this is something that you can also pursue."
– White, suburban, low-income participant currently involved in STEM (Medical Science)

Finally, participants shared how they make efforts to **shift the gendered views** that persist today regarding career pathways, to alleviate how the challenges they have faced impact future generations of women in STEM. Many said that media geared towards encouraging females into STEM is inadequate and "missing the mark," in some cases, and thus feel as though the most profound impact on this shift will need to come from individuals instead. Others shared how their community holds onto traditional views of the career opportunities that are "meant for" women and described their efforts to challenge those gendered notions. One participant described how it was an expectation in the small town where she grew up for women to choose one of three pathways after school: being a teacher, nurse, or a stay-at-home mother. Expressing her disagreement, she shared how she believes girls should be introduced and encouraged towards more career options, including STEM.

"You hear about that if you're a woman in a small town. It's either you're gonna be a nurse, a teacher, or a stay-at-home mom. Those are your three options. And I wanna make sure that girls know there are other options. If you wanna do one of those three things, that's great. I'm happy for you. But if you want to do something else, I want to let the girls know that they can do anything else. They don't have to be stuck in those three roles."
– White, rural participant currently involved in STEM (Mathematics)

"And we have more media that's representing [women in STEM] now. But I don't think turning things pink really helps that much."
– White, suburban, high-income participant not currently involved in STEM

IV.   The Impact of *FIRST* on STEM Career Preparation

Study participants shared many examples on how they thought ***FIRST* impacted their pursuit of STEM positively** and provided them with opportunities to determine how they wanted to advance academically and professionally. Some females discussed gaining better clarity about the sub-fields within STEM, which allowed them to determine which STEM field was most appealing to them personally. Others described how *FIRST* led them to more easily identify the college major they wanted to pursue. Several women also spoke to how *FIRST* encouraged them to set an example for young girls who may be interested in pursuing STEM themselves.

> *"[My FIRST experience] made me into what I am today. It's really made me want to help those girls and make sure that they feel safe…I'm happy I had [tough experiences in FIRST]. It's really my path that we help other women do things in STEM. I have turned a negative into a positive in a sense."*
> *– White, suburban, high-income participant currently involved in STEM (Environmental Science)*

Many of the women we talked to drew connections to their *FIRST* experience and how they strive to **maintain confidence at work** today, identifying how the skill of conflict resolution helps them manage their emotions and engage in productive conversations when faced with difficult situations that may otherwise undermine their self-concept. Study participants underscored that professionalism and cooperation in their *FIRST* experience had led to their **ability to be professional in the workplace** today, and that in turn, this has helped them earn important opportunities in their career. For others, the confidence that *FIRST* instilled in them enabled their ability to overcome facing gender discrimination and bias in their future careers, whether in STEM or otherwise. In some cases, women connected *FIRST* to their current-day experiences dealing with instances of anti-female sentiments in their workplace and spoke to how they were encouraged into leadership roles during their time in the program led them to see the value in working towards the inclusion of women in STEM.

> *"I felt like FIRST gave me this mindset of just being comfortable. And going into spaces that might not necessarily look like me, or women might not be present [in]. I was never afraid of science. I was never afraid of being the only girl in the room…I definitely think being young and able to walk into a robotics competition and just be like 'Hey, I'm here to have fun' changed my mindset going forward [into grad school today]."*
> *– Black, suburban, low-income participant currently involved in STEM (Biology)*

> *"…being able to take on leadership roles at a younger age in a male-dominated field [of robotics engineering in FIRST] just definitely makes you uncomfortable at first, but it's something that you just start to realize is very much important and very much needed to have that representation. And to keep driving that inclusiveness in those fields as much as possible."*
> *– Asian, suburban, low-income*

"…you always know that there's just gonna be someone looking down on you. And [you] just have to get through it, you know. And FIRST really taught me to deal with that. I was in middle school. There were a lot of rude little boys in my robotics class, and I learned how to deal with them."
– Black, suburban, low-income participant not currently in STEM

Some women, however, identified cases where ***FIRST* instead harmed and hindered their desire to continue in STEM**. While *FIRST* fostered confidence for some, other women faced the opposite and questioned whether STEM was the right path for them to continue along due to a growing **lack of confidence**. For example, one participant believed the program did not prepare them adequately for STEM fields outside of robotics. Another commonly shared stressor was the discomfort females felt from being the **gender minority in male-dominated fields**, including both at school and in the workplace. Some participants explicitly described their STEM classes and activities as "male-oriented." Females shared how they felt unable to fit into the environment due to discrimination, unfriendly behavior, and unequal treatment from male peers. One participant shared her adverse encounter with discrimination at a *FIRST* competition, attributing it to a lack of resources, which ultimately led to her decision to leave the STEM field after her time in the program. Another described an experience in which a male mentor was "verbally abusive," leading her to feel as though she and her teammates were not being "protected" as students deserving of a positive program experience. Ultimately, this study participant chose to leave STEM fields as a whole and created distance between herself and former *FIRST* teammates.

"I think one of the biggest reasons why I decided to apply for schools for hospitality management was because I didn't have the confidence to succeed or do very well in [STEM] fields, because I felt I wasn't as prepared as my peers…[I thought] knowing how to build a robot doesn't fully go into civil engineering."
– Asian, suburban, high-income participant not currently involved in STEM

"I still feel this weight, where I feel like [my mentors] should have been protecting us as students…No one really knows my experience, and I've never really had the chance to share. It was just really difficult. And it just felt like it wasn't fair. And I think the biggest thing was that he [my mentor] was verbally abusive to everyone…So my freshman year of college I became a referee for a couple of off-season events as well as the 2017 FRC games for a couple of regionals. But after that, I kind of just cut myself off…I've actually tried to kind of space myself from robotics. I unfollowed a lot of teams on social media so I wouldn't see those seasons and the robots and things like that."
– Asian, suburban, high-income participant

"I was in a Title IX school and you know, we don't have all those resources, but this one student who came from pretty much the equivalent of a private school [came] to [face our] inner city school and then used all those resources and then blew us all out of the water [at a FIRST competition]. It's the false sense of superiority when the reality was he just had better resources than us. And I decided that I didn't want to deal with that for the rest of my life because the irritation of that student made me realize that that's gonna be an obstacle that I was gonna keep reaching. I really don't like my intelligence being challenged for no other reason than the fact that I just didn't have what you had."
– Black, suburban, low-income participant not currently involved in STEM

V.   Family's Influence on *FIRST* Participation and Career

Family played an important role in the women's school and career decisions surrounding STEM. Parental economic positions impacted some of the women's pathways. Some with parents who had more limited resources felt pushed away from STEM careers that were considered to be less lucrative in the short-term. Naturally, those with such experiences expressed frustration at feeling limited from pursuing careers in STEM that they may have worked towards otherwise. One participant described how she desired a career in civil engineering as she hoped to work in a field that would help her improve the livelihoods of others, but felt she had to compromise this goal due to a lack of parental support. Despite remaining in STEM, she was unable to pursue her field and career of interest.

Others had the opposite experience with parents encouraging them towards a career in STEM. In some cases, this was due to their parent's own established careers in STEM fields, who felt more at ease with guiding the women as they had the knowledge to facilitate their STEM education. For example, one participant shared that she learned about airplanes and aerodynamics when she was very young due to her father's career as a flight test engineer. She proceeded to reflect on how these early experiences and learning opportunities are likely to have sparked her interest in STEM, and influenced how she made decisions in her own career pathways. Siblings, also played influential roles on the STEM journeys of study participants, as many participants shared how they became involved in *FIRST* due to having an older sibling who had participated in the program themselves.

"[My dad] works as an engineer, and so that definitely plays a big role for me, growing up getting knowledge of what he did. And really the application of engineering. Because I really think a lot of people don't know the exact thing an engineer does. You know they understand a very basic idea of it. But you know, getting to see my dad be a flight test engineer and go in airplanes, I thought it was so cool."
– White, high-income participant currently in STEM (Electrical Engineering)

> *"[My mom] still believes I'm a better business person to this day and encourages me to go through business…Maybe it's hard for her to just envision me as an engineer."*
> *– Asian, suburban, high-income participant currently in STEM (Systems Integration Engineering)*

> *"I definitely started [FIRST] because my sister did it. And I wanted to be like my sister, like a normal little sister does. So that was the initial thing that got me in."*
> *– White, suburban, high-income participant currently in STEM (Engineering)*

VI.   Discussion and Recommendation

These interviews with a diverse sample of *FIRST* female alumni underscored various themes from the *FIRST* Longitudinal Study's annual survey, while it also added new information not captured in the survey. While the interviews prompted former program participants with an opportunity to reflect on a variety of topics, they also underscored how *FIRST* shaped women's personal growth, how it provided a range of opportunities for technical and interpersonal skill development, and how the social components were experienced by females. The interview conversations also provided insight into the post-*FIRST* lives of female alumni, extending to topics such as empowerments to enter STEM fields and barriers they may be facing today in such fields, and how they respond to and cope with these challenges. Finally, many participants spoke to the role their families have played during both their time in *FIRST* and their overall academic and professional journeys.

Women overall felt that their problem-solving, teamwork, and communication skills were furthered by their participation in *FIRST*, making these three of the most commonly gained skills. Female alumni emphasized how helpful such skills have made their post-*FIRST* lives, often describing the ways they use their troubleshooting knowledge at work, turn to practicing empathetic communication with co-workers or peers, and ask questions when they are unsure of how to proceed with academic or professional tasks, among other actions. Further, study participants discussed how *FIRST* facilitated their development of socioemotional and leadership skills. This extended to conflict management and delegation, among a host of other areas of growth. Such findings align with empirical findings of how females have been shown to demonstrate a preference for careers involving interacting with others (Yang & Barth, 2015) and social and life science fields (Wegemer & Eccles, 2019).

The women interviewed shared how the *FIRST* program offered them opportunities and skill development in areas that would help advance their future careers, in the form of professional socialization and learning how to work with adults. Many study participants in fact referred to the *FIRST* core components of Gracious Professionalism and Coopertition when sharing how

they felt as though the program enabled their growth as future young professionals. Given the ways in which both STEM-involved and non-STEM-involved women described how Gracious Professionalism and Coopertition have become important assets to their careers today, it appears as though these program constructs have been significantly applicable and useful to alumni's post-*FIRST* experiences. Such findings signal the importance of social skills for preparing for the workforce in the contemporary moment (Lazarus, 2013; Weng, 2015).

Many of the discussions touched on experiences in male-dominated STEM fields, either in their time in *FIRST*, their later schooling, or careers, or in all three spaces. In *FIRST,* while many females felt as though they were treated as equal participants in the program and were offered the same opportunities as their male counterparts, several others shared experiences that told a different story. These women shared in detail how they experienced male mentors perpetuating a male-centric environment, making it difficult to feel empowered as young girls in STEM. Participants also described instances where they were relegated to tasks more typical for women, such as administrative duties, and were not able to work on the robot at competitions or engage in other hands-on technical activities. In their post-*FIRST* lives, many women also described how their college and/or early career experiences in STEM reflected underlying sexist tones. Though they felt their skills were strong in these spaces, the social dynamics often reflected the commonly found male-dominated culture of STEM fields (Wolfe, 2012), which for some led to their decision to switch to other career pathways. This finding aligns with various studies showing females are more likely than males to leave STEM fields in college to switch to a non-STEM major (Maltese & Cooper, 2017; Koch et al., 2022). Further, such findings reflect the ways in which the gendered nature of STEM in the United States favors males over females, leading to a skewed representation found most prominently in mathematics, engineering, and computer science (Koch et al., 2022; Cheryan et al., 2017; Fouad & Santana, 2017). However, some of the study participants persisted despite facing such dynamics, and described how they grew to become even stronger contenders within STEM spaces. Some credited their *FIRST* experiences providing the foundation to helping them build that confidence.

Discussions around the need to build confidence emerged frequently throughout interviews. Most prominently, this appeared in the context of discussing how the male-dominant environment in STEM led to decreased confidence, including some experiences in *FIRST* itself. Some study participants described how they did not feel empowered when tasked with responsibilities that the boys did not want to do while the boys engaged in their preferred hands-on tasks. Females shared how they felt they were given more administrative and menial responsibilities because they were considered unworthy of working on building their team robot, and as though they did not have the skills to do so. Such experiences posed a threat to their confidence, mirroring trends of females having both lower levels of enjoyment and lower confidence in STEM classes in high school (Huang, 2013; Nagy et al., 2008; Ma & Johnson, 2008). Interestingly, the vast majority of conversation around decreased confidence was contextualized more within post-*FIRST* experiences in college and professional experiences rather than in *FIRST* itself. This may signal that the broader STEM world has yet to catch up to how *FIRST* encourages inclusivity across all program participants, given the prevalence of these themes of females feeling disempowered in STEM in school and beyond.

Lastly, the involvement and influence of one's family appear to play a large role in the experiences of *FIRST* female alumni. Study participants described how their parents, and in some cases, siblings, shaped their journey into and throughout the program, with many appearing to have first gotten their start as a result of having an older sibling who had previously been a part of *FIRST*. Others felt supported by their parents throughout their time in the program, due to their own careers in STEM fields; women described how they felt as though their parent's involvement in physical sciences allowed them to become familiar with these topics before *FIRST*. As a result, female participants with this background felt more inclined to join the program, and some described how they felt better prepared and more comfortable engaging in *FIRST* activities. These findings signal how family socialization and influence are strong guiding forces for young people, especially young girls (Sameroff et al., 2014).

Recommendations

This qualitative study highlights a host of areas in which *FIRST* is associated with positive long-lasting outcomes, as well as other areas that would benefit from additional attention. It is clear from our study that females have felt as though *FIRST* actively and effectively encourages teamwork and allows participants to build skills in collaboration and treating one another with respect. Further, female alumni reflected frequently on how enjoyable they found activities where they were fully engaged in active tasks, as in competitions, and working together to build, co-create, and collaborate with others on their team. Study participants often spoke about how working alongside other females on their teams was of particular interest to them, as they felt a sense of comradery and closeness in their shared experiences as girls in STEM. For these reasons, *FIRST* should continue to include a focus on helping youth develop community-building skills that can enable their growth as future professionals, for whom such skills are a necessity in the workplace and beyond (Lazarus, 2013). Such community-building will be especially important for female *FIRST* participants, given how feelings of belonging and a sense of protection from gender bias can arise from interactions between female teammates (Kolker, 2021).

Study participants also shared previous experiences that signaled areas to which *FIRST* could direct greater attention.[2] Issues around confidence building (or lack thereof) were frequently brought up in the interviews, and while many felt they gained confidence for a host of reasons, many felt they experienced the opposite. Given the connections participants drew between decreased confidence and their social engagement with male peers and/or mentors, it appears there may be room for growth in 1) focus on developing and maintaining a less gendered climate in the program, 2) mentor recruitment and training, and 3) intentionally adding women in STEM as a discussion point during the program. Based upon the experiences that women shared in this study, more targeted or intentional scouting of mentors, in addition to sensitivity or culturally responsive training, could benefit future female *FIRST* participants. Mentors can then actively

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[2] As more than ten years have passed since the women in this study participated, these issues may have been addressed.

and more strategically work to ensure male and female participants are continuously treating one another with respect and are giving one another equal opportunity to engage in various activities in the program, rather than risking potential exclusion, which may or may not be gender-based. Critically, such training would also extend to ensuring equitable opportunities are offered across racial and ethnic backgrounds, in addition to gender identities.

As study participants underscored the impact of female mentors on their *FIRST* experiences, future mentor recruitment efforts should focus on recruitment of female mentors when possible. Such intentionality behind mentor recruitment and training is especially important for youth. Adolescence is a time when social dynamics are constantly evolving and can at times be potentially toxic, and an array of cognitive changes are experienced (Killen & Verkuyten, 2017). Additionally, interviews revealed cases where participant parents serve as team mentors with the potential of leading to favoritism and bias, furthering the call for careful and deliberate mentor recruitment.

FIRST has the opportunity to serve as an intervention that reduces the impact of the barriers that female participants will likely face in their future academic and professional lives. Evidence shows that the challenges to women persisting in STEM fields continue to be significant and prevalent, and at times lead those who may have otherwise remained in STEM to leave and pursue completely different professions (Maltese & Cooper, 2017). This signals to us that the larger world of STEM has yet to develop an environment that not only welcomes women, but allows them to feel as though they are truly accepted by their peers and mentors, and encourages their growth in these fields. Unfortunately, there are not measures that any single program can take that will dismantle these discriminatory systems on a broader structural level; however, based upon the interview data, it appears that *FIRST* provides a space where females are given opportunities that can help them build resilience and confidence that may protect them from such patriarchal and exclusive environments. By feeling welcomed as young women by both their peers and adult figures within the program, female participants may be better equipped to take on the world that awaits them after their time in the program, which also extends to those who do not pursue STEM.

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Appendix

Study Methods

The data used in this analysis are derived from the qualitative portion of a larger mixed-method longitudinal study evaluating the *FIRST* program. The longitudinal study has explored the effectiveness of an after-school robotics program on increasing STEM interest and attitudes of children, and on encouraging students to pursue STEM-related education and career options (Meschede et al., 2022). As part of the study, this qualitative project sought to study the impacts of *FIRST* on the academic and career decisions and trajectories of female participants of the program, as well as why *FIRST* has shown greater impacts upon females in comparison to males. To explore these areas, focus groups and interviews were held with *FIRST* alumni who identify as female and who were current participants of the larger *FIRST* longitudinal study. The focus groups and interviews focused on topics including STEM coursework in high school and college, the fields females were pursuing in their current careers, their experiences in the *FIRST* program they attended, and how they believed *FIRST* influenced their post-*FIRST* academic and work experiences. As interview and focus group participants were at various stages in life spanning from college to post-higher education career experiences, this study focuses on responses to questions about all relevant post-*FIRST* experiences.

Current female-identifying participants of the *FIRST* longitudinal study were solicited for interviews to participate in the qualitative study. Individuals were contacted first by a survey introducing the study, asking for confirmation of their interest in participating. Once responses were collected from all survey respondents, a new survey was sent to those expressing interest in the study to schedule or conduct their interview. In an attempt to gather the widest range of former *FIRST* female participants possible – including diversity of race, ethnicity, socioeconomic status, and geographical location, in addition to whether participants were currently involved in STEM fields or not – reminder emails were periodically sent to survey recipients requesting their responses before closing this phase of study recruitment. This process of quota sampling wherein we divided our sample into different strata (Mason, 2002) increased our likelihood of increasing the racial and ethnic diversity of the research sample, allowing us to gather data from groups historically underrepresented in STEM fields. Additionally, including a stratum pertaining to one's current academic or career field allowed us to draw comparisons between women who were and were not participating in STEM at the time of interviews. While this method of convenience sampling involves self-selection which can impact the representation of individuals in a study sample (Robinson, 2014), we found it to be the best option for recruiting a large group of participants who would be willing to share their experiences with us. Our combined usage of both quota and convenience sampling ultimately led to a diverse group of females in our final data sample (see Table 1).

In comparison to the sample of *FIRST* female respondents to the larger longitudinal study's most recent survey, which was distributed in the tenth year of the evaluation, the study sample had some notable differences. In particular, we saw more even distribution of white and non-white participants (50% of each group); and also had greater representation of Black or African American women in our study sample. We did, however, have lower representation of Hispanic females, and were unable to successfully recruit any women of indigenous backgrounds. Note that percentages in Table 1 do not always add up to 100% as demographic data was missing for some participants, due to the baseline survey questions requesting this information being optional.

Determining the STEM status of interview participants was an important step prior to the analysis process, as doing so helped identify trends across various groups. The categories developed by the research team included the following: STEM-involved in robotics, engineering or computer science; STEM-involved in all other science fields; and non-STEM involved. By distinguishing those who are specifically involved in the STEM fields that *FIRST* teaches to program participants, we were able to identify the ways in which these particular individuals have navigated their educational and professional experiences. Further, as the interview data would later show, the ways in which females defined STEM themselves varied, with some self-identifying as engaging in STEM while working in careers traditionally not considered within these domains. Most notably, several interview participants spoke about their careers as educators who teach STEM fields, which informed how they labeled themselves as working in STEM. Thus, we categorized study participants accordingly in order to highlight how the definition of STEM itself has evolved over time, and how many individuals feel as though their current roles reflect STEM engagement.

Table 1. Interview Sample in comparison to Longitudinal Study Sample of *FIRST* Female Respondents to Year 10 Survey.

Demographics	Study Sample (N=42)	Sample of *FIRST* Female Longitudinal Study Respondents to Year 10 Survey (N=186)
Race		
American Indian or Native Hawaiian	0% (0)	1.8% (3)
Asian	23.8% (10)	26.7% (46)
Black or African American	11.9% (5)	8.7% (15)
White	50.0% (21)	58.1% (100)
Multi-Racial	4.8% (2)	4.7% (8)
Ethnicity		
Hispanic	9.5% (4)	15.1% (28)
Not Hispanic	81.0% (34)	84.8% (156)
Socioeconomic Status		
High-income	64.7% (22)	69.1% (112)
Low-income	35.3% (12)	30.9% (50)
Geographical Location		
Urban	19.0% (8)	26.5% (48)
Suburban	59.5% (25)	54.7% (99)
Rural	9.5% (4)	18.8% (34)
STEM Involvement		
Currently STEM-involved (robotics, engineering, computer science)	31.0% (13)	21.5% (40)
Currently STEM-involved (all other science fields)	31.0% (13)	21.5% (40)
Not currently STEM-involved	38.1% (16)	57.0% (106)

In preparation of interviews, the research team formulated interview protocol to guide sessions with study participants. The protocol introduced the study in more detail and confirmed participant consent and their willingness to have sessions recorded. Participants received consent forms prior to interviews and before the research team facilitated a conversation amongst interview attendees asking a series of questions regarding a variety of topics. Interview questions included asking about general thoughts and experiences with STEM, and for those who were not engaged in STEM at the time of the interview, their experiences in their current field. Questions in this domain included the types of STEM courses participants were most interested in during school and why, what their initial experience in these classes was like, and what obstacles or reasons might have led to any hesitancy towards any particular STEM topics. Interviews then asked about participants' experiences in *FIRST*, including how and why they initially joined the program, the composition of their team – whether it was a mixed-gender or all-female group – and who their coaches and mentors were, and what they found to be most exciting about the program. Interview questions also covered how *FIRST* may or may not connect with one's current school or work experiences. Finally, we asked a series of questions to help us understand the trajectories of study participants who were currently involved in STEM fields. Questions included what these women found to be most compelling about their field of study or work and why it was that they have remained involved in it, if and how their pathway after *FIRST* has always involved STEM, and what they believed it took to be successful in STEM. We also asked participants if they believed particular STEM fields were more accessible to women than others, how they believed female representation could be increased in these fields, and what their thoughts were around how males could be allies for women in STEM. In addition to these core questions, we developed a broad range of probing questions, to follow up on how interview participants responded throughout the sessions.

To answer the research questions developed for our interview protocol, we used transcripts from 24 completed small focus groups and interviews (15 focus groups ranging in size from two to three individuals, and 9 interviews), including 42 individuals in total. These sessions were held between April 14th, 2023 through July 14th, 2023. Three pilot interviews were conducted during April, in order to assess the efficacy of the initial interview questions devised by the research team. Doing so assisted in our revision and finalizing of the questions to be asked at the remainder of the interviews. All focus groups and interviews were conducted virtually over Zoom, involved between one to three study participants in each session, and lasted approximately one hour. Sessions followed a semi-structured format that was meant to explore study participants' various academic and career experiences post-*FIRST*. Interviewers used an interview script including probing questions that would help follow all leads. Due to this structure, not all interviews discussed the exact same questions and material.

As we requested permission to record sessions from all study participants, nearly all focus groups and interviews were recorded, with only one pilot interview not having been recorded. The recordings were automatically transcribed through the Zoom platform, and were later

cleaned using Otter.ai to ensure accuracy of all language captured. Transcripts were then imported into Atlas.ti, a software package that enables computer-based qualitative data analysis. Each data record was associated with a set of attributes for each study participant including race and ethnicity, socioeconomic status, and geographical location – rural, urban, or suburban – in addition to various additional factors relating to the coursework participants engaged in during high school, their college major, and elements pertaining to their interest and engagement in STEM during their schooling.

Due to the time required to complete all transcriptions, data coding was completed in two phases based upon the availability of finalized interview transcripts. The first round of data coding included a preliminary assessment of emerging themes captured throughout the first seven pilot interviews and focus groups, which included 15 individuals. This batch was therefore coded as an exploration sample, which informed the finalized coding schema which would then be utilized for the analysis of the remaining 17 focus groups, including 27 individuals. As a result, the two batches were coded as an exploration sample and a confirmation sample before being combined for analysis.

For the exploration sample, the first step of the coding process involved data reduction. To reduce the data, we conducted an initial read-through of focus groups, while using open coding on the transcripts. We loosely followed a grounded approach and allowed the data codes to develop from the data (Lonkila, 1995). However, unlike strict grounded theory, we did not code the text in a word-by-word fashion, and instead coded sentences or paragraphs with multiple Atlas.ti codes. In this process, we included adequate surrounding text to provide context for the codes used, but also separated portions of text that pertained to distinct themes. As codes in grounded theory are produced through an iterative comparison throughout a qualitative dataset, the coding process continuously evolves. For this reason, after the first round of coding, we read through the data once again with our updated set of codes in order to ensure consistency in our data coding. Multiple members of the study team were involved in the various phases of coding to ensure inter-coder reliability, a technique which best facilitates coding qualitative data obtained from multiple questions for accurate, precise data analysis (Glaser & Strauss, 2017). After coding our exploratory batch of data, we coded the remaining transcripts within our confirmatory sample using the same coding schema. Once the exploratory and confirmatory stages of coding were completed, the data samples were combined for our analysis.