2022

Nebraska's Women in Stem | Listen Then Act

Josie Gatti Schafer

Morgan Vogel

Tara Grell

Amanda Parker

Barbara Gomez-Aguinaga

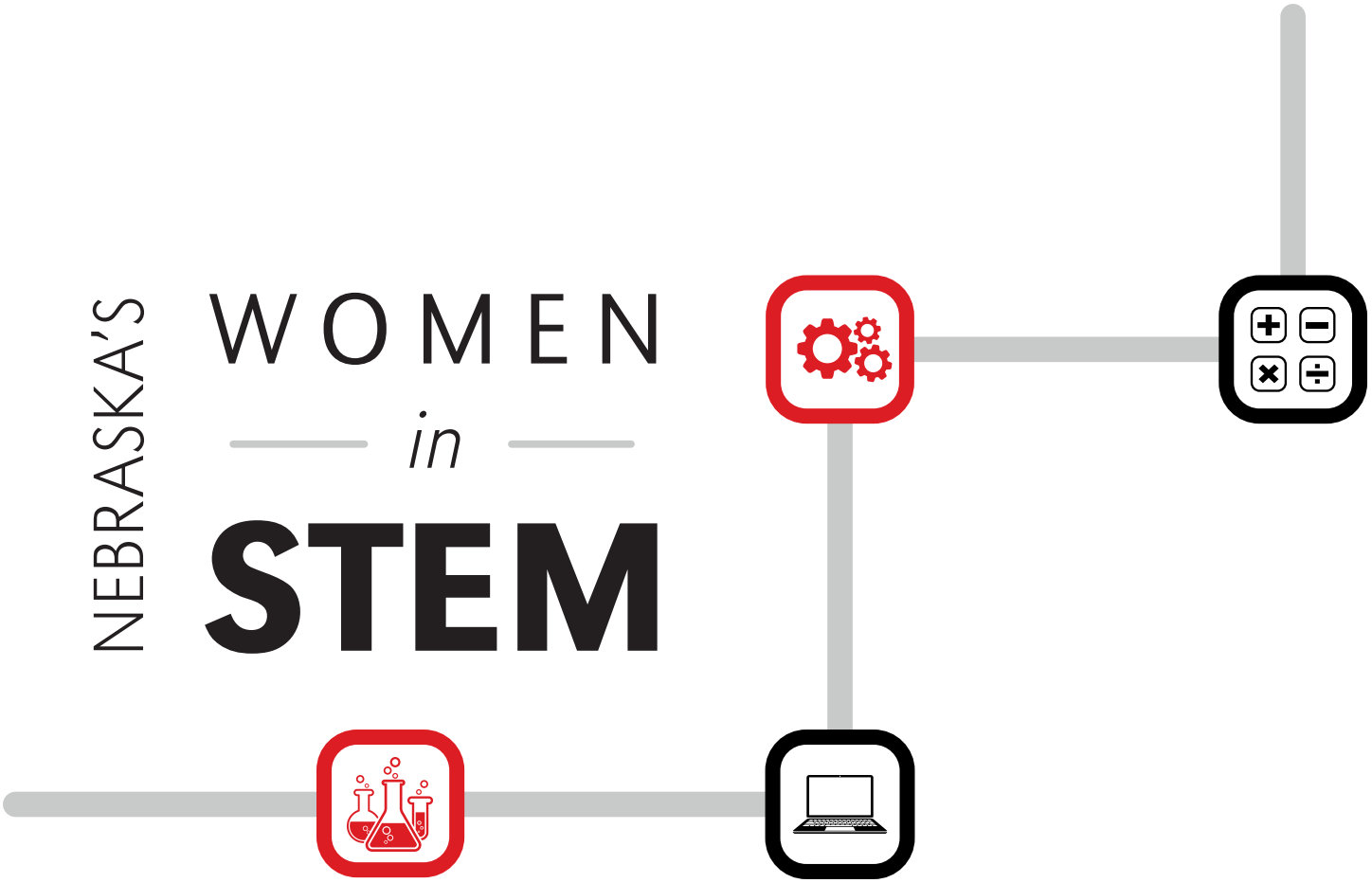
See next page for additional authors

Authors

Josie Gatti Schafer, Morgan Vogel, Tara Grell, Amanda Parker, Barbara Gomez-Aguinaga, Shawn Maxwelll, and Yeonkyung Kim

NEBRASKA'S

WOMEN *in* STEM



Listen Then Act

Nebraska Coalition for Lifesaving Cures

Bio Nebraska

UNIVERSITY OF NEBRASKA AT OMAHA
CENTER FOR PUBLIC AFFAIRS RESEARCH

Advisors
Sasha Forsen, assistant director, Bio Nebraska
Amanda McGill Johnson, executive director, Nebraska Coalition for Lifesaving Cures

Bio Nebraska

Nebraska Coalition for Lifesaving Cures

Report Prepared By
Josie Schafer, Ph.D., director, UNO Center for Public Affairs Research
Morgan Vogel, Ph.D., research associate, UNO Center for Public Affairs Research
Amanda Parker, graduate research assistant and recipient of NASA Nebraska Space Grant Fellowship
Tara Grell, graphic designer, UNO Center for Public Affairs Research
Bárbara Gómez-Aguiñaga, Ph.D., assistant professor, UNO School of Public Administration
Shawn Maxwell, doctoral student, UNO School of Public Administration
Yeonkyung Kim, doctoral student, UNO School of Public Administration

UNIVERSITY OF NEBRASKA AT OMAHA
CENTER FOR PUBLIC AFFAIRS RESEARCH

MISSION

The Center for Public Affairs Research collaboratively produces and disseminates high-quality public scholarship about topics that impact the lives of Nebraskans.

VALUES

C — COLLABORATIVE
Fostering connections between faculty; scholars; students; and community, statewide, and national partners to produce transformative public scholarship.

P — PURPOSEFUL
Focusing on timely topics in order to provide inclusive and actionable solutions to improve the lives of Nebraskans.

A — ASPIRATIONAL
Leading in the application of innovative and creative methods to conduct and communicate our research to further its impact in our community.

R — RESEARCH INTEGRITY
Conducting objective, high-quality research to create an evidence base for decision makers in Nebraska.

University of Nebraska Omaha

NEBRASKA'S WOMEN IN STEM | LISTEN THEN ACT

EXECUTIVE SUMMARY

A large and vibrant science, technology, engineering, and math (STEM) workforce has a range of benefits for the economic and social well-being of communities; yet, women continue to be underrepresented in these occupations. Nationally, in 2017, women accounted for over half of the college-educated workforce but made up only 29% of those employed in science and engineering occupations, while being overrepresented in STEM-related fields like healthcare. Nebraska's STEM workforce is reflective of national trends. In 2019, about 27% of Nebraska women 25 years or older worked in a core STEM occupation, which we can estimate to be about 15,300 women (U.S. Census Bureau, 2019). Women of color are even less represented.

In partnership with the Center for Public Affairs Research (CPAR) at the University of Nebraska at Omaha (UNO), Bio Nebraska and the Nebraska Coalition for Lifesaving Cures sponsored an extensive qualitative research initiative to better understand the challenges and opportunities for women working in STEM occupations in Nebraska. In order to hear the lived experiences of women working in STEM, researchers at UNO CPAR conducted 48 in-depth, semi-structured interviews with women working in STEM occupations and residing in Nebraska.

KEY FINDINGS

Through interviews, six key findings emerged as central to the experiences of women working in STEM in Nebraska, including:

INTEREST AND MOTIVATION FOR PURSUING A CAREER IN STEM
"I was brought up to know that if a male counterpart can do it, I can do it as well." (Interviewee 15)

HOW WOMEN PERSEVERE IN STEM CAREERS
"I will advocate for myself and stand up for myself, and I see that's not always happening with women in the workplace..." (Interviewee 20)

WORKPLACE POWER DYNAMICS IN THE STEM ENVIRONMENT
"...I could say something in a room and certain personalities will argue with me and the guy sitting right next to me could say the exact same thing that I said and those same men would be like, 'Oh yeah that makes total sense,' because a guy had said it..." (Interviewee 46)

UNIVERSITY OF NEBRASKA AT OMAHA
CENTER FOR PUBLIC AFFAIRS RESEARCH

Bio Nebraska

Nebraska Coalition for Lifesaving Cures

BARRIERS WOMEN FACE IN CAREER PROMOTION AND ADVANCEMENT

"I didn't know that we are allowed to do that [negotiate]..." (Interviewee 35)

NAVIGATING WORK-LIFE BALANCE

"...there's a couple things that are obviously different for women. You're the physical caretaker for newborns ... even as kids get older there's certain things they want mom for and not dad." (Interviewee 17)

UNIQUE NEBRASKA INFLUENCES ON THE STEM CULTURE AND WORKFORCE

"I would like to say that I wasn't discriminated against. I would like to say that I wasn't held back...but that wouldn't be true...I still see things happen to women and minorities in the STEM fields that aren't terribly encouraging...we need to figure that out in Nebraska." (Interviewee 11)

RECOMMENDATIONS

Researchers specifically asked women to share ideas and recommendations for how to improve the experiences of current and future women in STEM. Interviewees' recommendations are shared below.

GREATER AWARENESS OF BARRIERS FOR WOMEN IN STEM

We need our male allies to be in those rooms and to hear this.

Interviewee 2

INCREASING ACCESS TO PROFESSIONAL NETWORKS

I think one way to promote more grit in women is by giving them networks.

Interviewee 17

INVESTING IN SCHOOLS AND TEACHERS TO BUILD THE STEM PIPELINE

In Nebraska...we really need to start working with women and minorities to let them know that these are opportunities that exist out there and that these are good jobs.

Interviewee 11

GREATER FLEXIBILITY IN THE WORKPLACE

...the lack of good childcare options and affordable childcare options here is really challenging.

Interviewee 1

PROFESSIONAL DEVELOPMENT OPPORTUNITIES

Training for women is really important... You need to speak up...and make sure you're being treated appropriately...

Interviewee 12

ADVANCING SCIENCE LITERACY

...we need to repackage what science policy training is and science literacy and communication into some sort of science advocacy professional development training.

Interviewee 21

Overview

Science, technology, engineering, and math (STEM) represent large and vibrant industries, and their workforce has a range of benefits for the state of Nebraska. One benefit is to the economy – the average annual salary for an individual working in STEM is $88,000, and it is projected that STEM occupations will grow by 8% in the next ten years (Seitz, 2021). However, women are consistently underrepresented in STEM occupations (Corbett & Hill, 2015; Hill et al., 2010), and women of color are even less represented (Carnevale et al., 2021). In 2017, women across the country accounted for over half of the college-educated workforce but made up only 29% of those employed in science and engineering occupations (Barnett & Rivers, 2021). Additionally, a 2021 report from the National Academies of Sciences, Engineering, and Medicine predicted that implications from the COVID-19 pandemic may further exacerbate disparities in women's representation in STEM fields.

Nebraska's STEM workforce is reflective of national trends. In 2019, about 27% of Nebraska women 25 years or older worked in a core STEM occupation, which we can estimate to be about 15,300 women (U.S. Census Bureau, 2019). As we know, women of color are even less represented than White women in STEM careers. Data demonstrates that 85% of women in a STEM occupation in Nebraska are Non-Hispanic White (U.S. Census Bureau, 2019). Latinas account for just 4% of women working in STEM occupations in Nebraska, Black women account for approximately 3%, Asian women account for 6%, and Native American women account for less than 1% of the STEM workforce (U.S. Census Bureau, 2019). The lack of representation of women in STEM in Nebraska, particularly women of color, demands that we seek to understand the barriers and challenges for women in these careers.

This research broadly defines STEM to include the contributions of women who work in, promote, and support the fields of science, technology, engineering, math, and medicine in Nebraska. In fact, one interviewee from this research too shared our sentiment for this broad definition and important focal group:

> "STEM touches every part of our lives, period. From the moment that you wake up in the morning and get out of bed to the moment that you brush your teeth and crawl into bed, STEM is touching your life. So why are we, as people who believe and understand the power of STEM, trying to differentiate between 'you are STEM' or 'you are not STEM enough.' If you are interested in and care about the impacts of STEM on our community, on our economic development, on our tech structure, on the future generations, on solving world problems, why are you trying to be exclusive in nature in the first place?" (Interviewee 43)

While this study focuses on the experiences of women in STEM occupations, we also recognize that many of the experiences shared by women in this research extend to women in other sectors and occupations. Similarly, many of the recommendations put forth at the end of this white paper are not exclusive to STEM careers and, as such, would benefit women in all sectors and occupations. Increasing awareness about the challenges and opportunities women experience in the workplace is an important topic that deserves attention in all fields.

This research studied the barriers and opportunities for Nebraska's women in STEM by conducting 48 in-depth interviews with women working in STEM occupations. During interviews, women shared extremely personal and humbling stories. We sought to honor their time and commitment to their occupations by sharing their experiences, in their own words, wherever possible. What we heard from Nebraska's women in STEM were stories of grit and determination, despite a range of barriers and challenges. The women interviewed in this study are inspirational and demonstrate a path for overcoming gender barriers in STEM and achieving success in these auspicious careers. In addition, we heard thoughtful ideas to better support women in STEM in Nebraska in the future.

Research Design

The purpose of this research was to examine the barriers and opportunities that exist for women in STEM occupations in Nebraska. Given the complex and individual nature of this topic, a qualitative research design was adopted. Qualitative research allowed us to hear the lived experiences of women who work in STEM occupations in Nebraska and understand the meanings women ascribe to their workplace motivations, interactions, and decisions (Creswell & Poth, 2018). This study was guided by the following research questions:

1. How do a diverse group of women in STEM occupations in Nebraska describe their current professional environments in Nebraska?
2. According to women in STEM in Nebraska, what barriers exist for women to enter and stay in STEM occupations in Nebraska?
3. According to women in STEM in Nebraska, what opportunities exist for women to enter and stay in STEM occupations in Nebraska?

The qualitative research design for this study included in-depth, semi-structured interviews with current females in STEM occupations who reside in Nebraska. Semi-structured interviews are useful for open-ended questions that require extensive probing (Adams, 2015). Additionally, given the personal and potentially sensitive nature of this topic, open-ended interview questions enabled a more in-depth understanding of women's experiences working in STEM occupations in Nebraska.

Data collection

In total, 48 interviews were conducted using Zoom video conferencing. Interview participants were recruited using multiple methods. Initially, interviewees were recruited using professional networks

of Bio Nebraska, Nebraska Cures, and the CPAR research team. Interviewees were also recruited using professional social media platforms, such as LinkedIn, and websites from STEM-based organizations, such as university and college online faculty directories and personnel directories for STEM organizations. Then, we utilized a snowball sampling methodology in which researchers ask interviewees for recommendations of women in STEM who might be interested in participating in this study. Interviewees' identities were always protected, with only the research team aware of which interviewees recommended additional interview participants. In recruitment, special attention was given to representation of the diverse experiences of women in STEM, including variety in STEM occupation, geography, income, race, and ethnicity. Researchers continued interviewing women in STEM until a point of saturation was reached in which no new information was obtained during interviews (Guest et al., 2006).

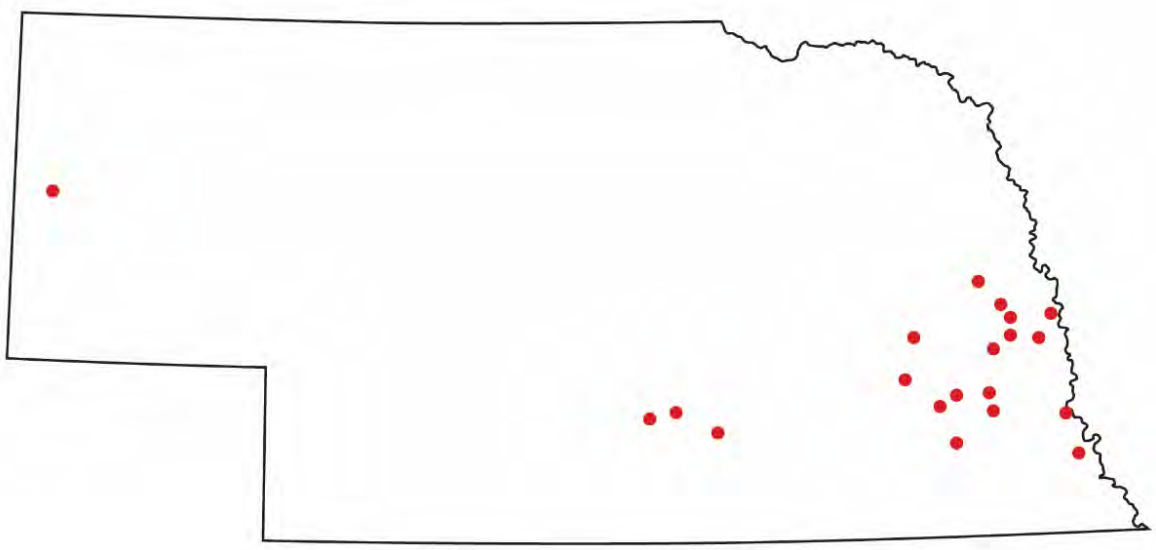
Demographic information of interviewees is presented in Table 1. The median participant age was 43 years old. Interviewees were highly educated, with most holding an advanced degree in their field. Interview participants were recruited statewide, though many reside in the Omaha and Lincoln metro areas due to the concentration of women in STEM occupations in eastern Nebraska. Of the women interviewed, 38 identified as White, nine identified as persons of color, and one participant preferred not to answer.

Table 2 provides detail on the STEM occupations represented among this study's sample. Broadly, 13 interviewees work in science, seven work in technology, 19 work in engineering, three work in math, and four work in medicine. One participant works in architecture, which was recently officially recognized as a STEM field (see Walsh, 2019). Finally, among the women we interviewed, 21 currently work in academia, 24 work in industry, and three classify themselves as full-time graduate students.

Table 1: Participant Demographic Breakdown

Age	Median age: 43 years old Range from 24 to 66 years old
Race	White: 38 Persons of color: 9 Prefer not to answer: 1
Level of Education	Bachelors: 11 Masters: 12 PhD: 21 MD: 3 JD: 1

Figure 1: Geography of Interview Participants



Geography Represented				
	Ashland	Elkhorn	Kearney	Palmyra
	Brainard	Fremont	Lincoln	Papillion
	Cortland	Gibbon	Mitchell	Peru
	Denton	Gretna	Nebraska City	Seward
	Eagle	Juniata	Omaha	Valley

Table 2: STEM Occupations Represented

STEM Occupation		
	Aeronautics	Cyber systems
	Agricultural engineering	Data science & technology
	Agronomy & horticulture	Entomology
	Animal Science	Environmental engineering
	Architectural engineer	Geological engineering
	Architecture	Immunologist
	Biochemistry	Informatics
	Bioinformatics	Mathematics
	Biology	Medicine
	Biological systems engineering	Mechanical engineering
	Biomechanics	Microbiology
	Chemical engineering	Natural resource sciences
	Chemistry	Nuclear engineering
	Civil engineering	Physics
	Community & regional planning	

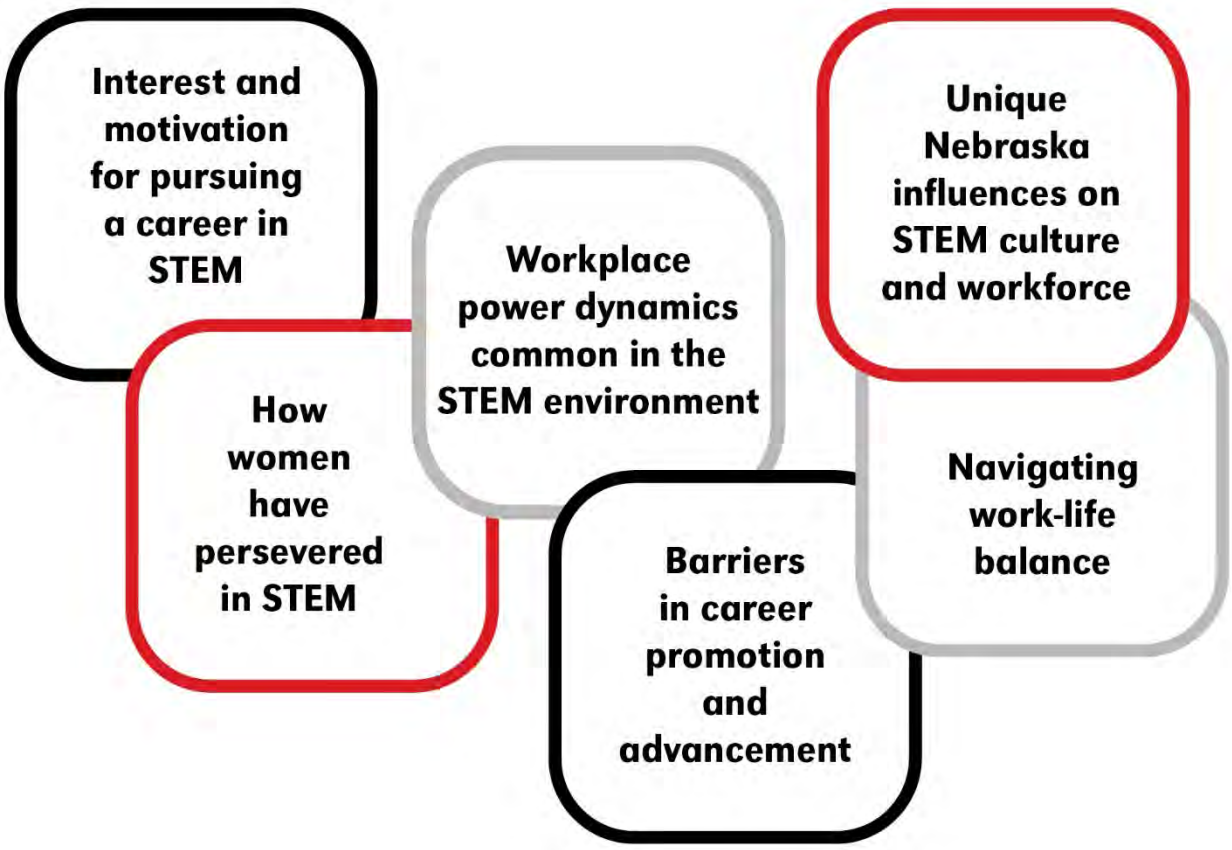
This study was approved by the University of Nebraska at Omaha Institutional Review Board (IRB) and interviewees received an interviewee information sheet via email in advance of the interview. Researchers reminded interviewees of their confidentiality and anonymity protections prior to the

start of each interview. Once interviewees verbally consented, the interview commenced. The average interview length was approximately 45 minutes. Interviews were recorded with interviewees' permission. All but one interview participant consented to being recorded. Interviewees were not provided with interview questions in advance in an effort to illicit more raw responses and emotions on the most impactful aspects of their STEM journey. See Appendix A for the full interview protocol.

Data Analysis

All interviews were transcribed using Zoom. The transcriptions were saved and reviewed for accuracy by a member of the research team. In addition, researchers wrote summative memos to document key information and the main points discussed after each interview (Rubin & Rubin, 2012). The research team used MAXQDA qualitative data analysis software for coding interview transcripts. Analysis included deductive coding from themes in academic and professional literature on STEM occupations as well as inductive coding based on themes from interviewees' stories. A two-stage coding process was employed with two members of the research team reviewing the transcripts to ensure inter-coder reliability. A complete list of codes used during analysis is included as Appendix B. All steps in the coding and analysis process focused on ensuring the depth and richness of interviewees' experiences.

The remainder of the report presents women's stories and experiences as they relate to:



Interest and Motivation to Pursue STEM

For many of the women interviewed in this study, their stories about what it means to be a woman in STEM start with their initial interest in STEM and their early family and educational socialization experiences. Many women in this study specifically acknowledged family and upbringing as key factors in their success in STEM. Strong parental support early on is also documented in the academic literature for women's later persistence in STEM fields (Mullet et al., 2017). Participants acknowledged the difficulty in ensuring everyone has access to a stable upbringing, but still noted its significant influence. Interviewees' reflections on this topic are presented below.

> "I had a good family background. I did always have the backup of knowing that people are going to be supportive of me. That is one aspect. Having faith in yourself...my faith life is the most important thing to me. And so I guess I always had that belief of, it didn't matter if I did fail, there was going to be something else to pick me up and be able to transition to. I guess I just didn't have a fear of failure in the technical side...It's just that belief in yourself." (Interviewee 28)

> "I grew up in a home where everybody had higher education. My mom did her master's degree, while my brother and I were young, so we watched her do that. I remember her studying, I remember watching her do that. My dad had done his master's degree when we were really, really young, so I don't remember that as much. But watching my mom getting her master's degree with children and while working I think made a huge imprint on me, and knowing that after I had children that it was still okay to go back and do my master's degree and continue higher education. So I think that was an important thing for me to see." (Interviewee 43)

> "I really gravitated toward science and technology and math...my mom is a professor...I can remember her taking us to graduate functions and some conferences and it was so cool to see her do her thing...I know it's probably frowned upon now, with all the safety regulations, but we used to go and play in her lab while she worked and she would laugh at us on the sidelines...but, you know, it was still cool, 'oh we're at mom's work.'" (Interviewee 25)

> "I was brought up to know that if a male counterpart can do it, I can do it as well. So that is how I was brought up and I will say that shaped how I see things. It gave me the confidence that I can enter a field like this one, which is sometimes luck...how a female or male child is brought up in their communities..." (Interviewee 15)

The women interviewed attribute much of their success in STEM to their family upbringing. Family stability, support, and structure were common themes.

Many interviewees shared specific stories about a class or influential teacher in middle school or high school who sparked their interest in STEM. Some of these stories are shared below.

> "In fourth grade, I remember learning about the digestive system on a film strip...I started saying at that moment, 'I want to be a doctor.' And nobody said, 'oh honey, that's a dumb idea' or 'you should be a teacher' or 'you should be a nurse.' They didn't gender-type me into a role...They didn't say, 'oh sure you are going to be that.' They indulged me in my fantasy." (Interviewee 6)

> "I always enjoyed math throughout elementary school. Honestly, I was one of those strange kids who liked the timed-tests, where you have to do so many questions in so little time. I liked that challenge. I was always good at math, science, physics, the STEM fields. So that's kind of what led me to pursue my bachelor's degree in STEM..." (Interviewee 9)

> "My love for chemistry came from my high school teacher...our lab wasn't to that level where we could do experiments, so we could not see equipment, there were no chemicals. Our teacher took us to manufacturers, so we visited a soap manufacturer, yogurt manufacturer, plastic processing plant, those things. And then we went to one of the universities in the city to do experiments in their labs. I was like 'Oh, my goodness, I want to do more'." (Interviewee 5)

Additionally, women acknowledged the importance of influential educational opportunities during college. They cited these experiences, including internships, scholarships, and post-doctoral fellowships, as important factors contributing to their success. Some of the frequently cited scholarships and fellowships among study participants included the Nebraska INBRE program, the University of Nebraska at Omaha Walter Scott Jr. Scholarship Program, and the National Science Foundation ADVANCE program. They also cited other National Science Foundation and National Institutes of Health grants that became available once women entered the STEM workforce. One interviewee who received several Nebraska-based scholarships specifically noted how meaningful these opportunities were in keeping her in Nebraska:

> "...all of these programs had told me, 'The purpose of us giving you this money is so you can be a scientist who works in Nebraska, who stays in Nebraska.' So there's that sense of obligation... And I remember thinking these people have sunk so much money into me that it would be wrong for me to leave...They've invested all that...they'd be so disappointed, my mentors who have helped me would be so disappointed." (Interviewee 7)

Finally, many women had an altruistic motivation for entering STEM professions – to help people. Indeed, this altruistic motivation is a common theme among women entering the STEM professions (Wegemer & Eccles, 2019; Mullet et al., 2017). When women talked about wanting to help others through STEM, it was often a direct response to personal issues they experienced throughout their lives. The quotes below speak to how interviewees' experiences encouraged their interest in STEM for altruistic reasons.

> "I was diagnosed with Type 1 diabetes, and so I got really interested in [understanding] what the heck is wrong with my body? Why is it not working? I want to understand this. I loved science from that point on just because I wanted to learn more." (Interviewee 23)

> "I think my aspiration comes from using the discipline to help others. How could the science of agriculture help others? So that is my aspiration..." (Interviewee 36)

> "...when I was eight, my mom was diagnosed with breast cancer, and my grandmother had been diagnosed with breast cancer when I was born...so my mom got tested at the time for the BRCA1 and BRCA2 genes and she was negative. And they shared all this with me as an eight-year-old...And my mom survived thankfully, but I remember being puzzled at the time...I was like 'I don't understand, that makes me mad, why don't we know more?' (Interviewee 7)

> "...we lived in the metro area in low ground that flooded all the time. I thought, if I could figure that out, like how and why things flooded and when, I could make people's lives better. That was always something that interested me." (Interviewee 11)

Based on our conversations, interviewees' initial interest in STEM began early in life. Women in this study's sample grew up as adventurous, curious, and determined children and were intrigued by opportunities to build things or solve problems. This insight shows that motivation from family members, teachers, and other role models is critical in socializing girls and young women to pursue STEM careers.

Key Attributes for Persevering in STEM

Interviewers directly asked participants why they were able to succeed in STEM careers even though few women enter and remain in the field. Many interviewees were intrigued by this question and reflected on their own personality traits. Two key attributes were prevalent among all interviewees: grit and confidence.

As explained by scholar Angela Duckworth (2016), grit includes a combination of passion and perseverance to pursue long-term goals. In this case, passion refers to the idea of "consistency over time." This concept parallels with interviewees' reflections on how they persevered in their STEM careers despite barriers.

> "I'm very stubborn. I don't care a ton about what other people think of me. I'm very self-motivated, not that other women aren't, but once I decided that it was a challenge, I will meet that challenge, even if it is at the detriment of my own health or my own family. I don't recommend that, but that is my personality." (Interviewee 2)

> "...there's a lot of times in my life to when I was younger where grit served me really well and then I persevered and I set a goal for myself and I would be successful...I feel like you just keep going and find a way around the challenges or the obstacles in front of you...there's always a path, even when it seems like there's not...You just keep trying until you find a way forward." (Interviewee 16)

> "...I've always considered myself having tenacity. And just being able to...put up with it. Because, yes, I have seen some harassment in my field, especially in the early years...but that has changed. And it's a good thing that has changed...it's kind of my own personality, the tenacity of just pushing, being a self-starter." (Interviewee 28)

> "I've always been a question asker, just being so interested in finding out the answer that I didn't ever not ask the question. So even though, sometimes traditionally, women are thought to be a little bit meek or a little bit less likely to raise their hand, that wasn't me. I do feel like my personality is probably part of why I did succeed, in the sense that I didn't fit a traditional female gender role...No one told me I couldn't be an engineer, no one told me I couldn't see in 3D...I think part of it was just early on, I decided I'm going to do whatever I want to do." (Interviewee 48)

Women in this study each refer to grit in a different way. Common words to describe grit included stubbornness, tenacity, and determination. However, the need for grit to be successful in STEM careers in Nebraska is clear. Women in this study also noted the importance of having confidence in both themselves and their technical skills.

> "...you have to have some inner confidence and strength, and I think that is very true...I didn't always have confidence in my skills and how I was producing things, but I have a lot of confidence just in myself. And so I will advocate for myself and stand up for myself, and I see that's not always happening with women in the workplace. I think to succeed you do need to have that trait...I like to be involved and I take a lot of ownership in my work and that connection, that pride, just how much I fit into that really helps to stay the course and get through times that are hard or keep pushing..." (Interviewee 20)

> "Every year of my career I've been challenged being a female versus my male counterparts. I'm always questioned, or somebody will ask, 'Well is that what so and so would do as well?' There's always that comment at least once in a year, if not more. When I was early on in my career that was more often...I had to prove myself a lot more...it was very hard, I'm not going to lie, working with some of the guys out in the field was very difficult. But it provided me with a spine or confidence that I knew what I was talking about. I've seen it done in the field and I had confidence behind my design. So, even though, yes, they challenged me because I was a female, I think some of that challenge actually gave me the confidence to get me to where I am today." (Interviewee 34)

It should be noted that although women in this study exuded confidence in themselves, many women shared stories about times when they doubted their abilities or desire to continue in STEM. Many women admitted that they still struggle with wavering confidence today.

> "Imposter Syndrome is another item that is out there. I do find it to be true personally. Some of it is natural I am sure, but other facets seem to be heavily influenced by society and our experiences...Many are their own worst critic..." (Interviewee 20)

> "I never really negotiate anything...I fell into the trap of 'I'm a female and if you offer me the job, I'm just going to take the job and I'm not going to negotiate. I'm just so grateful I have a job, I'm so grateful.' I have imposter syndrome today, it never leaves...someone's going to figure out that I don't know what I'm doing." (Interviewee 2)

While self-doubt was common, the women interviewed have important lessons for how to cope with and overcome these feelings.

> "...it's really, really helpful for me to talk to other women about it, especially other women in technology. Talk to other people on my team who aren't necessarily in technology, but understand my value and move on...You want to try and prove your value through your accomplishments and earn your respect that way, and I think I have. But I think I've really come to the realization that also part of it is just the organization that I'm in and what they value." (Interviewee 30)

> "Whenever I was in my early 20s, I would not speak up for myself. I was so scared to talk. But then I just think, maybe it's the older you get or the situations I had been put in where it's like, well I am just going to, in a respectful way, let them see how their words could be taken and what that means." (Interviewee 31)

> "...when I first started in the early 2000s, [I was] flat out being told 'this isn't an appropriate job for a woman' or 'I don't think women should do that.' And now, I don't feel like anybody would dare say something like that. So there's been some of that change in society where we realize that you can't say things like that anymore. But that has not necessarily taken care of attitudes and microaggressions...I've never been harassed on a job, but I've definitely been told, 'Oh, back in my day women just needed to know how to type,' or that kind of stuff. When you're constantly hearing that, you need to be able to identify it as inappropriate and push back." (Interviewee 44)

Lastly, we heard that mentors are a crucial source of support to help women in STEM achieve. Previous research highlights the integral role of mentors in recruiting and retaining women in STEM disciplines (Mullet et al., 2017; Moghe et al. 2021). Women interviewed for this study were no exception. One interviewee concisely summarized how mentors contribute to the success of women in STEM:

> "Mentors are important, so important, because when you're feeling weak and vulnerable, and you don't have a safe place to land and ask those questions, that's where your mentor is...and you can ask that safe place and just say, 'I think I'm going crazy. I don't really understand this stuff. How can I do this? I don't feel like I fit in,' whatever the problem is. And you talk to your mentor and your mentor says 'Oh, I totally used to feel this way, and this is what I did' or 'Have you thought about this, have you thought about that?'" (Interviewee 6)

Grit and confidence have clearly helped women in our sample achieve and maintain success in their STEM careers. However, we also learned that their confidence was challenged on many occasions.

In response, women have developed coping strategies and acquired mentors to regain confidence, seek encouragement, and navigate the traditionally male-dominated STEM environments.

Power Dynamics

Perhaps the most prominent barrier women in STEM experience manifests through gender power dynamics in the workplace (Mullet et al., 2017). In our sample, women experienced biased and unsupportive supervisors and colleagues (both male and female), explicit gender discrimination, and even sexual harassment.

Participants noted that women in STEM are often viewed differently than their male counterparts and colleagues may be skeptical of their skills and abilities. One interviewee described:

> "I mean, there have been several times that I think I may have surprised people by showing that I know what I'm talking about. [They are] like, 'Oh wow, I didn't expect that.' And I'm like, just because I'm female?" (Interviewee 41)

Stories from the women interviewed about relationships with supervisors and colleagues often evoked traditional gender stereotypes. The quotes below illustrate some of the typical gender stereotypes women in STEM encounter.

> "So, as a woman, I guess I have experiences where men have said stuff to me, when my kids were young, 'I can't believe that you are here,' and basically did the whole shaming thing, like, 'you should be at home, who's teaching your kids?' I mean, I had some male supervisors with that mentality of first one here, last one to leave...some of those things were tough." (Interviewee 31)

> "Every year, we have an annual evaluation with our supervisor. They sit us down. They go over what we've done for the previous year and what our goals are for the future. With my female supervisor, I always had a good feeling when I left that meeting. But with my male [supervisor], I felt kind of dismissed. And if I talked about things that I was interested in doing...it just wasn't expanded upon. It was 'okay that's good, that's nice.' It was brief and to the point." (Interviewee 18)

> "...I could say something in a room and certain personalities are arguing with me and the guy sitting right next to me could say the exact same thing that I said and those same men would be like, 'Oh yeah that makes total sense,' because a guy had said it, as opposed to me..." (Interviewee 46)

> "I almost feel like with age and experience I've become more and more aware of additional barriers...just things like you're not invited out to get drinks with the guys where they're discussing grants or research opportunities, or they invite themselves in little circles for seminars and things like that and women tend to not be thought of as much. And the women are the ones who are thought of for awards that are related to service and teaching, whereas the men tend to get thought of for awards more for research, and so it's just the cycle that continues to perpetuate and the barriers just build up..." (Interviewee 14)

Gender stereotyping was not solely practiced by men in leadership positions. Power dynamics between female supervisors and female subordinates were also sometimes described as tense. While many women did share examples of supportive and nurturing female supervisors and colleagues, some note "territorial female" leaders. The following two quotes describe this power dynamic in more detail.

> "...there's two phenotypes of senior females. One is almost anti-female, these women who have fought their way to the top and they expect everybody else to do the exact same thing, and they are not going to do anything to help anybody out below them, even to the extent of feeling like they're harsher on women than men. And then there were others, but much, much, much less frequent, who were there to provide support and help...within my own department, there were two senior women, one of each basically, one that was supportive and nurturing and would nominate me for things, just was incredible, and another who was just mean...you would think that as women would get to these positions, they know what they've gone through, and they would be making a concerted effort to help those underneath them. And some women do and they're amazing, but it's not universal across the board. I think that's where some of the real challenges come, because this other type, they're the ones saying, 'we don't need to do anything special, we shouldn't be treating them any differently.' And that just adds fuel to the males in the room who also don't want to do anything, like 'oh well, here's a senior woman who agrees with me, so...'" (Interviewee 14)

> "Even in the corporate world there is that 'queen bee syndrome' that exists... women above you...they don't see you as somebody who's just going to come up alongside and you can work together as a team. They view you as a threat, and so they will undermine you and push you down...they will genuflect to a male and they will do everything they can to not support a woman by picking on their clothes, picking on the tone of their voice, not supporting their orders, being passive aggressive..." (Interviewee 6)

To present a comprehensive description of women's lived experiences working in STEM, some women admitted that they have, from time to time, also used power dynamics and gender bias to their advantage. Two examples of this are detailed below.

> "I looked for some opportunities then to say, 'well, fine, if I know you have a gender bias, how can I work that to my benefit?'...I had at least one older, kind of gruff superintendent that had a chip on his shoulder about engineers, you know didn't like young engineers. And so for me, as a female, I actually ended up realizing that if I start my conversations with a question for him to be able to share some of this knowledge with me, then we're going to do well. And we were able to have quite a positive working relationship, but I'm confident that was because I was a female, and I could take that approach with him and he responded well to it. If I had been a young male, I think that might have been a lot more difficult to do that..." (Interviewee 20)

> "...I'm not proud of it, but I'm being honest with you. When I'm with groups, not so much in the workplace, but at conferences or something like that, when I'm with peers in the industry, I act a little bit flirty...that's the way that I get in with those people...otherwise, if I was just standing there, and you know spouting brainiac stuff, they wouldn't listen to me. But by being a little bit flirty, it opens doors." (Interviewee 3)

Some interviewees also shared stories of overt gender discrimination and harassment. Several of the more egregious experiences from interviewees are detailed below.

> "When I became pregnant with my son in the mid 90s, I actually had all of my engineering projects taken away from me and given to somebody else because they didn't think a pregnant woman should have projects, which was really sad." (Interviewee 11)

> "The supervisor was horrible to me. I was young, and I didn't know any better at the time. I initially survived because I thought that he was that way to everybody. Once I learned that he wasn't that way to everybody, I can't say that I didn't go home and completely lose my mind...he was just so mean. It wasn't even attacking just what I was doing at work, but where you start making fun of people's clothes and the way they're wearing their hair and all these things that are personal attacks, and other people would see it...I went to HR because I didn't want to go through it myself. I didn't want anyone else to have to go through it either..." (Interviewee 46)

> "There was an instance where I think I was setting up a meeting with him and a couple of reviewers and he made the comment something to the effect of, 'You can bring the coffee and donuts. I like my coffee blonde and weak.' And my hair is blonde. And I'm just like what is that supposed to mean? I was always nice to him, I never really said anything. And part of it was because I thought I might be working with him in the future." (Interviewee 41)

> "Early on we were at a social situation, so there were cocktails involved and my boss, with a drink in his hand, said, 'Well, the only reason we hired you is because you have big boobs'...I thought, 'okay first off, that's a lawsuit, but I don't want to be like that. Second, how much of that is real?' Because I thought you hired me because I was a good manager." (Interviewee 3)

> "During [school], I had a member of my committee make sexual advances on me and that was a really challenging situation. He was paying my salary at the time; he was paying a research assistantship and part of the deal was that he would pay for me if I worked in his lab...it was just a super hard situation to navigate, and you just feel very alone and unsure how to move forward." (Interviewee 14)

The women we interviewed continued to pursue careers in STEM despite harassment and discrimination. However, the prevalence of these situations should cause many to wonder how many women have left STEM careers after enduring similar experiences.

Race and Gender in STEM

Although the majority of interview participants identified as White, the women of color interviewed for this study provided insightful reflections on the intersection of gender and race. Women of color described how the combination of race and gender can provoke instant assumptions.

> "...when I got the offer letter, the instant assumption is because I am a female and I am a minority, so you were offered that because X and Y instead of your qualifications. And so that was really kind of annoying to have people assume, 'oh well, you are going to do great because you're a woman and you're nonwhite.' And, it was kind of like, what do you mean? I don't want to be seen as a woman or nonwhite, I just wanted to be seen for my program or my contributions. Being a female and being a minority always comes up. It overpowers and over highlights other aspects of your traits, of your qualifications, of your personality. I feel like that's kind of unfortunate." (Interviewee 21)

> "I can't hide my accent, I can't hide my color, my culture is super loud. But the way I overcame all that, I decided to adopt a professional outlook... I never had side conversations with my bosses. I kept it so professional...my language barriers, my cultural barriers, like I can't do jokes, for example...I made sure that everything I did was in writing. I had a personal dress code. That made my life so much easier. Because I knew, I am a female, things are going to happen. I am Black, bad things may happen." (Interviewee 5)

Women of color interviewed for this study described barriers related to their race or ethnicity in pursuing STEM careers in addition to gender barriers. We found that women of color suppress aspects of their identity with the hope of being more accepted in their careers, as indicated above. These findings are consistent with previous research on the experiences of women of color in STEM (Ballenger et al., 2016; Alfred et al., 2019; Reyes, 2011).

Advancement and Promotion

Gender discrimination and bias were especially common for interviewees during times of advancement or promotion in their careers. According to one interviewee:

> "I've actually experienced more sexism, the higher up I get. At first it was kind of cool to have a female faculty member, 'let's just treat her good.' And then it was kind of cool to have a few female faculty members, 'let's treat them good, but they're still lower than us.' Now I am [in leadership]. The men that were my supporters are not now." (Interviewee 2)

Many interviewees felt particularly unequipped for negotiating offers, salaries, and terms of employment. In fact, when asked about their previous experiences negotiating, some women did not know negotiation was even allowed in a professional setting. Interviewees noted that without guidance from mentors or professional trainings, recent female college graduates are often unsure what to expect when trying to negotiate and, when presented with an offer, usually accept. These experiences are expressed in the quotes below.

> "I didn't know that we are allowed to do that [negotiate]. So, when I came here to work, they said, 'here's what your salary is going to be,' and I said, 'okay.' And then I was on a search committee after that and the candidate was negotiating what they were going to get paid. And I go 'what, you can do that?' I didn't know you could do that." (Interviewee 35)

> "I did not actively negotiate. I was pretty pleased with the offer they laid out initially, but honestly I didn't quite know what to expect. I had been an intern and a student my whole life, and so you see that full time salary number and it's like 'wow that's so much more than what I'm making right now. I'll take anything.' But I really didn't actively negotiate that number at all." (Interviewee 9)

> "...probably your best bet if you want to get a good raise is to go interview somewhere else. I will tell you flat out that I wouldn't do that because I think that's dishonest. I don't want to leave here...guys are like 'I do whatever I can to get more money' and women are like 'I know I deserve more but it's dishonest'...I don't know how to fix that, but it is a major impediment to females getting raises like their male counterparts do." (Interviewee 4)

Interviewees' hesitancy to negotiate often continues as they progress through their careers, diminishing their opportunities for promotion or advancement within their organizations. These experiences are reflective of macro trends in which women face disadvantages when engaging in negotiations. This is often due to existing power dynamics within workplace environments (Sturm, 2009; Roth, 2009).

Work-Life Balance

The challenge of work-life balance for women in STEM careers is well established in existing research (Wang & Dagol, 2017; Weisgram & Diekman, 2017). To better understand the role gender plays in managing work-life balance, we asked participants about how they approach the issue.

Working mothers in STEM reported that they are often the primary caretaker at home, including staying home with sick children, providing transportation to and from school activities, and keeping the family's calendar organized.

> "I mean, there's a couple things that are obviously different for women. You're obviously the physical caretaker for newborns, in particular, but I mean even as kids get older there's certain things they want mom for and not dad. And then the other thing that I think women typically manage is just the family calendar, right? Organizing the activities and how is the kid going to get from point A to point B and everything...it seems like that mental load of, 'okay we've got all these things today, this person has to do this, I need to remind them.'" (Interviewee 17)

> "...it still falls on me to schedule appointments, to get kids to appointments...when the kids are both in school, the days that I'm working from home I'll be the one that's dropping them off and picking them up. And that mental load just falls heavier on women, it just does. And that's something, as a society, that we need to fix, but I think we really struggle within STEM careers because they're very male dominated and there aren't many people that understand that piece of it." (Interviewee 46)

Interviewees noted that they often have to make difficult choices between work and family, and either choice can feel detrimental.

> "Ultimately, there truly are not enough hours in the day to be able to do it all. I don't think I can do it all. I don't do it all at work, I don't do it all at home." (Interviewee 37)

> "It's a constant sense of guilt. I'm guilty because I am not with my children. If I am with my children, I feel guilty because I'm not doing my research... It never goes away." (Interviewee 10)

> "I learned pretty early on that you can't do it all, and you've got to figure out what's important to you and, if you have to say no, then be prepared for whatever those consequences are...whether it's a church or a school group or whatever, we all sometimes tend to say 'yeah I can bake cupcakes'... you have to realize you just can't do it all... (Interviewee 26)

Like childcare, maternity leave can also be fraught for women in the STEM workplace. Interviewees noted that navigating company maternity leave policies and insurance is extremely difficult. Many were unaware of their company's waiting periods for short-term disability and maternity leave pay, resulting in many mothers returning to work prematurely. Some women also returned to work prior to the end of the recommended six-week recovery period because they felt guilty for leaving their coworkers and bosses to cover their projects while they were gone.

> "Because the man is not the one forced to stop working, I don't think there's any interest or understanding of what a woman has to figure out or go through...she's a working mom and dealing with paying bills, figuring out insurance, figuring out short term disability. They're [men] not going through that. Sometimes now I've noticed that men take a lot longer paternity leave than they used to, just even from when I started years ago." (Interviewee 39)

> "I have three kids so maternity leave has affected me personally...I think by the third time I finally figured out what to do, but it's never really explained to you very well. I've talked to some other women about that too...it's not very clear..." (Interviewee 40)

It should be noted that women in STEM who do not have children still struggle to balance work and life pursuits, often to the detriment of their own health. Side effects of this can include stress, loss of sleep, and loss of leisure time with other family members (Mullet et al., 2017).

Nebraska Ideology and Culture

Many in Nebraska have traditional viewpoints and ideologies, particularly around family values (Benes, 2021; Boyles, 2008). Interviewees cited Nebraska's traditional values as sometimes hampering women's progress in the workplace, particularly when recruiting and retaining women in STEM.

> "I would like to say that I wasn't discriminated against. I would like to say that I wasn't held back, that I wasn't held to a different standard but that wouldn't be true. And so sadly, even in our current conditions, I still see things happen to women and minorities in the STEM fields that aren't terribly encouraging. I really think that from an economic standpoint, we need to figure that out in Nebraska, because until we embrace diversity, we are not going to have true economic growth." (Interviewee 11)

> "...looking at households in my neighborhood, they tend to have a lot more of those traditional gender roles where the mom stays home or is a teacher, rather than goes off to the office...And so I think breaking into that more conservative traditional family and saying, 'It's okay for girls to like math. It's okay for girls to play with Legos or Science Kids'...And trying to do outreach in that community..." (Interviewee 44)

> "My coworker is an engineer and she has a son...her son was very gifted mathematically, he was encouraged to participate in their fast-track program for math and science. And when her daughter at the same age, with the same test scores, and the same interests came to that decision, she was discouraged from pursuing that path. And my friend fought for her and said, 'why is there a difference here?' And I don't think she ever got a really good explanation...it's surprising to me in this day and age that those kinds of biases are still out there." (Interviewee 47)

Conversely, several interviewees shared how traditional farm and family values in Nebraska can support gender equity and women's empowerment.

"...in Nebraska it's kind of funny because you think, 'okay it's a conservative, maybe traditional state,' but I grew up in a home where my mom stayed home with us, and my dad was a farmer. My mom did as much on the farm as my dad. I think that here in Nebraska we're pretty open to women having leadership roles and there's a really high respect for women, whatever role they choose to take. I mean whether they're going to stay home with their kids or whether they're going to be the governor..." (Interviewee 17)

"...my mom and my maternal grandmother were not scientists at all, but were both very strong women and so they were my role models...they both grew up on farms, so I always think about the grit of someone that has to be a farmer or a farmer's wife...I mean I see it in our students that come from rural areas in Nebraska versus bigger cities...their work ethic is 10 times greater than the average person." (Interviewee 23)

This traditional Nebraska viewpoint, as well as the grit and determination learned on the family farm, may help us understand how to better support women in the workplace.

Breaking Down Barriers for Future Generations: Recommendations

An integral component of this research was how, collectively, Nebraskans can recruit and retain future generations of women into STEM professions. As one interviewee expressed, "I don't want to say that the stories aren't important, but at the end of the day, if all we do is share our stories, where have we gone, where have we progressed?" (Interviewee 27)

This section presents the ideas and recommendations from interviewees – in their own words – for how we can recruit and retain women in STEM occupations in Nebraska, including:

- Greater awareness of barriers for women in STEM
- Professional development opportunities
- Increasing access to professional networks
- Greater flexibility in the workplace
- Investing in teachers and schools to build the STEM pipeline
- Advancing science literacy

Greater awareness of barriers for women in STEM

Interviewees commonly suggested more recognition for achievements of women in STEM. Recognition of the barriers that exist and the work women have done to overcome them is a critical first step in growing representation of women in these fields. Interviewees suggested that everyone in and around STEM fields needs to be aware of these barriers, including young women and girls considering STEM careers, current women in STEM, and male colleagues and supervisors in STEM. Awareness leads to change along with recognition for the grit and perseverance of women.

> "One of the biggest things is recognition. Just increasing the recognition for all of the various things that women are constantly juggling that often their male colleagues are not." (Interviewee 14)

> "From my vantage point, we need women in the room because we bring a different viewpoint and a different level, generally speaking, of empathy. Understanding clients' needs, understanding human needs…men just don't always understand everything at play…you have a job to do, and you have to do it. But you also have to realize that people have things that go on outside of work, and you have to have a little bit of understanding. I have seen time and time again where that doesn't happen." (Interviewee 46)

> "…the first thing I'd say is maybe we need to make these careers not so crappy that we don't have to have like complete determination to just do a job that we probably have the skills to do…I would hope that we can make it such that you don't all have to be so self-determined…that the only way to get this career is to just trudge uphill in a blizzard constantly, right?" (Interviewee 2)

Professional development opportunities

One commonly cited recommendation by interviewees included more opportunities and support for professional development. Interviewees recommended two types of professional development trainings: equity and inclusion training and opportunities to support personal growth and development for women in STEM.

Regarding equity and inclusion training, many women expressed the need for an overall shift in attitudes to promote gender equity and representation, particularly among leaders. Opportunities to address greater equity and representation include reviewing promotion and performance requirements and reviewing practices to ensure an organization's workplace is representative of the population it serves (Snyder & Schwartz, 2019). Women interviewed for this study shared important insights on why greater representation of underrepresented groups in STEM occupations is important.

> "Women are great everywhere, in all fields. And if we can get more of them in fields where that's not quite as dominant, it's always a good thing. Women bring a sense of confidence and compassion and I think, especially in the STEM fields, that can bring a new level to the work and the output. So, I think having that balance is absolutely needed and necessary." (Interviewee 24)

> "…there's a lot of group-think here, there's a lot of socialized-think here, like this is what you're supposed to be, this is who you're supposed to be. And I do think that is a barrier when you see a lack of representation growing up in our extraordinary school systems." (Interviewee 43)

Many interviewees expressed how such training, especially for colleagues, could positively change their workplaces.

> "I've been to so much training, you know whether it's from micro-aggressions, to how to have work-life balance, so much training for females in STEM that are usually structured by professional societies or universities. It's all attended by women. That is not helpful. I mean, I quit going because it was just more people saying stuff I already knew. We need our male allies to be in those rooms and to hear this." (Interviewee 2)

> "I think if we could find ways to tap into the current infrastructure...So you have Chambers of Commerce and you have others that are working with C-suites, getting those trainings for C-suite executives. Having ways to empower their employees to talk directly to the top without ramifications so they understand what women need in order to stay in the workforce and getting them to be champions, that is critical." (Interviewee 43)

There was also a call for more professional support for women in STEM. Many women recounted memories or experiences that either increased or decreased their confidence in themselves and their STEM abilities. Providing more confidence-building opportunities for women of all ages and at all stages of their careers would help more women achieve an upward career trajectory in STEM. The quotes below explain the importance of these opportunities to interviewees.

> "We have got the skills portion down – math, engineering, medicine. We've got the skills, the technical academic skills down. What we're missing is the emotional personal development skills to match that; we've got the IQ not the EQ. I think we need to make a concerted effort on personal development and leadership skills that go alongside that..." (Interviewee 6)

> "There's a lot of this going on for girls...things are wonderful there and could continue to keep going on for girls. There's just not a lot for women. There's a lot of people who just fall into their jobs who have the capability to do all kinds of things. But for whatever reason, they didn't get lifted up the way I did, or they weren't as stubborn as I was, or they had more self-doubt." (Interviewee 30)

> "Training for women is really important...I always train the young ladies that work for me that they need to be able to stick up for themselves if they're going to progress to where they want to be. That's important. Their goals in life are dependent only upon them and nobody else. If you're too afraid to speak up, then you're going to have problems. You need to speak up for who you are, and you need to make sure that you're being treated appropriately..." (Interviewee 12)

> "As young women approach STEM career fields, we really have got to teach them that you can do it just as much as anyone else can. You have hands, you have feet, you have a brain, you have eyes, you have ears, you have a mouth that you can voice. You can do it as long as you apply yourself to do it. My perspective to STEM is that you really have to think critically about everything. But I always say this to everyone, you can do it. The only person that's holding you back is you. The only person that is holding anyone back from applying to that scholarship, from applying to that internship is you." (Interviewee 38)

Increasing access to professional networks

In addition to increased professional development opportunities, many interviewees called for better access to professional networks. Indeed, networks facilitate the sharing of tacit knowledge among women that can help prevent feelings of isolation and provide opportunities to share their experiences (Feeney & Bernal, 2010). While many women acknowledged the value of informal peer support networks, a more formal, statewide network for professional women in STEM is missing. The quotes from interviewees below acknowledge the value of professional networks and opportunities for mentoring among women in STEM.

> "I think that the biggest thing that has helped me has been a support system and a network and it's all female." (Interviewee 14)

> "I think for most women what motivates them is encouragement. Encouragement and honest, truthful feedback, but feedback that's constructive, that doesn't just put them down, but it gives them direction in terms of where they need to go. I think one way to promote more grit in women is by giving them networks...finding a network of support and not just a network where you can go and talk about your difficulties. You want to have a network that's going to speak the truth to you and say, 'Okay, this is hard but this doesn't have to be an obstacle, you can overcome, and these are ideas for you that will help.'" (Interviewee 17)

> "We have to develop a culture that supports [women] and nurtures [women]. And I think that's what we're missing, the nurturing. Because, as women, we know that we have to be hard just to survive, so we're not very nurturing. So we need to somehow figure out how to do that and really lift everybody... know, 'Okay, I have a problem with this, who do I go talk to?'" (Interviewee 27)

> "For me, there was some intimidation, as far as like 'Am I smart enough? Can I keep up?' That was kind of a big question that was always in the back of my head, 'Am I good enough for this?' And to be able to see other women that went through it and came out on the other side...maybe they say, 'It wasn't the easiest thing. But you guys can do it,' that would be really helpful." (Interviewee 39)

Greater flexibility in the workplace

During our conversations, women specifically called for workplace policies that promote greater balance and flexibility. One interviewee recommended providing accessible, affordable, and quality childcare. She shared:

> "One thing that I preach about a lot is the lack of childcare options. It's very hard for any parent to be in the workplace if they don't have a place for their child. And the lack of good childcare options and affordable childcare options here is really challenging... So that's probably the number one that comes up for me is just making sure there's access to childcare and that will help recruit and retain women." (Interviewee 1)

Additionally, some interviewees cited paid paternity leave as a solution for supporting and retaining women in STEM occupations. Many of the working mothers interviewed for this study shared experiences of working through maternity leave, not taking maternity leave at all, or utilizing family medical leave and disability as a substitute for paid time off from work to care for their newborn. As one working mom said:

> "I do have people on my team that having paid paternity leave would be very beneficial to them...showing people that we value their home life as much as we value their time at work is something that's vitally important..." (Interviewee 46)

Finally, women called for more acceptance of remote work and flex schedules. While the COVID-19 pandemic accelerated the acceptance of remote work and flex schedules, many women expressed concern about returning to the workplace.

> "It's more about giving people options...there are women who think working from home is great, there are women who think working from home is terrible. Why can't you enable people to make that decision on their own, especially in a professional role where that requires a high degree of autonomy?" (Interviewee 30)

> "Maybe it's not just specific to women in STEM, but one of the major barriers that I see, of course, is motherhood, and what that does and the inflexibility that comes with the realities of what a working mom experiences today... Working moms are the ones, especially the ones with young children, who want to continue to work from home. So here we are in this moment where women are working from home and working efficiently and working productively and it's not one size fits all." (Interviewee 43)

Providing more support for women who balance work and home lives would have far-reaching effects for eliminating many of the barriers that prevent women in STEM from succeeding.

Investing in teachers and schools to build the STEM pipeline

Thinking more broadly about how to recruit young women and girls to pursue STEM as a career, interviewees passionately explained the importance of building the STEM pipeline early. In addition to families, teachers can be an important way to raise awareness about STEM. Some interviewees suggested that Nebraska needs to support and prepare teachers as they encourage students' interest in STEM. The quotes below summarize interviewees' thoughts on this topic.

> "In Nebraska we need to get into the schools and really start even in junior high level or high school level...really start working with women and minorities to let them know that these are opportunities that exist out there and that these are good jobs." (Interviewee 11)

> "I really think starting in elementary schools and starting with the elementary school teachers, and build their confidence, so that when they teach, they are teaching with confidence and portraying a love for [STEM]..." (Interviewee 35)

> "I think also how we teach the subjects is part of the problem. Math doesn't have to be taught the way it's taught. If it was taught with some applications and some fun things, without having the stereotypes of boys are good at math and girls aren't...we need to actually rethink how we teach these subjects, how we incentivize..." (Interviewee 48)

> "...specifically targeting the teachers, I think, is a really interesting concept. And helping them to understand that message is so incredibly critical, so that if you do have a student who perhaps represents an underrepresented community in the discipline in which you teach, making sure they are hearing that message from that teacher, and that the teacher is making sure to really be that direct line of communication of 'hey, you are good at this. And this could be a career for you, if you want to have that.' I think that's a really smart approach." (Interviewee 43)

Teachers may be a particularly important conduit for STEM awareness in rural communities of Nebraska. Interviewees who grew up in rural Nebraska and who were interested in STEM suggested they were unaware of the possible job opportunities in the STEM professions. As one interviewee suggested, for young girls who are proficient in math and science in school, "you think doctor or nurse, and maybe for women that's just not what they want to do, and that's where they think science stops at that point in time" (Interviewee 24).

Advancing science literacy

Advancing a broad understanding of science and increasing the science literacy of Nebraskans may have a range of benefits for the growth of the entire STEM workforce, including women. One interviewee offered the following explanation:

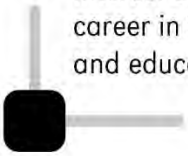
> "...we need to repackage what science policy training is and science literacy and communication into some sort of science advocacy professional development training. Because that's what women need. They need to build confidence within themselves. And that's in their ability to advocate for themselves, but also to translate what their complicated science means in a relatable way. If you can't relate to people, then it also inhibits you from building confidence in your own achievements." (Interviewee 21)

Advancing science literacy across Nebraska provides a holistic approach to elevating the importance of women in STEM and the value of Nebraska's STEM workforce across the state.

Conclusion

While it is widely known that women are underrepresented in STEM occupations, the purpose of this research was to better understand the barriers and opportunities specific to women in STEM in Nebraska. Researchers conducted 48 in-depth interviews with women in STEM who bring a diverse set of experiences to their work.

Key findings from our interviews with Nebraska's women in STEM are summarized below.



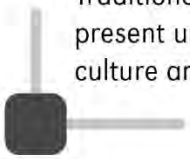
Interest and motivation for pursuing a career in STEM begins with early family and educational socialization experiences.

Women face barriers in career promotion and advancement and are reluctant to negotiate.

Women's perseverance in STEM requires grit, confidence, and support from mentors.

Navigating work-life balance is a constant challenge for women in STEM.

Workplace power dynamics are a common barrier for women in the male-dominated STEM professions.



Traditional Nebraska culture and values present unique influences on STEM culture and women in the workforce.

Finally, the women interviewed for this study shared important recommendations for how to recruit and retain women in STEM occupations in Nebraska. Most notably:

- Greater awareness of barriers for women in STEM
- Greater flexibility in the workplace
- Professional development opportunities
- Supporting teachers and schools to build the STEM pipeline
- Increasing access to professional networks
- Advancing science literacy

References

Adams, W. C. (2015). Conducting semi-structured interviews. In K.E. Newcomer, H.P. Hatry, & J.S. Wholey (Eds.), *Handbook of practical program evaluation* (pp. 492-505). San Francisco, CA: Jossey-Bass.

Alfred, M. V., Ray, S. M., & Johnson, M. A. (2019). Advancing women of color in STEM: an imperative for US global competitiveness. *Advances in Developing Human Resources, 21*(1), 114-132.

American Community Survey 5-year estimates (2019) U.S. Census Bureau. Accessed May 2021. Analyzed by UNO CPAR.

Ballenger, J., Polnick, B., & Irby, B. (Eds.). (2016). *Women of color in STEM: navigating the workforce*. IAP.

Barnett, R. C., & Rivers, C. (2021, May 12). STEMMing the tide of women's progress. Retrieved on May 17, 2021, from https://womensenews.org/2021/05/stemming-the-tide-of-womens-progress/

Benes, R. (2021). *Rural rebellion: How Nebraska became a Republican stronghold*. Lawrence, KS: University Press of Kansas.

Boyles, D. (2008). *Superior, Nebraska: The common sense values of America's heartland*. Doubleday.

Carnevale, A. P., Smith, N., & Quinn, M. C. (2021). *Mission not accomplished: Unequal opportunities and outcomes for black and latinx engineers.* Georgetown University. Retrieved on December 22, 2021, from https://repository.library.georgetown.edu/bitstream/handle/10822/1062948/cew-fr-engineering.pdf?sequence=1&isAllowed=y

Corbett, C., & Hill, C. (2015). *Solving the equation: the variables for women's success in engineering and computing.* American Association of University Women. Retrieved December 22, 2021, from https://www.aauw.org/app/uploads/2020/03/Solving-the-Equation-report-nsa.pdf

Creswell, J. W., & Poth, C. N. (2018*). Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). Thousand Oaks, CA: SAGE Publications, Inc.

Duckworth, A. (2016). *Grit: The power of passion and perseverance*. New York, NY: Scribner.

Feeney, M. K., & Bernal, M. (2010). Women in STEM networks: Who seeks advice and support from women scientists? *Scientometrics 85*, 767-790.

Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough? An experiment with data saturation and variability. *Field Methods 18*, 59-82.

Hill, C., Corbett, C., & St. Rose, A. (2010). *Why so few?: women in science, technology, engineering, and mathematics.* American Association of University Women. Retrieved on December 22, 2021, from https://ww3.aauw.org/research/why-so-few/

Moghe, S., Baumgart, K., Shaffer, J.J., & Carlson, K.A. (2021). Female mentors positively contribute to undergraduate STEM research experiences. *PLoS ONE 16*(12): e0260646. https://doi.org/10.1371/journal.pone.0260646

Mullet, D. R., Rinn, A. N., & Kettler, T. (2017). Catalysts if women's talent development in STEM: A systematic review. *Journal of Advanced Academics 28*(4), 253-289. DOI: 10.1177/1932202X17735305

National Academies of Sciences, Engineering, and Medicine. (2021). *The Impact of COVID-19 on the Careers of Women in Academic Sciences, Engineering, and Medicine.* Washington, DC: The National Academies Press. https://doi.org/10.17226/26061.

Reyes, M. E. (2011). Unique challenges for women of color in STEM transferring from community colleges to universities. Harvard Educational Review, 81(2), 241-263.

Roth, L. M., (2009). Leveling the playing field: Negotiating opportunities and recognition in gendered jobs. *Negotiation and Conflict Management Research 2*(1), 17-30.

Seitz, H. (2021, July 22). *Experiences with vision and change in undergraduate life sciences*. Nebraska STEM Education Conference, Lincoln, Nebraska.

Snyder, C. R., & Schwartz, M. R. (2019). Experiences of workplace racial discrimination among people of color in healthcare professions. *Journal of Cultural Diversity 26*(3), 96-107.

Sturm, S. (2009). Negotiating workplace equality: A systemic approach. *Negotiation and Conflict Management Research 2*(1), 92-106.

Walsh, N. P. (2019, January 2). Architecture becomes a STEM subject in the United States. *Arch Daily*, retrieved from https://www.archdaily.com/908830/architecture-becomes-a-stem-subject-in-the-united-states

Wang, M.T., & Degol, J. L. (2017). Gender gap in science, technology, engineering, and mathematics (STEM): Current knowledge, implications for practice, policy, and future directions. *Educational Psychology Review 29*, 119-140.

Wegemer, C. M., & Eccles, J. S. Gendered STEM career choices: Altruistic values, beliefs, and identity. *Journal of Vocational Behavior 110*, 28-42.

Weisgram, E. S., & Diekman, A. B. (2017). Making STEM "family friendly": The impact of perceiving science careers as family-compatible. *Social Sciences, 6*(2). https://doi.org/10.3390/socsci6020061

APPENDIX A: INTERVIEW PROTOCOL

UNIVERSITY OF NEBRASKA AT OMAHA
CENTER FOR PUBLIC AFFAIRS RESEARCH

Nebraska's Women in STEM: Listen Then Act

– INTERVIEW PROTOCOL –

Date:
Time of Interview:
Interviewer:
Interviewee:
Title:
Organization:
STEM Core Occupation:

Project Description (to be summarized at start of interview):
My colleagues and I are working with Nebraska Cures and Bio Nebraska to try to better understand the experiences of women in STEM in Nebraska. Our intent for this research is to tell the story of how women in STEM in Nebraska have overcome barriers in their careers and to apply those lessons to recruit and retain more women in STEM careers in Nebraska. Our hope is that this research will lead to actionable policy, recommendations and solutions to support women currently in STEM careers and women intending to pursue STEM careers in the future.

We are conducting interviews with women in a variety of STEM occupations throughout Nebraska, giving special attention to variation in geography, race, and ethnicity. We sincerely appreciate your willingness to talk with us today. We provided you with an electronic copy of the interviewee information sheet which guarantees that all interview results will be confidential and kept anonymous.

Do you mind if we record this interview so that we can ensure accurate transcriptions of our conversation? We will destroy the recording as soon as it has been transcribed. Your name will never be shared or associated with any of your comments today.

START RECORDING ZOOM SESSION

To start, can you share your name, your title and the organization(s) you work with.

Demographic Profile Questions

We would like to gather additional demographic information. If you're not comfortable answering any or all of these questions, please tell us to skip the question.

With what gender do you identify?

Are you a person of color?

What is your highest level of education?

What is your age in whole years?

Where in Nebraska do you maintain residence?

How would you describe your level within your organization?

Background Questions

1. We would like to learn about your path into your current career and position. Can you tell us about the experiences that led you to where you are today in your career?

   PROMPTS:

   - Education
   - Mentorship
   - Socialization /internships/ experiences
   - Previous employment
   - Promotions/advancement/professional development

Identify responses that suggest that they have had significant barriers on this path or specific experiences - either positive or negative - as a result of gender and/or racial and/or ethnic identity. If so you will want to follow up.

Some negative examples: switching jobs, considering leaving, slow advancement, poor performance reviews, high stress, relegated to service work, self-doubt, poor relationships with colleagues or superiors, overworked, undervalued, work-life balance, poor health outcomes ....

Some positive examples: promotions, advancement, higher pay, heavily recruited, successful family leave situations, professional development opportunities, supportive colleagues, supportive leadership, strong mentorship....

   If you want to follow up: "Thank you, you have had an interesting career trajectory and I would like to ask you more about some of your experiences, in particular, ...but can we get back to those after a few more questions.

   If not: "Thank you, my next question is..."

2. Many women in Nebraska don't pursue careers in STEM. American Community Survey data from 2019 shows that in Nebraska, 27% of women 25 years or older worked in a core STEM occupation, and women of color are even less represented. Why did you pursue a career in

STEM and how did you overcome the barriers that exist for many women when pursuing careers in STEM?

3. Many women in Nebraska do not advance in STEM careers. Why do you think you have?

    a. Follow-up: Are there any job factors such as pay, benefits and work environment that you have been able to negotiate for yourself to help sustain your career in STEM?

4. Based on your experiences, what do you think could be done better in Nebraska to attract and retain women in STEM careers?

ADDITIONAL QUESTIONS

In your response to my first question, you mentioned some experiences in your career trajectory that I would like to learn more about. Do you have time to talk more now?

5. Can you tell me some of the specific details of .....?

Ask about specific situations that they mentioned applying the provided criteria of significant barriers or positive and negative experiences as a result of identity.

PROBES:

- What were the specifics of the situation?
- How do you think gender or any intersections in your identity influenced how people behaved during this situation?
- What did you do?
- What was the outcome?
- What assistance and/or resources do you wish were available to you at that time?
- Was this direct discrimination or harassment in the workplace?
- How have you coped with this situation in the workplace?
- Based on your experiences, how do you feel gender has shaped your career overall?
- What resources do you think women like you need in the workplace to ensure better experiences for women in STEM?
- .....

6. Is there anything else you would like us to know?

Ask of all participants:
We are trying to interview a diverse group of women in STEM occupations in Nebraska. Is there anyone else you'd recommend we speak with for this project?

Closing: Thank you for participating in this interview. Again, all results will be kept anonymous. Would it be okay for us to contact you if we need to clarify any of your statements?

APPENDIX B: COMPLETE LIST OF ANALYSIS CODES

Advancement/Promotion	Flexibility	Networks/Connections	Remote Work
Awareness/Exposure	Grit	Next Generation	Representation
Barriers	Harassment	NSF Advance	Schools
Childcare	Interest in STEM	Peer Support Network	Science Literacy
Confidence	Imposter Syndrome	Personal Development	Supervisors
Coping Strategies	Maternity Leave	Personal Preferences	Teachers
Ethnicity	Mentorship	Pipeline	Tenure/Academic Promotion
Equity	Money	Power Dynamics	Training
Fellowships/Scholarships	Nebraska	Race	Upbringing/Family
Female Advantages	Negotiation	Realistic Options	Work-Life Balance