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Strategies to Support (Female) STEM Faculty as Voiced by Female STEM Faculty at a Major Research University

Pamela S. Lottero-Perdue Ph.D., Towson University

Pamela S. Lottero-Perdue, Ph.D., is an Associate Professor of Science Education in the Department of Physics, Astronomy & Geosciences at Towson University. She has a bachelor's degree in mechanical engineering, worked briefly as a process engineer, has taught high school physics and pre-engineering, and has taught engineering and science to children in multiple informal settings. She prepares future early childhood, elementary and middle school teachers to teach science and engineering, and has provided numerous professional development experiences in science and engineering for practicing teachers in Northeastern Maryland. She is also a partner and collaborator with the Engineering is Elementary project. Dr. Lottero-Perdue has investigated a range of topics within elementary engineering education, and has also studied faculty-to-faculty mentoring.

Strategies to Support Female STEM Faculty as Voiced by Female STEM Faculty at a Major Research University

Abstract

This paper reports the results of qualitative research, viewed through the theoretical lenses of social learning theory and communities of practice, which aimed to investigate strategies to support female STEM faculty at all ranks at East Coast University (ECU). Sixteen such strategies were identified via the iterative analysis of interviews with 19 tenured/tenure-track female STEM faculty at ECU, representative of all academic ranks and of multiple departments across the College of Science & Mathematics and College of Engineering. The strategies responded to initiatives and policies in place at ECU to support female STEM faculty, were specifically mentioned by at least one participant, or attended to issues common to female faculty such as work-life balance. The strategies were organized into four categories: 1) changing culture (category contains five strategies, including "emphasize data-driven decision making"); 2) building networks of support and information (three strategies, including "encourage informal networking among female STEM faculty"); 3) supporting work-life balance (three strategies, including "continue, clarify and enhance family-friendly policies"); and 4) other strategies to support female STEM faculty (five strategies, including "increase opportunities for female STEM faculty to be officially recognized for their work"). The study has implications not only for how ECU might better support female STEM faculty, but also how other universities might do the same.

Introduction

This paper reports the results of qualitative research that aimed to investigate strategies to support female STEM faculty at all ranks at East Coast University (ECU).[i] Sixteen such strategies were identified via the iterative analysis of interviews with 19 tenured/tenure-track female STEM faculty at ECU, representative of all academic ranks and of multiple departments across the College of Science & Mathematics (CSM) and College of Engineering (COE).[ii] These strategies are presented along with participants' relevant perspectives and experiences, both positive and negative, as STEM faculty. In what follows, the background, theoretical context, study context, reason for the study and research questions, methodology, findings, and conclusions and implications are presented.

Background

The relatively low number of tenured and tenure-track female faculty in STEM fields continues to be a concern for universities and colleges, and for good reason. In a report by the Committee on Maximizing the Potential of Women in Academic Science and Engineering, *Beyond Bias and Barriers*, the following summary findings were asserted:

1. Women have the ability and drive to succeed in science and engineering.
2. Women who are interested in science and engineering careers are lost at every educational transition.

3. The problem is not simply the pipeline.
4. Women are very likely to face discrimination in every field of science and engineering.
5. A substantial body of evidence establishes that most people – men and women – hold implicit biases.
6. Evaluation criteria contain arbitrary and subjective components that disadvantage women.
7. Academic organizational structures and rules contribute significantly to the underuse of women in academic science and engineering.
8. The consequences of *not* acting will be detrimental to the nation's competitiveness.[1]

The third finding may need some clarification. This is the idea of the "leaky pipeline," i.e., that female STEM faculty leave the profession, leading to even smaller percentages of female STEM faculty at associate and full professor ranks.[2,3]

Multiple studies reported in the research literature, as well as in reports from programs such as the National Science Foundation's ADVANCE grants, have supported the findings from the *Beyond Bias and Barriers* report.[4,5,6] Some recent studies that contribute to this growing body of knowledge have illuminated interesting findings regarding critical mass and bias, topics that are voiced by participants in the present study. Work by Carrigan and colleagues illuminated the ways in which critical mass – i.e., a "bare minimum" number/percentage of female STEM faculty working within a unit (e.g., a department)—helps to mitigate a gendered division of labor in which, for example, female faculty tend to do more service (which is less valued).[7] In another recent study, Holleran and colleagues explored female and male STEM faculty members' talk about research and other topics.[8] Among other findings, they found that when women and men talked with one another about research, female STEM faculty were not regarded as being as competent as their male counterparts.

To address the final finding of the *Beyond Bias and Barriers* report – the need to act – the committee recommended actions to be taken by universities, professional societies and organizations, funders, federal agencies, and Congress. The first agent and stakeholder in this list, the university (and within it, colleges and departments), is the context of focus for the present paper. The recommendations for universities spoke not only to deans, department chairs and faculty, but also to university leaders at higher levels (i.e., trustees, presidents, and provosts):

1. Trustees, university presidents, and provosts should provide clear leadership in changing the culture and structure of their institutions to recruit, retain, and promote women – including minority women – into faculty and leadership positions.
2. Deans and department chairs and their tenured faculty should take responsibility for creating a productive environment and immediately implement programs and strategies shown to be successful in minimizing the effect of biases in recruiting, hiring, promotion and tenure.
3. University leaders should work with their faculties and department chairs to examine evaluation practices to focus on the quality of contributions and their impact.[1]

Throughout the details of each of these three action items presented within the report, university leaders at all levels are encouraged to: address campus climate, explore issues of "unexamined bias," find ways to make tenure processes more flexible, and consider fair hiring and evaluation practices.[iii] Additional recommendations from the research literature recommend these practices, as well as effective mentoring of female STEM faculty.[9,10]

The committee that wrote the findings and recommendations for the *Beyond Bias and Barriers* report included many impressive female STEM faculty and academic leaders. The present study sought input from another accomplished group of female STEM faculty and academic leaders, in this case working at ECU, regarding the following broad question: What can be done to support female STEM faculty at ECU? The participants' answers both overlapped and elaborated on recommendations by the committee and within the research literature.

Theoretical Background

This study examined strategies to support STEM faculty at ECU through the connected theoretical lenses of social learning theory and communities of practice. Social learning theory emerged from seminal works including those of Lave and Vygotsky.[11,12] Wenger, drawing from this theory to support the notion of communities of practice, suggested that learning occurs "not in the head or outside it, but in the relationship between the person and the world, which for human beings is a social person in a social world."[13] Here, learning and doing/engaging are regarded as synonymous.[14] In other words, learning is outcome of our social engagement with the world, rather than simply being an assumed activity taken up by students.

Social learning systems include communities of practice, which may be regarded as the simplest social unit within which learning occurs.[15] A community of practice is a group of individuals "who share a concern or passion for something they do and learn how to do it better as they interact regularly."[16] Communities of practice include: academics within civil engineering departments, runners in a running club, and political activists. All communities of practice have three essential components: 1) domain, 2) community, and 3) practices.[17] The domain constitutes the reasons – the common goals, issues, or agendas – why people come together to form the community: "A well-developed domain becomes a statement of what knowledge the community will steward. It is a commitment to take responsibility for an area of expertise …"[18] Here, the community represents the individuals who come together and interact. This identification of what constitutes the community also identifies those who are outside of it (i.e., beyond the community's boundaries). The third and final component is the 'stuff' of the interaction in the community, i.e., practice.[17] Practices are acts of doing and ways of being, and involve ways of sharing knowledge and using resources.

Beyond these three essential components, four additional ideas – regime of competence, identity, legitimate peripheral participation, and the notion of change within communities of practice – are important when considering individual members' engagement within those communities. Communities of practice are formed and maintained when its members co-define, implicitly or explicitly, a "regime of competence," i.e., "a set of criteria and expectations by which they recognize membership."[19] The perceived actions and contributions of individuals,

then, are evaluated by those in communities of practice, which may result in the affirmation or questioning of the appropriateness of fit for a particular or potential community member.

Closely related to this notion of the regime of competence is the construct of learning as a process of identity formation.[20] As a relational, discursive, and responsive process, individuals form identities as they consider who they want to be within communities of practice and in response to others.[15,21,22] Regimes of competence as defined by communities of practice are part of the feedback mechanism to signal to members or potential members whether or not the performance of individuals' identities is consonant with that of the community. In other words, identity includes how an individual sees oneself as belonging to a community of practice, but also how those in the community recognize the individual as being a competent member of the group. In addition, the individual must negotiate the ways in which their identification with a community of practice (e.g., academic science) is in consonance or conflict with other identities (e.g., as caregivers) or other communities of practice in which they participate.

Legitimate peripheral participation, according to Lave and Wenger, describes the process by which newcomers enter communities of practice and move towards full participation. [21] Initially on the figurative periphery of the community of practice, newcomers may be formally or informally mentored or guided by those firmly fixed within the community, i.e., "full participants" or the "old-timers."

Even with an influx of new participants, the practices – the ways of doing, being, interacting, and creating artifacts – supported within the community may be relatively static. This consistency may be an asset to the community of practice, but, as is evident in the following quote by Wenger, may also be a detriment:

> The history of practice, the significance of what drives the community, the relationships that shape it, and the identities of members all provide resources for learning-for newcomers and old-timers alike. Of course, by the same token, these resources can become obstacles to learning … The long beak that made a species successful can be its downfall if circumstances change. Communities of practice are not immune to such paradoxes. Remaining on a learning edge takes a delicate balancing act between honoring the history of the practice and shaking free from it. This is often only possible when communities interact with and explore other perspectives beyond their boundaries.[23]

Given that a community of practice is shaped primarily by its participants, if participants within the community are resistant to change, so will be the broader community of practice; practices – be they good or harmful – will remain.

The theoretical lenses of social learning theory and communities of practice are fruitful ways to consider the experiences and suggestions of female STEM faculty at ECU. Each of the participants in this study has been engaged in one or more professional communities of practice, including STEM departments and interdisciplinary teams, at ECU. The domains of these communities are shaped by the objectives of the participants' respective disciplines, and their academic roles to attend to research, teaching, and service. The very fact of their hiring placed the participants into these communities, reflecting their competence in the field; however, other

community members seem to subtly call some participants' identities within those communities into question. A range of practices has shaped the experiences of the participants, including both receiving and not receiving the kind of apprentice-like mentoring suggested by the construct of legitimate peripheral participation. Newer practices, including those emphasized through ECU's institutional objectives to support women and minority faculty in STEM and those suggested by participants and shared in what follows, are, as Wenger suggested, pushing communities of practice at ECU to be dynamic and on the "learning edge."[23]

Study Context

ECU has an institutional objective to recruit, support and retain female STEM faculty. Four major efforts, all of which have impacted the CSM and the COE, have attended to this objective thus far: 1) enhanced faculty recruitment initiatives; 2) a faculty mentoring program; 3) administered load and stop-the-clock policies for faculty members with newborns or newly adopted children, and 4) a brown-bag and seminar lunch series for female STEM faculty. These efforts not only aim to shape practices within CSM and COE departments (e.g., how recruitment and mentoring occurs), but also the community itself—attempting to increase the numbers of women who are hired onto and stay within these departments.

Recruitment

Over the last four years, grant funding has supported two efforts to support female STEM faculty in the CSM and COE, the first of which involves recruitment. Recruitment strategies and resources were primarily developed at another institution, and applied to the ECU context (with permission from the original institution). A team of ECU STEM faculty leaders (hereafter, faculty leaders) and grant Program Managers (hereafter, Program Managers) studied the relevant research literature at the start of the grant, and subsequently applied recruitment strategies and resources to ECU.

During each semester in which there have been open STEM faculty positions, faculty leaders have led workshops on faculty recruitment for those closely connected to the hiring process: search committee members, search committee chairs, and department chairs. In addition, Program Managers have disseminated multiple resources to guide the operation of search committees.

Recruitment workshops and resources emphasize the importance of careful – i.e., thoughtful, informed and not hasty – evaluation, interviewing, and selection of candidates for tenure-track faculty positions. Specifically, workshops and resources encourage search committees, search chairs and department chairs to, for example: make ample time to meet and make decisions about hiring; recruit from a high-quality, diverse pool of candidates; fairly evaluate those candidates (e.g., using rubrics to guide this assessment); and use best practices in interview techniques (e.g., learning what can and cannot be asked).

Impacting all of these aspects of faculty recruitment is a topic that is addressed directly in ECU's STEM faculty recruitment workshops: the need to be aware of our unconscious biases and their negative effects on recruitment. Search committee members should avoid taking

"cognitive shortcuts" – i.e., using our quick-to-access assumptions, which may include gender or other biases (e.g., women with families are less committed to their jobs) – to guide decision making during the recruitment process. Rather, best practices for recruitment should be data driven, involving the careful review of each candidate's accomplishments.

Faculty Mentoring

The second effort of the aforementioned grant aimed to develop and support a faculty mentoring program. In contrast to the recruitment initiative, which applied successful strategies and resources developed at another institution, the faculty mentoring program was more of a homegrown ECU effort. Informed by a review of relevant research literature, knowledge of the ECU CSM and COE contexts, and personal experience, STEM faculty leaders and Program Managers developed a three-part faculty mentoring program. The three key aspects of the program are: 1) the assignment of a formal departmental mentor to each assistant professor; 2) a mentoring protocol for use by mentors and mentees; and 3) workshops to inform and support mentors and, separately and more recently, mentees.

The assigned mentor in the formal mentoring program is a senior faculty member within the department, appointed by the chair, and able to inform the mentees of departmental policies and expectations on the mentee's path towards promotion and tenure. Program Managers identify this mentor as one of four possible kinds of mentors that mentees might seek; the others include evaluative mentors (e.g., department chairs) and outside professional mentors (e.g., a member of a professional organization in the mentee's research area). A network of mentors, including but beyond the assigned departmental mentor, thus provides support and guidance to the mentee.

Program Managers developed the mentoring protocol as a resource for mentors and mentees to use during their interactions. For example, before an assistant professor's first semester, the mentoring protocol prompts the mentor and mentee to discuss: initial contact with graduate students, lab set-up and needs for renovation of space, equipment ordering, teaching load, teaching location and other logistics (e.g., syllabi, student policies). Although the focus of the mentoring protocol and formal mentoring program is on assistant professors, the mentoring protocol includes suggestions for ongoing support of mentees post-tenure, including continuing to provide feedback regarding grant or award opportunities as the mentee works toward promotion to full professor.

Workshops for mentors are typically held once or twice per academic year. Most attendees are senior professors, and thus, most are male. During the workshops, mentors are informed about and discuss: the importance of and best practices for faculty mentoring; the types of mentors in a faculty member's network; relevant policies (e.g., stop-the-clock); useful resources (e.g., the mentoring protocol); unconscious bias; and expectations for their participation as mentors (e.g., meeting regularly with mentees, minimally once per month; sharing both written and unwritten rules and policies). Mentors discuss any concerns they have about their roles, and are assured by faculty leaders that while this role is important, no one expects them to be the sole mentor for the mentee or completely "responsible for this person's life and career" (direct quote from a Program Manager).

The above efforts both encourage the broad practice of mentoring within departments, and attempt to hone the way in which mentoring occurs (as per the aforementioned workshop topics). These efforts to encourage mentoring – an assumed practice within academia – is consonant with the concept of legitimate peripheral participation in communities of practice, i.e., the movement of newcomers towards fuller participation in the practices of the community through the guidance of associate and full professors. Attempts to reshape the nature of mentoring suggest an attempt to alter this academic practice.

Administered Load & Stop-the-Clock Policies

At ECU, a male or female faculty member at any rank (assistant, associate, or full) who becomes the parent and primary caregiver of a newborn or newly adopted child may receive "administered load." This is full or partial release from teaching during the semester immediately following the birth or adoption of the child. If the faculty member is untenured, s/he additionally has the option of utilizing the "stop-the-clock" policy. This enables the faculty member to extend the pre-tenure probationary period for one year (per child; maximum of two children). Recently, ECU's stop-the-clock policy has shifted from involving the faculty member *requesting* that the department chair allow the application of the policy to *informing* the chair about her/his intent to utilize it.

Brown Bags & Seminar Speakers

In addition to the above formalized initiatives and policies, CSM and COE leaders have hosted approximately one to two brown-bag lunches per semester for female STEM faculty. These are largely informal in nature and aim to provide an opportunity for these faculty – some of whom have very few other women to connect with within their home departments – to network. At times, an internal or external seminar speaker has provided a focus for conversation (e.g., sharing perspectives from women in leadership positions, or discussing a book about communication skills).

Reason for the Study and Research Questions

Despite the above efforts to recruit, support, and retain female STEM faculty, there continues to be a concern by many ECU faculty, leaders, the aforementioned Program Managers, and others regarding the low numbers of, climate for, and retention of female STEM faculty at ECU. In particular and recently, several female faculty in the CSM and COE who were associate or full professors have left, leaving – among other things – some to wonder about the climate for senior women faculty. Largely, however, ECU is not extraordinary; female STEM faculty are in the minority in nearly every field that falls under the STEM umbrella at most institutions.

There are multiple possible responses to this situation for ECU. Many of them are cognitive shortcuts, coming to mind quickly and without much depth of thought (e.g., there are few faculty women because the pipeline is small, or women leave because of their family responsibilities). Another response is to ask female STEM faculty at ECU about their perspectives and experiences, and the strategies they would suggest to support faculty like themselves.

The options to gather information for this latter approach include the use of climate surveys and interviews. Climate surveys can be expensive and – to provide significant information – tend to be long. The author of the present study worked with Program Managers to modify and contextualize a survey based upon and similar in length to a well-regarded NSF ADVANCE climate study for ECU. This survey was to be given to both female and male STEM faculty in CSM and COE. Leaders in these colleges rejected it for its length, worrying that many faculty would neither have nor take the time to complete it. College leaders and some faculty who reviewed it worried about being identified. The survey was shelved.

The study presented here is a qualitative, interview-based study involving only those female STEM faculty who volunteered their time and thoughts, the aforementioned Program Managers who reviewed interview protocols and assisted with Institutional Review Board approval, and, of course, the author. With a qualitative approach, this study does not aim to provide generalizations about female STEM faculty, and it cannot compare female and male STEM faculty perspectives (or perspectives of STEM versus not-STEM faculty). Rather, what this study does well is explore and express – in depth – the range of perspectives and experiences of female STEM faculty at ECU. In particular, the research questions that guided this study are as follows:

1. What strategies do participants suggest to better support female STEM faculty? In other words, how do female STEM faculty suggest ways in which practices may be changed or enhanced to better support their participation (and thus identification) within their respective communities of practice?
2. How are these strategies informed by participants' experiences and perspectives?

Methodology

Data Collection and Analytical Methods

In February 2012, female STEM faculty who were or had been employed at ECU within the last five years were asked to participate in the study via an email sent in the middle of the 2011-2012 academic year. Two follow-up emails were sent to faculty requesting their participation. Attached to the email was a letter of consent and the interview protocol. Three options for interview types were provided in the emailed request: face-to-face, audio-recorded interview; audio-recorded interview via phone; and interview protocol questions sent to participants via email. The interviews, conducted by the author, were semi-structured in format (i.e., the protocol was followed, yet clarifying and follow-up questions were interjected either verbally or via email).[24] In both the email and in a letter of consent attached to the email, participants were assured that their names would not be used and they would not otherwise be easily identified in study reports. Further, only the author (not the Program Managers, ECU administrators or others) would know who participated in the interviews.

Twenty faculty responded affirmatively that they would be interested in participating in the study. Ultimately, 19 of these faculty participated in the following types of interviews between March and June 2012: face-to-face (13 participants); phone (5); and email (1). The face-

to-face and phone interviews lasted, on average, 1 hour 20 minutes each. Interviews were transcribed, with pseudonyms replacing names throughout.

Participants

The 19 participants in this study represent approximately 45% of the female faculty in CSM and COE departments (i.e., science, computer science, engineering, and mathematics departments) at ECU. They are distributed relatively evenly across ranks and science/engineering colleges, and include those in leadership positions (department chair level or higher). Two participants are no longer at ECU. More specific information cannot be shared to protect the identity of the participants.

Analysis proceeded in two major stages: 1) an iterative search for themes (i.e., codes and subcodes) within a representative sample of interviews, and 2) coding of the entire data set using HyperResearch™ software.[25,26] Relevant to the present study were four major codes: Background (e.g., regarding the ECU programs, participants prior experiences, etc.); Past Supports (i.e., programs, policies, relationships, etc. that have been helpful to participants); Challenges (i.e., struggles and difficulties that participants have experienced), and Suggested Strategies (i.e., strategies that participants suggest to support female STEM faculty). In all, over 75 subcodes within these codes were identified to describe the data.

Throughout the report, estimates (e.g., "several") or percentages of responses (e.g., the percentage of participants who expressed having had positive mentoring relationships) are provided. These are meant only as a means to further describe the data, but not to compare findings in any statistical sense.

Caveats

Although every attempt has been made to ask participants to consider one variable (sex/gender), it may be difficult for some participants to tease this minority category apart from others. Two participants mentioned, for example, going to social events and pointedly noticing how young they were compared to others. Other identities and characteristics, not specified here so as not to reveal participants, may have impacted their experiences and perceptions and thus would be difficult to isolate from those experiences and perceptions as women.

Additionally, this study relies upon the participants to provide their perspectives and experiences in reliable and trustworthy ways. Triangulation of the data occurred through two primary means: 1) the author has personal knowledge of some of the STEM departments included in the study, and 2) the report of findings went through a member check process (i.e., it was reviewed by participants prior to dissemination to those outside of the study). Finally, although this study aims to include the full range of participants' perspectives and experiences, space constraints and a need to protect participants' identities necessitated that not all of these be shared.

Findings

The findings in this section are limited to those strategies that responded to initiatives and policies in place at ECU to support female STEM faculty, were specifically mentioned by at least one participant, or attended to issues common to female faculty such as work-life balance.[iv] Table 1 outlines the 16 strategies determined through analysis and organized into 4 categories: 1) changing culture, 2) building networks of support and information, 3) supporting work-life balance, and 4) other strategies to support female STEM faculty.

Table 1. Strategies suggested by participants to support female STEM faculty at ECU.

#	Strategy
Category A. Changing Culture	
1	Foster an appreciation of the strengths of a diverse faculty.
2	Value service that builds community.
3	Raise awareness of subtle negative messages towards female STEM faculty.
4	Value and demonstrate transparency as a means of achieving equity.
5	Emphasize data-driven decision-making.
Category B. Building Networks of Support and Information	
6	Continue and enhance the faculty mentoring program.
7	Encourage informal networking among female STEM faculty.
8	Provide workshops for female STEM faculty.
Category C. Supporting Work-Life Balance	
9	Continue, clarify and enhance family-friendly policies.
10	Improve and expand childcare resources, including the addition of lactation rooms.
11	Consider creative solutions to dual-career situations.
Category D. Other Strategies to Support Female STEM Faculty	
12	Support all STEM faculty, and in doing so, female STEM faculty will be supported.
13	Increase opportunities for female STEM faculty to be officially recognized for their work.
14	Provide personnel support to STEM faculty who are new parents.
15	Listen to female STEM faculty, both those who stay and those who leave.
16	Continue recruitment efforts to increase the number of female STEM faculty.

In what follows, participants' names are pseudonyms. Pseudonyms are used whenever possible, but excluded (in favor of more generalized language such as "one participant shared …") when patterns of pseudonym use might reveal participants' identities if the institution was to be determined.

Category A. Changing Culture

Janeen expressed the following: "the root problem is the culture." Culture may be loosely defined as the beliefs and actions of a group, both of which are included within the umbrella of "practices" within a community of practice. Changing culture, and thus shifting what may be ingrained practices in the community, is a complex task. In this section, five strategies are elucidated, each of which requires some degree of change in practice within departmental or college cultures of the CSM and COE. These five strategies are: 1) foster an appreciation of the strengths of a diverse faculty, 2) value service that builds community, 3) raise awareness of subtle negative messages towards female STEM faculty, 4) value and demonstrate transparency as a means of achieving equity, and 5) emphasize data-driven decision making.

Strategy #1: Fostering an appreciation of the strengths of a diverse faculty.

Shane and Janeen, coming from different departments, both offered perspectives about the need for their departments to value diverse contributions:

> I think people mostly view increasing diversity as checking off boxes that are required by people … [to] get to some number that is needed, as opposed to thinking about the value of … the different opinions you get when you include people with a whole variety of different experiences. (Shane)

> I think what really has to happen is that everybody has to actually see the value of having a more diverse department – and like, really believe it, not just because it's p.c. [politically correct] to say that you care about diversity, but … actually be able to explain why it would help our department or help our profession … some do, some don't [believe it], but until they really believe it, then you're just checking boxes and you're just sort of doing what you're asked to do because you have to do it … following the letter of the law. (Janeen)

The argument that Shane and Janeen make with regard to diversity is that departments and fields can be made better with increased diversity (i.e., the community will be able to better address its domain, of excellence in STEM research, for example, if its membership is made more diverse). This way of viewing diversity as a means to improve, rather than make different for difference's sake, may be difficult for departments to accept. This may be particularly true for faculty who have viewed their largely male (and white) departments as having a history of success and are in no need of fixing with diversity or other measures. In some departments, as in Brenda's, "change happens slowly." Brenda suggested that her department's response to change seemed to be as follows: "we've been doing this so well for so long, and to change it would be like a disrespect or deviation" from the history of the department.

Strategy #2: Value service that builds community.

Another strategy to support female STEM faculty has to do with valuing and rewarding service that is typically undervalued at ECU and often performed by women: service that aims to foster a sense of community. Shane explained:

> A sense of community is really a key feature within the university and within the department, but there's no reward for trying to build that, right? … There needs to be more rewards for doing things that … fall under this different category from what we're used to rewarding in terms of … academics … Those features are often really critical, and they get done – not always, but many times – by women. (Shane)

Such contributions are often not valued, argued Shane, until the community builder is gone or has moved on to a new position.

The nature of the existing status of teamwork and community at ECU is wide-ranging. Most participants (14 of 19) shared that in many respects, they found the communities of practice in which they worked within ECU to be supportive and collegial. For example, Denise found the overall ECU community to be: "scientifically collaborative, without being scientifically combative." Carol described a culture in which "we succeed or fail together":

> I think most of us realize that whether he's successful or she's successful … is directly relevant to whether I'm going to be successful here … We're not a large enough place to … be introverted and cut-throat. (Carol)

Cynthia and Denise shared a similar sentiment that departments succeed or fail as a team. Others mentioned: finding "some great collaborations here" (Amanda); "we have a real collegial department" (Brenda); "there are very nice people here" (Carla); "I have colleagues that I really like" (Janeen); "it's very friendly" (Karin); and "my interactions with individual faculty and my interactions in my department have had a very good sense of community" (Shane).

However, there are exceptions to these positive feelings of community, collegiality and teamwork. The level of collegiality that faculty members have experienced ranges, with, in the words of one participant, "some departments [being] … more friendly than others." Vieve offered that there was "not much of a culture of team building and collaboration" and that "ECU seems to follow a policy of 'every man and woman for himself/herself'." Similarly, Amanda shared: "People are too concerned about their individual successes that … they don't seem to be working … as a team." And Paula characterized the culture as: "'Damn we're good,' or 'Are you good enough? – You'd better prove it.'"

Several participants described the deterioration of a sense of community within one of the colleges during a recent financial crisis. According to those participants, poor leadership decisions were made to spend and hire when austerity would have been a more appropriate response to the difficult economic context. In the words of one participant reflecting on this time, "It felt bad to be here." These fiscal challenges were confounded by some longstanding hurt feelings across departments, where certain departments at ECU have been regarded as having more status, 'getting more' from the Dean's office, or being more culpable with regard to the aforementioned financial crisis.

Strategy #3: Raise awareness of subtle negative messages towards female STEM faculty.

Certainly, faculty within CSM and COE would do well to avoid overtly offensive comments and inappropriate remarks towards women. Some of the participants of this study, particularly those who have been at ECU for a significant period of time, have experienced those. For example, one participant had informed her department chair that she was pregnant. He responded, "Oh, I see you've been taking martini with your birth control pills."[v]

In contrast to the rarity of overtly offensive comments, many participants (74%) mentioned receiving *subtle* messages from male colleagues and students about their behaviors, potential, and abilities as STEM faculty. Two participants summarized the presence and challenge of these subtle messages:

> More overt gender problems are rare now, I think. Or … they are much less frequent than they were … But there's still these sort of hidden unintended biases which can have a very real impact … And … even though they're unintended – I don't think people … you know, would overtly say 'I think women aren't as good,' or 'I don't want them to succeed' – but they have these ideas that end up having the same effect … But that makes it harder to fight it … because people don't – I think a lot of people just don't think there is a problem at all. (Janeen)

> I mean, we have equitable opportunity. We are … right here … we are done … I think this is what makes it more of a problem, is that it [appears to be] … a solved problem. (Carla)

These participants and most others who shared examples of subtle messages presumed that the (almost exclusively) male colleagues who shared them meant no harm (e.g., Brenda characterized this as "*unconscious* gender bias," and Sharlene described it as "*unintentional* exclusion and careless behavior"; emphasis added). However subtly or innocently intended, these negative messages make some participants wonder if their colleagues truly consider them to be within the regime of competence for the community.

This strategy aims to raise awareness of these subtle messages and their frustrating effects. Carol, who did not speak of receiving subtle messages (and considered women who did largely to be whiners) shared the following related concern: "I feel really, really sympathetic for guys … [who] get seriously rolled over the coals, because for some women, they say nothing right." Most participants were not interested in bashing their male colleagues. Rather, the idea is to be frank to the community at large – not that male colleagues can say nothing right – but rather that some of what they say can make for an environment at ECU that is less supportive than it could be for female STEM faculty. These messages have been captured under five themes, shared below.

Theme 1: The trouble with being assertive. A common perception of women echoed by three participants is as follows: Women who are assertive are regarded as "bitches." Two corollaries, especially for women in primarily male-populated STEM fields, are applicable here:

1. It is an admirable display of competence to be an assertive man.
2. Women who are too nice, cordial, or express emotions are regarded as incompetent.

This places female STEM faculty in a difficult position. As Linda suggested about the "man's world" in which she operates, she constantly picks up cues from the men in her department regarding their interactions, and thus, how she should interact so as not to be perceived as too emotional or unstable:

> Yeah, I still have to … learn how to. I think this is very much a man's world. You know, you somewhat have to behave like one of the [men], because they can easily label you as emotional or unstable, right?

Janeen described having to balance her desire to be respected and viewed as competent with her interest in being polite and collegial. She was interested in neither being perceived of as a "little girl" in need of paternalistic care (i.e., too polite and cordial), nor a "bitch" (i.e., too assertive in the demonstration of her competence).

This challenging balance for female STEM faculty extends to the classroom. Kim offered: "Students have a different expectation from what they get from a female professor." Women are socialized to be nice, and then expected to behave in this way. Kim has received teaching evaluations about her "not being nice," and believes – based on discussions with her male colleagues – that they have not been criticized in this way. Although this bothered her at first, she then reconsidered: "That's really not my job to be nice to you. I shouldn't be mean, but … that shouldn't be a primary criteria [sic] that you're using … to evaluate me."

Theme 2: Is she good enough? Related to the above theme is what some participants regard as an assumption that male faculty are good enough, as juxtaposed by an absence of such an assumption for female faculty. Rather, some female STEM faculty feel as though they need to either prove to colleagues that they're good enough (i.e., that they are well within the regime of competence within their respective communities of practice), or demonstrate achievement well beyond their male peers to be considered equally competent. Margaret and Carla articulated these views in the following interview excerpts:

> So people look at you [and] they don't believe in you, and you have to … to show them that yes, I'm good enough, right? (Margaret)

> I believe that women are not good negotiators because it's always [that] we have to prove … that we are good … because I don't think we are taken by default that … you are really good. (Margaret)

> This whole idea of … let's see how good you are, I think, is something that they, that women experience … and men don't. (Carla)

> I think if you're a woman and you're fantastic, you can … get anywhere. I think if you're a man and you're good, you can still get anywhere. And if you're a woman and you're good, you are not good enough … but maybe we feel it because probably there is – out there – a sort of pre-judgment … maybe not intentionally. But … I … personally feel that I have to prove five times more than a male has to prove. (Carla)

These subtle messages may translate to the classroom, as Kim felt a sense of "automatic skepticism" upon entering her classes that she strongly suspected was not experienced by her male counterparts.

Theme 3: She's not quite ready. Three of the contexts in which participants have felt the application of 'she's not quite ready' are as follows: 1) early tenure and promotion processes, 2) promotion to full professor, and 3) leadership positions. The first two of these contexts represent either a decision to go against the normal timeframe for promotion and tenure (context 1) or to determine when to apply for promotion to full professor (context 2); these will be referred to broadly in this section as going up for "promotion" to protect the identity of participants. In all three contexts, there is no single policy-enforced time to 'go up' for promotion or to be a leader.

In the first two contexts, some participants have felt that their readiness to go up for promotion has been questioned. Margaret felt that she surprised her colleagues when she went up early, although no one stated this feeling explicitly:

> Somehow when I applied, I … saw … people in my department, those who didn't know my work, maybe they didn't expect [me to go up early]. Probably this has to do with being a female and I don't know, people do not pay much attention [to] … your work … Some of them didn't expect, 'Oh, she's going up already?' (Margaret)

Sharlene received a more explicit message about not being ready. She felt more than prepared to submit her dossier, comparing hers to those of others who had successfully done so. However, she was told to wait another year or two. Cheryl made the following comment about promotion:

> People that aren't getting mentored and don't have the kind of drive or initiative to think it's time to go do it … would just kind of float … And that would happen to women more than men. (Cheryl)

In Sharlene's case, she had the kind of drive and initiative that Cheryl suggests is critical; she disregarded the advice to wait, submitted her dossier, and was promoted.

Leadership is another area of struggle for women. There are few females in leadership positions – especially department chairs – within the CSM and COE. Denise shared: "There has, at least in the past, been an attitude that 'it wasn't quite time' for females to take leadership roles." This denotes more of an idea that 'they're not ready' (i.e., the faculty are not ready to be led by a woman) rather than a 'she's not ready' to be a leader.

Two participants remarked that a woman in the COE who was considered for a leadership position was largely disregarded because of an unfair perception that she was 'not quite ready' for it. One of these participants suggested that she was "perceived as too young to be in the position," despite being of comparable age to other leaders and highly competent for the position. This participant shared: "Women in a leadership position … have to essentially be head and shoulders above … any man to be perceived as … powerful and not too young."

Theme 4: Her focus is on family. Some participants have expressed concern that their roles as mothers, if discussed too regularly and openly, can call into question their commitment to their work. One participant shared: "Most of the people outside my immediate area that I work with closely … when I see them, the first question is like, "So how are your kids?" In these oft-repeated occurrences, she quickly shifts the conversation to work (e.g., "I'm working on a grant proposal."). Her worry is that if she is perceived as a mother (first) and a professor (second), this will have negative implications for how she is perceived in the department, and what she regards

as important. Another participant who felt similarly shared that she tries to filter herself in her department, limiting her conversations about her children.

Others have experienced more direct questions about their commitment and dedication to their academic lives as they juggle identities as mothers and professors. For example, at a prior institution, upon learning that a participant was pregnant, a male colleague asked: "Are you really going to keep doing this? [i.e., keep being a professor]." She wondered what, with all of her training and hard work thus far for well over a decade, had caused him to doubt her commitment.

Theme 5: There is women's work to be done. A final subtle message expressed by several participants was that certain forms of service were expected from women. Kim and Vieve both shared this:

> [When] working on service things together … [men expect] that I should be the one to, like organize things and other people need [to make the decision] … like [me] putting all the data together for everyone. (Kim)

> In the department, women tend to take on more responsibilities for advising, coordination and many of the activities that the guys think is beneath them. Above the department level, it is difficult to distinguish gender specific differences. (Vieve)

As Vieve alluded, these forms of service are often undervalued.

Some of the work that Kim mentioned that is often imposed upon women in committee settings is clerical in nature. This brings out an interesting tension that two participants mentioned with regard to some female administrative assistants. These participants mentioned feeling as though the administrative assistants are more inclined to do clerical work for male than for female faculty. Linda, who needed assistance to conduct business and assumed that she could receive help from an administrative assistant was denied help and then reprimanded by the assistant and department chair for this assumption. She suspected that if she had been male, she would neither have been denied assistance nor reprimanded. Vieve had more direct evidence of this. She recalled a case where: "a staff member explains that they don't provide that service, but then turns around and provides exactly that service for a male faculty member." Perhaps the assumption by these female administrative assistants – like some male faculty colleagues – is that women (including faculty) – should do what has been traditionally regarded as women's work.

Strategy #4: Value and demonstrate transparency as a means of achieving equity.

In order for there to be equity within a community, argued both Cheryl and Paula, transparency must be valued and demonstrated. Cheryl offered:

> I think we need data on … what are the sizes of their labs versus [those of] the men in the department? What is their salary versus [that of] the men in their department? How much equality is there? … What is their service and teaching load versus [that of] the men in their department? (Cheryl)

For Paula, transparency was the single most important strategy for ECU to enact in order to make for a more supportive and fair environment for female STEM faculty. If salary, the attrition of senior faculty women, teaching loads, the number of teaching preparations per faculty member, the distribution of who does and does not receive graduate students, and the process to nominate or select candidates for awards – to name a sampling of examples – were made transparent, then inequities would be clear and action against those inequities would likely follow.

The need for transparency also speaks to the need to make explicit any unwritten rules about tenure and promotion. While most participants felt that promotion and tenure processes had relatively clear expectations, two participants were frustrated by a late realization of unwritten rules (i.e., practices only realized by community members if others inform them verbally about those practices). In one of those cases, the participant had not been told that organizing department seminars should be a means of inviting speakers who would later write external letters for promotion; not realizing this, she organized department seminars that aimed to present a number of topics well beyond her research area.

Strategy #5: Emphasize data-driven decision-making.

In order to support equitable and fair recruitment and evaluation of female STEM faculty, 11 participants (58%) suggested that data-driven practices must be employed. Three participants asserted the importance of merit in the recruitment of female STEM faculty:

> I think the right way to go is I want to encourage [and] identify young women to come into this field … but based on merit … so, in this way, men don't say, 'well … you are in because you are a woman'. (Linda)
>
> I don't think women should be admitted because they are women; I think women should be admitted because they are good. (Carla)
>
> Our department isn't going to hire a candidate just because they're … [in an] underrepresented group which I think is the right thing to do in the end. They want the best candidate for the job. (Brenda)

In this way, recruitment practices should be data driven, i.e., should be based upon the candidate's application materials or CV. It is fair to suggest that these participants would argue that the promotion and tenure process, for example, should be based upon merit.

Data-driven decision-making practices take time. It is easier and faster to apply a cognitive shortcut to make a decision about whether or not to hire a candidate, or to retain or promote a professor. Denise articulated this point in the following statement:

> The university and the college as a whole needs to be more thoughtful about what are reasonable expectations of faculty in the current funding and higher education climate, and to take the time to re-evaluate what we do, what is most important, and to give people the time they need to make good decisions. This is especially important for matters of hiring and retention, since cognitive bias is exacerbated when people are distracted and relying on too much of their 'gut instincts' when making decisions. (Denise)

Another candidate described a search committee in which time to make good decisions was not a priority: "we were like rushing to make a decision five minutes before the faculty meeting and they wanted to quickly make a decision so we could have a faculty vote." This, she said, was not indicative of best recruitment practices.

Seven participants (37%) described situations in which they compared their dossiers with others who had successfully achieved the next level of promotion to determine if they had a strong case to proceed. Cynthia, for example, offered that it was nice to "compare my accomplishments" with other colleagues who were going up for promotion. After doing so, she "thought it was a good time … took a chance, and went up." Sharlene and Denise, both of whom were discouraged from going up for promotion, compared their dossiers to others. As Sharlene shared, "Mine was much better … I'm not sure why there was a hesitation." The hesitation – described earlier as the subtle message that 'she's not ready' – was addressed with the provision of data. These data gave Sharlene and later, her committee, the ammunition to assert that she was indeed ready.

One caution expressed by a participant with regard to using data to make decisions is that decision makers must be trusted to use valid data and not concoct data for some political or other purpose. This participant described two situations to substantiate this point. In the first case, male faculty members were first presumed to be good or exceptional in some area (e.g., for awards), and data were inflated to support this presumption. In the other case, a female faculty member with nationally recognized research was let go for having insufficient research.

Strategy Category B. Building Networks of Support and Information

Three strategies aim to build networks of support and information for female STEM faculty at ECU. The first of these represents a continuation of and adjustments to the aforementioned faculty mentoring program within the CSM and COE, while the second urges the growth of less formal networking opportunities for female STEM faculty. Each of these two practices encourages the aforementioned process of legitimate peripheral participation, whereby those embedded within the community of practice can assist those newer to the community as they increase their participation within it. The third strategy describes workshops of interest to study participants.

Strategy #6: Continue and enhance the faculty mentoring program.

The faculty mentoring program for the CSM and COE at ECU involves: the assignment of a departmental mentor for each assistant professor (and the expectation that the mentor and mentee will meet regularly); the use of a mentoring protocol by mentors and mentees, which contains suggested topics and milestones that help structure the purpose and content of mentoring meetings; workshops for mentors, providing tips and information for departmental mentors; and, most recently, a chance for mentees to meet (without mentors) to network and share their experiences. This strategy suggests that these efforts continue and expand. Before discussing the reasons for this continuation and expansion, however, a summary of participants' past mentoring experiences is warranted.

Participants' past mentoring experiences. Participants collectively, and in some cases individually, experienced a mixture of positive and negative mentoring experiences during their time at ECU and at prior institutions. Six participants (32%), most of whom were at ECU as assistant professors prior to the faculty mentoring program, recalled having received no mentoring, little mentoring, unhelpful mentoring or – in one case – toxic mentoring. Sharlene, for example, shared her experience as an assistant professor with a mentor who was not helpful:

> I had an official mentor in the department … the person that I had was not particularly helpful … so I had to set up my own mentors. And that, you know … that's not atypical. (Sharlene)

The mentors she located for herself were both within and outside of the department.

Of the 12 participants (63%) who shared that they had at least one positive past mentoring experience as a mentee, approximately half indicated that their assigned mentors were effective or helpful, and most described having multiple mentors. Brenda, for example, identified multiple individuals within and some outside of her department who provide mentoring for her. Her assigned mentor was effective, and she felt that there was a culture of support for mentoring in her department. About her department, she shared:

> I think [we have] … a good culture of mentoring … Even in our hiring … the question always comes up: "Do you think this is somebody [who] with good mentoring will get tenure?" (Brenda)

Brenda is one example of mentoring success for the formal mentoring program.

Participants' informal mentors included helpful colleagues, some of whom ultimately became collaborators, individual peers and peer writing groups. One participant described the peer mentoring that she has received (and, in turn, provided) in the context of a peer writing group as follows:

> That's really the most useful mentoring that I've gotten. I don't know if it will get me tenure, because none of us have it … but in terms of people who I see on a regular basis, who it's easy to ask question or … [who I can ask:] 'This thing is happening, what do I do about it?' … We're all in the same boat.

Her peer mentors critiqued one another's work, and were generally empathetic listeners.

In addition to these kinds of informal colleague or peer mentors, some participants shared that their assigned mentors were department chairs or other leaders within the CSM or COE; these mentoring relationships had varying degrees of success. Finally, one participant who would not go so far as to say that she had been mentored described her departmental environment – coupled with her own outgoing personality – as enabling her to knock on colleagues' doors without hesitation.

Given this summary and introduction of participants' mentoring experiences, it follows that the first aspect of this three-part strategy is to continue successful elements of the faculty mentoring program and make efforts to increase fidelity to it. It also follows that the second aspect is to address the challenges that negative mentoring may pose. Finally, and articulated

below, a third aspect of this strategy is to add to the faculty mentoring program by including associate professors as mentees.

Continue the program, and make efforts to increase fidelity to it. Participants who met regularly with their mentors and used the mentoring protocol seemed highly satisfied with the advice they received. Pro-active mentoring, where mentors occasionally contacted mentees to check in and see how they were doing, was another highly valued feature. Kim, for example, was fortunate to experience all of these aspects of mentoring with her mentor, who clearly enacted the key aspects of the faculty mentoring program.

Current efforts to encourage department chairs to assign or support the assignment of mentors, to educate mentors about the mentoring protocol and the need to be proactive and meet with mentees should continue. This may make Marie's mentor, for example, somewhat less worried to meet with her; he is, according to Marie, "afraid he might tell me something wrong," and thus avoids mentoring meetings. These efforts may be helpful to Vieve and others as they gain experience and confidence as mentors. Furthermore, a continued education about the nature of departmental mentoring may help combat lingering thoughts that "mentoring is coddling," a perspective that a participant shared was common in her department, and that was suggested by another participant in a different department.

Enhance the program by creating a way out of negative relationships. One potential enhancement for both workshops (for mentors and separately, for mentees) would be to consider what mentees can do in the event that they are not being adequately mentored. For example, mentor and mentee groups could ask and answer: What are the appropriate steps for mentees to take in this instance, particularly given the sensitive nature of breaking off a mentoring relationship with a senior member of the department?

Enhance the program by including associate professors as mentees. A Program Manager mentioned that the initial intent of the faculty mentoring program was to include associate professors as mentees. The present study suggests that this continue to be an aim of the program. Many participants described the associate professor years to be a period of time in which service responsibilities are significant and the expectations to reach the next promotion are less clear ("a fuzzier process" in the words of one participant). Also during this time, for many participants, any faculty mentoring they had received discontinues.

For example, one participant shared that her past mentoring supports – albeit somewhat weak – were "gone" as soon as she became an associate professor. Another participant seemed to be an exception to this rule, continuing to ask her mentors to "look at my case each year and tell me when do you think this is going to be at the right stage" for her to be promoted. The problem with those who do not continue to be supported – through mentoring or other means – was described by another participant: "So the problem is … [if] you don't nurture them after tenure, I think you're very likely to lose them. Because they're poachable. I mean, everyone wants to have more women in their departments."

Strategy #7: Encourage informal networking among female STEM faculty.

An ongoing effort at ECU has been to create opportunities for female STEM faculty to network with one another through brown-bag lunches and seminar speakers. Many participants have suggested continuing these efforts to build community of practice among female STEM faculty who are otherwise spread across departments in which there are few women, e.g.:

> Women in [two COE departments] are one bridge from each other … [but] they don't talk. And so … I think within each department they feel isolated because they're not taking advantage of their numbers across the ... college. (Cheryl)

Although some participants did not express a need to interact with other women, many did, suggesting a need to feel a sense of belonging and the ability to say what is on their mind to someone who is likely to understand (e.g., the juggles of motherhood and academia, the subtle messages that women, at times, frustratingly receive).

While the existing brown-bag lunches and seminar speakers were regarded as being helpful means of encouraging networking, five participants suggested doing more. Here, doing more involves the following: 1) providing access to successful female role models in STEM, and 2) supporting time for female STEM faculty to network in one-on-one informal contexts and settings. After elucidating these two extensions beyond existing networking strategies, some caveats on the topic of networking and female-female relationships will be shared.

Role Models. Cynthia shared that young female STEM faculty "need time to talk with people who … have made it" and who can suggest to them that "if you keep your eye on the prize, you can make it." Describing a similar sentiment, Margaret offered:

> I think the university should probably pay attention to more successful women in [STEM] … for younger women … I mean, for me, a role model … it's … really strong, stimulating and inspiring. (Margaret)

While Margaret valued workshops and seminars in which she may listen to such a speaker, she was especially interested in having one-on-one interactions so that the role model could "talk to me in person" about specific ways, for example, that she could promote herself and achieve similar success.

While Margaret and Cynthia suggest – and other participants would likely agree – that more female STEM role models, particularly at higher ranks, are needed, many shared experiences of having had these and similar role models at ECU. One of the most contented participants, who is both successful and feels supported at ECU can look to her own family for strong, female STEM role models. Others have shared that they value the senior female STEM faculty at ECU, demonstrating success in STEM and as mothers. One faculty member shared that a reason she came to ECU was because those role models existed there. Another looked up to a male role model, who – at this point in the participant's career – represented what she wanted to become with regard to both professional and personal life.

Informal, One-on-one Networking (Walks, Lunch and Coffee). Having role models is clearly important to many of the participants. Being able to interact with them and other female STEM faculty on a one-on-one (or even small group) basis is also important. Both Cheryl and

Margaret articulated the importance of female STEM faculty getting together out of the context of the board room or classroom (where brown bags and seminars are often held) and into less formal territory, as evident in this exchange with Margaret:

> Interviewer/Author: You mentioned going for walks with [other female STEM faculty] … You are the second person that has mentioned that to me.
>
> Margaret: Oh, going for walks, right. Yeah. Yeah it's nice, because, I mean … so after work you go and have a drink, or have a coffee with a group of colleagues or visitors, but that is great because the setting is different. It's informal and … you can ask all kinds of questions and you feel more free to … ask the questions in that setting. So [in] … a workshop, I will think twice if I ask this question – does that makes sense? I don't think twice [in these informal settings].

For Denise, one-on-one interactions like these, yet perhaps in other venues, are much more comfortable than larger social formats in which she tends to feel uncomfortable:

> I don't socialize a lot. I probably should socialize more than I do, but I try to get around it by these one-on-one interactions that I can have with people so that I'm comfortable … [and] really get to know people better. (Denise)

Denise's one-on-one interactions with other female (and male) STEM faculty are constructed around a shared goal (e.g., discussing a common research interest or a grant), which serves an additional purpose so as not to feel contrived or awkward.

Although other participants did not explicitly share a strategy to walk or share in coffee or lunch with one another, some acknowledge that social interactions with men can be challenging or expressed a desire to find a way to connect with other women. This is evident in the following two interview excerpts:

> Socially, there's some segregation … but maybe that's natural … human interactions … the women go to lunch with the women, the men go to lunch with the men. (Kim)
>
> I find that finding a lunch partner is something I'm working on, because I don't really eat lunch at the same time every day. So, okay, it's easier if there are more women. That's the only minor thing. So I – I don't feel comfortable knocking on men's door who I don't really know very well saying "Do you want to have lunch? (Linda)

The strategy suggested here (i.e., to encourage one-on-one interactions among female STEM faculty) is less in support of segregation, and more in support of helping female STEM faculty have access to other women, feel a sense of belonging, and share experiences. Simple and inexpensive gestures from CSM and COE to pay for coffee vouchers, for example, may be enough to encourage these potentially positive interactions.

Caveats. For some participants, situations in which women getting together with nothing else in common (i.e., for the single purpose of getting together) can feel artificial and awkward. Having a clear additional purpose for meeting, as suggested by Denise, may be warranted for such gatherings. In addition, just as not all men get along with other men, the same is true of women. Elaine and Tiffany offered:

> [We] obviously have more women faculty [than in the past], which helps … because occasionally you couldn't find someone around to talk to. One of the mistakes people

> think is just because there's two women they should get along, right? … And so that's part of critical mass, you know. (Elaine)
>
> A woman in the department tried to organize … a women's lunch for STEM faculty … And I went to a few of those, but for the most part, they're kind of uncomfortable, right? Like you actually don't have that much in common with these other people … other than your gender and …[STEM] (Tiffany)

Further, some participants found senior women in their departments to be "far less welcoming than I expected," and in some extreme cases, actively destructive to participants' careers (with examples of this both within and outside of ECU).

Strategy #8: Provide workshops for female STEM faculty.

Seven participants suggested a variety of workshop or seminar topics that would support female STEM faculty at ECU. Both Cheryl and Sharlene indicated that these workshops and seminars needed to be supported with resources, such as money to pay external speakers and human resources to organize such events. One of the main topics that was suggested by three participants had to do with communication, people skills (a.k.a., soft skills):

> I have never had an opportunity to … [do] things that kind of build your people skills. You know, we're all managing students, we're all managing labs … but we don't really get any kind of training to do that. (Amanda)
>
> I think … seminars might help in terms of … making for more effective communication … I know, for instance that I … don't usually talk with question marks at the end, and I don't do the cutesy talk. But there are quite a few women who do, and I don't think they're aware of it. (Carla)

Other potential workshops and seminars that were related to improving communication included: making persuasive arguments, how to respond to challenges or inappropriate comments from students, and effective negotiation. Margaret shared that she has heard that "women are not good at negotiating" and "can attest to this personally." Negotiation topics could include negotiating for salary (although this is a moot point for starting salary for faculty), laboratory space, funding, etc.

Other participants suggested workshops particularly for those post-tenure. One of those was how to do a sabbatical. Another was how to craft an academic life once full professorship has been achieved. This is not surprising given that over half of the full professors in the study expressed some degree of uncertainty regarding the direction of their work and balance of research, teaching and service. Two participants also suggested workshop topics for female graduate students in STEM, including interviewing skills and why academia is a good place to work.

Category C. Supporting Work-Life Balance

The most significant work-life balance issues for the participants in this study revolved around family, specifically children and spouses. Certainly, those without children or spouses aim to have balance in their lives; and family other than children and spouses may be in need of

care (e.g., one participant mentioned caring for an aging parent). However, for most participants in this study, strategies to support work-life balance issues were these: 1) continuing, clarifying and enhancing family-friendly policies (i.e., administered load and stop-the-clock); 2) improving childcare resources; and 3) considering creative solutions to dual-career situations.

To preface the first two of three strategies within this section that have to do with childcare, it is important to note that study participants have had range of experiences in which they have felt both supported and challenged with respect to caring for infants and children. Many of these supports and challenges are of a personal nature. Spouses, for example, were mentioned as being significant supports for some participants, as evident in the following exchange:

> Interviewer/Author: How have you negotiated work-life balance?
>
> Carla: You choose your husband very carefully. One has to be very particular when choosing a husband.

Carla's husband is able to share equally in the care of her children, as was the case for seven other participants (representing a total of 42% of participants) whose husbands either equally or largely assisted with childcare. Other participants were not quite so fortunate, due to their husbands' demanding careers or lack of involvement in childrearing for other reasons. It is not within reason or purview of this study to suggest to female STEM faculty that they "marry well," yet the benefits of marrying a spouse that can assist with the care of children were evident in participant interviews.

An additional support that is a part of academic life is the largely flexible nature of faculty members' workdays, mentioned by nearly half of all participants. Carol offered: "There were very few times when I had a sick kid, that it's a big problem." Karin and Amanda shared similar sentiments, and added that access to the Internet makes it even more possible for them to work from home. Two participants cautioned that this flexibility has a downside. Carla offered: "I mean, I can work from home. I can work from anywhere. But I never stopped working." And Janeen similarly shared: "Just because I'm flexible doesn't mean that I don't have a huge amount of stuff to do."

Denise alluded to one final point that is worthy of note before sharing the three strategies in the Supporting Work-Life Balance category. Both the ability to be flexible and the support of colleagues are helpful with regard to issues related to childcare:

> I feel like I'm in an environment here that's flexible enough that when those days come and I have to drop everything [to pick a child up from school] … that I can do that and [that] … I'm in a group of people where that's okay. (Denise)

Two participants, Carol and Cheryl, appreciated male colleagues with children who tended to be empathetic with regard to issues around childcare, and their occasional needs to apply the flexibility of academic life to accommodate childcare needs.

Strategy #9: Continue, clarify, and enhance family-friendly policies.

The two family-friendly policies that participants mentioned included stop-the-clock and administered load. These were widely regarded as helpful policies for both male and female faculty who have a newborn or newly adopted child. Participants shared that stop-the-clock helped them "make a stronger case" for tenure and gave them the "sense of peace of mind" since "nobody does your research if you're not doing it." Administered load was widely applauded as a necessary break from the scheduled demands of teaching.

Faculty who did not have access to these policies in years past had more mixed experiences since, as one participant described, whether or not a faculty member was able to adjust her schedule or tenure clock was "an adhoc relationship with your chair." If the chair happened to be forward-thinking and understanding, the faculty member was lucky. If not, female faculty were quite unlucky; for example, some participants shared shocking stories of early returns or only week-long breaks from teaching to give birth to a child. As official, university family-friendly policies, stop-the-clock and administered load are no longer dependent upon the chair. One participant framed this as follows: "The reason it's important to put it in university policy is that it gets around the potential asshole in the administration."

The strategy suggested here is to both continue and clarify these family friendly policies. This need for clarification arose from several participants' concerns about how the policies are interpreted by promotion and tenure committees, chairs, deans and others. Participants raised three related concerns regarding how those who utilized stop-the-clock would be evaluated in promotion and tenure decisions, i.e., that:

1. *Stop-the-clock represents an advantage or holiday for those who take it.* For example, a participant described a male colleague (at a prior institution) who wondered what she should do with her time off (e.g., Write a book?). Another participant was sure that some male colleagues with children and wives who had careers would indeed understand that stop-the-clock was not a vacation, and would understand the amount of work associated with a newborn or newly adopted child. She was not sure that others, who did not have children or who had stay-at-home wives, would be as understanding.
2. *Since the faculty member took an additional year, their productivity should be one year beyond what an 'on time' faculty member would produce*. One participant, who had not used the policy, remarked:

   It will be interesting to see how they're evaluated when they go up … for tenure. You know, I think even though you stop your tenure clock, sometimes … people still add in that year in terms of the amount you should [complete] … I don't know … I don't know how people will interpret things. (Participant)

   Another who had used the policy explained: "I think some people don't understand the policy and so they felt like I had an extra year and I should have done more during that time."
3. *Utilizing stop-the-clock suggested that the faculty member 'couldn't handle' their work responsibilities.* One participant shared that since faculty members can opt into or out of stop-the-clock, this sets up a potential perception that those who do not utilize this policy

> 'can handle' their professorial responsibilities while those who do cannot. For this participant and one other, the need to place an asterisk on the front page of the dossier declaring that stop-the-clock was used was like a disclosure of disability.

Although these concerns exist for several participants, one suggested that she had "never even heard a whiff" of unfair judgment in the promotion and tenure process with regard to the stop-the-clock policy.

As noted earlier, the stop-the-clock policy recently transitioned from one in which the faculty member needed to *ask* the chair if s/he could use of the policy to one in which s/he needed to *inform* their chair that they would use the policy. Two participants suggested that this be pushed one step further, either towards an 'automatic' application or mandate:

> I think it would make sense for the stop-the-clock policy to be just an automatic [policy] as opposed to informing. So that if you have … birth of a child or adoption of a child, then the clock is stopped and then if you want to go up at the time you would have gone up if you hadn't had your kid then you are going up early. (Shane)

> There's [sic] some universities that mandate that you take the time. And I could have liked that idea because I don't like the option … anyway, my feeling was … you just had a kid [and] there's really too much going on for you to really make those [decisions] … and just not having a choice is the best thing. (Sharlene)

This would be a significant shift in the policy (i.e., from request to inform to mandate) that may not be accepted by male and female faculty at ECU. Some participants, for example, opted not to use stop-the-clock with no regrets and some satisfaction that they were able to receive tenure 'on time' or early.

Finally, one participant suggested that something similar to, yet perhaps less formal than stop-the-clock be considered for associate professors. Although not under the same tenure clock as their assistant professor peers, associate professors do seem to have an unwritten half-life after which, they are generally considered to be terminal associate professors. Kim wondered, hypothetically: What if, due to having one or more children during this time, she or another woman reached or exceed the half life? Is that fair?

Strategy #10: Improve childcare resources, including the addition of lactation rooms.

There are three aspects to this strategy: 1) improve access to the ECU daycare facility, 2) assist female STEM faculty who need childcare in order to attend ECU weekend or evening events, and 3) establish and provide female STEM faculty access to a lactation room (in each building within the CSM and COE).

Improve access to the ECU daycare facility. The ECU daycare facility is an on-campus facility that is advertised to be one of the 'family-friendly' measures for faculty at the university. However, the experience of many of the participants is that there is a significant wait-list to get into the daycare facility. One participant recalled:

> My [child] was on the wait list for about nine months before she got in. So you basically need to apply when you find out your pregnant if you want your kid to go there … I think

> that it was true at one point that faculty got priority, but they don't anymore … but they still use this as like it's part of their family-friendly policies. (Kim)

Another participant's child had to wait over three years to get into the facility.

Two interesting facts about the ECU daycare facility are worthy of note. First, a few years ago, according to one participant, ECU leaders attempted to close the center, but received a huge amount of pushback from the ECU community. Those whose children get into the facility are highly satisfied (and beyond this, the facility supports significant research by many different departments). Second, ECU's daycare facility is still reported as one of the family-friendly policies (e.g., along with stop-the-clock and administered load) on a brochure.

Assist female STEM faculty who need childcare in order to attend ECU weekend or evening events. One participant, mentioned that she appreciated that most meetings were scheduled within the day when her children were in daycare (e.g., not in the early evening). Although this may be the case for most meetings, evening and weekend events – including recruiting and outreach events in which female STEM faculty are asked to have a presence to represent the diversity of the COE or CSM – create daycare challenges for faculty whose spouses are unable to care for children during these times. Another participant shared that she would participate in more of these events if she had access to childcare:

> I can't do many of these because of childcare, and I've been talking with a few people here about the idea of trying to set up essentially a babysitting network. We have … this great early childcare program with lots of … prescreened people … who are local to this area that, you know, have the c.p.r. training, the childcare experience, and I think putting together a simple network of babysitters that are local would be helpful generally … But also could be funded … through the different colleges … you know, if you're asking me to come in and volunteer for two hours on a Saturday, then you're going to pay for my babysitting.

ECU leaders may be concerned about legal issues with officially or unofficially endorsing a babysitting network, or hesitate to support the above ideas for other reasons. However, the ideas are worth considering. As Denise suggested, ECU leaders would do well to "be more knowledgeable about what creative things can be done to accommodate work-family balance for both male and female faculty, and to set a tone that such balance is valued."

Establish and provide female STEM faculty access to a lactation room (in each building within the CSM and COE). Finally, a participant shared that having a lactation room would be extremely helpful for women who are breastfeeding. Although she has a locked office, other department members have keys to her office and have walked in on her when she was nursing her child. Such a lactation room would minimally be a separately keyed room in which women could pump, store milk, nurse their child, change a diaper, etc.

Strategy #11: Consider creative solutions to dual-career situations.

Some study participants were in circumstances in which their spouses would benefit from a careful consideration by ECU leaders of how to best provide career opportunities at ECU that

fit the spouses' skills and ambitions. This is another case in which being "knowledgeable about what creative things can be done to accommodate work-family balance" (Denise) would support female STEM faculty. Those female STEM faculty with spouses who, for example, commute extremely long distances to get to work or work in less-than-ideal positions for which they are overqualified, are more likely to look elsewhere for employment that can accommodate their own and their spouses career ambitions.[vi]

Category D. Other Strategies to Support Female STEM Faculty

Participants mentioned other important strategies to support female STEM faculty aside from strategies that aim to change the culture, build networks of support and information, and support work-life balance. The first of these presented here is less a strategy and more an approach, i.e.: support all STEM faculty – and in the course of doing so, female STEM faculty will be supported. The other strategies represent a mix of actions (again, practices, in the contect of communities of practice) that ECU leaders can take, including: increasing opportunities for female STEM faculty to be recognized for their work; providing personnel to support STEM faculty who are parents of newborns or newly adopted children (for a semester or academic year); listening to female STEM faculty – both those who stay at and those who leave ECU; and continuing and enhancing recruitment efforts to increase the number of female STEM faculty.

Strategy #12: Support all STEM faculty, and in doing so, female STEM faculty will be supported.

Four participants suggested that the question – What can ECU do to better support female STEM faculty? – was not the right question at all. Rather, a better question was: What can ECU do to better support all faculty or STEM faculty. Carla's answer to the original question was definitive: "there is no way to do this [i.e., to support *female* STEM faculty, in particular]." Brenda's was a bit more tempered, suggesting that strategies like improved childcare resources at ECU (Strategy 10) would benefit both men and women, the only difference being that "female faculty members are just particularly sensitive" to those issues.

Tiffany was uncertain "if there are things [to be done] … specifically for women." She shared that she did not feel "down trodden" as a woman, and felt that "she probably benefitted more from being a woman in [STEM] than hurt by it," referencing review panels she's been a part of that given the choice between an equally qualified male and female candidate, choose the latter. Referring to the initiatives at ECU that aimed to support female faculty, she offered:

> It's [the initiative is] specifically to help women get tenure … and become academics, right? … I think a lot of men need encouragement to do that, as well. [Being a faculty member is] huge. It's a risk and investment and cost, right? In terms of, you know, your life. (Tiffany)

Carol's views of the aforementioned initiatives were largely negative. She indicated that she had been "subjected to" these initiatives, which were "a complete and utter waste of time." In her view, strategies aiming to specifically support female STEM faculty were unnecessary, unfair and harmful. Perhaps 25 or 30 years ago, she argued, there may have been a need for those female-specific supports, since women around at that time "really did go through a lot of shit." However, today "the female-specific challenges are largely gone" and "the dysfunctions in the

profession are equally challenging to men and women." Carol was supportive of stop-the-clock and administered load policies, since they were applicable to both men and women.

Strategy #13: Increase opportunities for female STEM faculty to be officially recognized for their work.

Official recognition of work beyond tenure and promotion includes such things as named professorships, awards, and press. The first of these, in particular, was an important strategy to Elaine for supporting senior female STEM faculty at ECU. Four other participants mentioned frustrations with a perceived lack of opportunity for or inequity with regard to these forms of recognition, suggesting that ECU should increase opportunities for women to be officially recognized for their work in these ways. Cheryl was disappointed by the absence of named professorships held by women within the COE. Sharlene revealed the following:

> I have external people … to the department come in … [and] shut the door to my office and say, "I'm from the awards committee and their department nominated this other person, and honestly, your CV is stronger. Why didn't they nominate you?" (Sharlene)

Considering a similar question about why she may not be nominated for as many awards as her male counterparts (despite similar academic success), Shane wondered if male colleagues may be more inclined to put themselves "in a position to get nominated" for awards. In Paula's case, she experienced a discrepancy in that while she was not made aware of an award for which she was well suited, male colleagues – both junior and senior to her – were made aware of and subsequently received this award. Paula also shared that she was frustrated that positive publicity her research received in the national scientific media was suppressed within her department, whereas a male colleague's research, reported in more local media, was vigorously applauded.

Strategy #14: Provide personnel support to STEM faculty who are new parents.

As mentioned earlier, ECU faculty have benefitted from policies such as administered load and stop-the-clock, which support faculty in the semester or year, respectively, following the birth of a newborn or new adoption of a child. However, some participants have suggested that more could be done to support female faculty during this first year. For faculty with experimental laboratories, the continuation of work – including the management of graduate students, post-docs, and the experiments themselves – is extremely important, yet difficult when balancing new family responsibilities. Both Tiffany and Shane mentioned that having a sort of laboratory manager (or post-doc) that could be hired to maintain this continuity. Tiffany explained:

> One thing that I think would be amazing is if … there were funds for a post-doc to come in [for] … one year on maternity leave … Nobody actually goes on maternity leave, right? Like you can't. You can't leave your research program. I mean you … still need to check in every week or every few days … but to have somebody in the lab that you knew was going to be responsible and train your students and keep your research moving forward – I think would be huge.

She shared that this could be made available to both men and women (like the other policies). Shane suggested a similar idea for "essentially a lab manager," one that while available to men

and women, would likely be more often applied to women "trying to raise a family, which … often falls to women."

Administered load is applicable the semester following childbirth or adoption of a new child, and as mentioned previously, results in reduced teaching load (and often no teaching at all) during that semester. However, some participants have shared that the semester following that one is particularly difficult. Babies, for example, are often still nursing during this second semester. Brenda suggested that making teaching assistants available during this semester – even if the normal minimum number of students to receive a teaching assistant is not met – could ease this challenge. This kind of a support does not seem to be much of a stretch from existing support systems for teaching mentioned by participants (e.g., co-teaching arrangements, reduced teaching loads during the first year, access to paid graders, reduction in number of preparations).

Strategy #15: Listen to female STEM faculty, both those who stay and those who leave.

Sharlene urged leaders at ECU (e.g., in the Dean's offices, department chairs and other leaders) to make time to listen to women (and minorities), a necessary first step towards considering their concerns and subsequently responding to them. This is notably different than, as Janeen mentioned, much of the dialogue by and about female STEM faculty at ECU that has been more of a case of "preaching to the choir."

A related issue is the frustration that four participants shared about the need for ECU leaders (and, in one case, leaders at a prior institution) to determine the reason(s) why female STEM faculty leave. For example, Janeen, who left a prior institution to come to ECU, regretted not having a frank discussion about her departure, and as a result, she felt: "No one ever learned anything … they never talked about it in the department." It is fair to suggest that the two participants who left ECU felt similarly.

Paula argued that the assumption when women leave is that they do so for family reasons – an easier sentiment for ECU leaders to swallow than reasons where ECU might bear some degree of responsibility. Family issues are often in the mix of reasons for leaving for female faculty; yet they are not the only factor. Both Elaine and Paula wondered if women often left out of frustration, not captured or disseminated by thorough exit survey or interviews. These are missed opportunities for ECU to learn and grow, as Sharlene and Janeen suggested, and to ultimately create a better environment of support for female STEM faculty.

Strategy #16: Continue recruitment efforts to increase the number of female STEM faculty.

The argument that underlies this strategy is as follows: Having more female STEM faculty will itself be a support system for female STEM faculty. Seven participants (37%) suggested this strategy, and collectively provided five reasons why this is especially important. Each of these reasons will be elucidated in this section, followed by a discussion of connections between this strategy and retention efforts.

Reason 1: To share the burden of work. Many female faculty at ECU have a heavy service load. For example, when there are few female faculty in a department, as is the case for

nearly all CSM and COE departments, they are highly likely to be on search committees to meet requirements for representation on the committee. When possible, serving on search committees and other service obligations are tasks deferred to post-tenure female STEM faculty, increasing the service workload on senior faculty. Brenda shared that these faculty "do a really good job" of handling these responsibilities, but are "overburdened by the lack of females at the top." Linda shared:

> These women are overloaded because they have to serve on every single committee. … So you overload women like this … Actually women are punished because of it because you say, okay, there has to be a woman in this committee … but you only have [one, two, or three] people to rotate but … you have [over 20] men so you can … divide the task. (Linda)

Margaret commented on the importance of search committees, in particular; despite being a lot of work:

> I felt that I could affect … the search committee [which] … has a lot of say in the evaluation of applicants, [and] I kind of look for good women … to bring in for [the] interview. (Margaret)

When there "enough" female STEM faculty, contributed Linda, "then senior women will no longer be overwhelmed."

Furthermore, female STEM faculty are often called upon to: be present and visible during ECU's community outreach days; reach out to K-12 education to "have somebody other than a white man" as a role model for what a scientist, engineer, or mathematician looks like; and share their experiences and advice about being a woman in a STEM field with undergraduate and graduate students. While Kim, Vieve, Amanda and others expressed the personal importance of this kind of work, it would be helpful to have more female STEM faculty available to share in these tasks. These tasks, according to these participants, are often undervalued forms of service in the promotion and tenure process.

Reason 2: To relieve a sense of isolation. Some participants felt isolated within their departments. These ranged from temporary and situation-specific feelings of isolation (e.g., walking into a meeting room full of men), to – particularly for those who had been at ECU for longer periods of time – more acute experiences with being socially and professionally excluded within their departments.

As an example of less acute forms of isolation, Cynthia described how women can feel socially excluded even when invited on excursions to get coffee or lunch with male colleagues. Women, she offered, seem to temper the conversations that would have occurred if not for their presence, creating a sense of restricted, rather than relaxed discussion. In the presence of women, she shared, men "can't … pop these jokes." She also restricted her own interactions in contexts where she was in the minority. For example, when she was on an almost entirely male committee, she asked one of the only other women on the committee for another copy of a meeting agenda (she inadvertently deleted hers) rather than asking one of the men who, she suspected "might look down on me" for her error.

It is important to note that other participants did not experience feelings of isolation. Tiffany, Karin, and Carol, for example, acknowledged that they were numerically in the minority as women in their fields and departments, but this did not translate into feelings of isolation. For Carol, the idea of being isolated as a female simply does not make sense:

> I don't see why being a single woman in … a group of male faculty means you're isolated. I mean, yeah, you're not going to talk about your period. But you can talk about everything else. …. I don't necessarily see why that should be isolating. (Carol)

She described instances in which she felt comfortable talking with male colleague about personal issues (e.g., family), and asserted that women who have a sense of isolation are "isolating themselves."

Reason 3: To give female faculty a collective voice to raise concerns. Related to the relief of isolation, is the need to create a collective voice. For Cheryl, having enough women who can network is a protective feature, enabling a sort of collective bargaining power:

> And that's why networking is so important because now you can talk to each other and say, "yeah, I don't think it's fair either." And as a group, you can go to the Dean and say, "look, we want this data." … You know, if you're all these people in isolation, you don't have that power of a group to do that … So you just feel like a whiner, and then you're going to be considered a whiner and brushed aside. (Cheryl)

Paula felt not only this sense of isolation, but also that she was characterized as a whiner when she attempted to address issues of fairness.

Reason 4: To serve as role models for female graduate students in STEM fields. Margaret worried that many graduate students in her field (i.e., a potential pipeline for future female STEM faculty) were turned off from academia by the low numbers of female STEM faculty in her department. She suggested:

> Having more women [in STEM faculty positions] … would help [because] … if they [graduate students] see two or three women in the … department, they say that probably there is no chance for us.

Others, including Linda, discussed the need to attract more women into Ph.D. programs and ultimately, STEM faculty lines. Marie argued, "You have to have more women just so people know it's possible and know that you exist. Otherwise … the students coming up … can't picture themselves doing that, right?"

Reason 5: To change the culture. As discussed previously with respect to the five strategies within Category A, many participants argued for the need for a cultural shift to support female STEM faculty. This cultural shift, argued a few participants, will be achieved in part through the presence of more women in STEM departments. Janeen offered:

> I think definitely efforts to hire more faculty are really important because that will eventually change the culture … having just a couple doesn't have the same effect as having a critical mass. (Janeen)

Marie provided some explanation as to why having a critical mass is critical to changing culture:

> To some degree, you just have to have more women around in order for … the male faculty to notice that what they're saying is sometimes crazy. Right? … The [male faculty in my field] have all been [around] for so long that they don't notice that what they say is weird to women. And now they do, but they're not used to noticing. (Marie)

Another aspect of changing the culture is creating a place in which women in leadership positions is normal (opposing the perception that women are not strong leaders). Increasing the numbers of women in visible leadership positions, argued Cynthia: "increase[s] those that have to speak with, listen to females from the top."

Connecting to Recruitment Initiatives. The strategy to increase the number of female STEM faculty suggests that recruitment initiatives, like those already in place at ECU, should continue to ensure that women (and minorities) are included and fairly evaluated during the recruitment process. This is essential in all STEM departments with traditionally low percentages of female faculty, even if those departments are currently on par with or above national averages. Both Brenda and Elaine provided examples in which departments at ECU have quickly shifted from "critical mass to sub-critical mass" (Brenda) since it only takes one or two women leaving a department to make a significant change in the percentage. It behooves administrators to be reminded that senior female STEM faculty at ECU often invited to apply for positions elsewhere, as mentioned by three participants, e.g.: "Once you get [tenure] … people try to pick you off" (Denise).

Conclusions & Implications

One participant shared the following about the perplexing problem of too few female STEM faculty at ECU:

> I don't know. It frustrates me a little that people who typically / are so like persistent about solving problems give up on this pretty easily. They just say, "Oh there are no women applying, sorry there's nothing we can do."

Yet the solutions to problems of all sorts can indeed be engineered. A place to begin this process is with problem definition (e.g., a small pipeline, attrition) and the brainstorming of potential solutions (i.e., the 16 strategies shared here to support female STEM faculty).

Table 1, presented earlier in the paper, lists the 16 strategies organized into 4 categories. This constitutes the basic conclusions of the report. These strategies can serve as a guide for ECU leaders, as well as leaders at other institutions, to: determine mechanisms for cultural change, seek funding to support enhanced or new initiatives, and energize internal change agents. In what follows, I will share some additional concluding thoughts and implications related to these strategies.

Range and Power in the Data

The strategies shared in this report were gleaned from a range of voices, opinions, perspectives, and experiences within the CSM and COE at ECU. In fact, capturing such range is an important aspect of qualitative research. Range has been captured in the interview process upon 'saturation' – i.e., when similar ideas and are heard time and again. Range was indeed

captured among these participants, who collectively constituted a considerable percentage (45%) of all tenured and tenure-track female STEM faculty in the CSM and COE. Although this does not equate to the data being able to represent all female STEM faculty at ECU or elsewhere, it does indicate some power in the data. Included among the participants in the study were: those who were at the beginning of their careers (i.e. legitimate peripheral participants in their communities of practice at ECU); those in the midst of figuring out the assistant professor years; and those who had "made it" to and beyond tenure (i.e., full participants); those who left and those who stayed; those with and without children; and those who considered that female STEM faculty had unique challenges because of their gender, and those who did not.

Changing Culture & Adapting

The aforementioned report, *Beyond Bias and Barriers*, mentioned the need for university leaders and faculty to address climate or what I have referred to as "culture." Culture also represents the collective practices within a community of practice. Culture was indeed was a topic of conversation, both explicitly and implicitly, among the participants. Leaving interviews, the following question would often enter my mind: How does one change culture?

STEM departments at ECU and elsewhere have deeply rooted histories and practices, many of which have helped to make those departments successful. Recall the earlier analogy of the "long beak that made a species successful" regarding how communities of practice maintain successful practices to address their domains.[23] This sentiment was echoed by one participant's aforementioned description of her department: "we've been doing this for so well for so long, and to change it would be like a disrespect or a deviation."

Recall now the extension of the analogy: the beak may be the species "downfall if circumstances change."[23] This is not to say that all practices within STEM departments and interdisciplinary STEM groups at ECU must change to support female STEM faculty. Rather, it seems time for some long-held practices – e.g., unwritten rules about time for promotion, implicit bias that quietly questions female STEM faculty's regime of competence, practices that make work-life balance difficult, or overly optimistic assumptions that mentoring or other faculty-to-faculty interactions are occurring productively for faculty – to change, enabling ECU STEM departments and the faculty (male and female) within them to mutually benefit from a more supportive environment.

This study has by no means figured out the answer to the question: How does one change culture? However, the five strategies within the "Changing Culture" category make this nebulous construct a bit more concrete. Of these, the one that seems least surprising coming from a group of scientists, engineers, mathematicians, and computer scientists is this one: Emphasize data-driven decision making. Data-driven decision-making is a regular practice within each of the participants' communities of practice as it pertains to research. Employing data-driven decision-making in, for example, hiring and evaluation practices, is simply a different application of this familiar practice, ensuring that hiring and evaluation are fair and equitable. It also helps to create a *culture* of fairness and equity.

Going Out for a Walk or for a Cup of Coffee

While participants suggested that formal mentoring programs and workshop programs should be continued, I also heard about the need to support less-formal networking among female STEM faculty. Such support might take the form of a simple voucher for two colleagues to grab a free cup of coffee at the local corner coffee shop – or even encouragement to log miles walking, thinking, and talking together. Perhaps a full professor seeking leadership possibilities might be encouraged to do these kinds of things with a respected female administrator from another college, or an assistant professor may do so with an informal mentor who shares similar research interests. These simple strategies, which do not require the level of commitment of more formal mentoring relationships, will not be of interest to all female STEM faculty – but they would be to some. This affordable gesture might be one way to support female STEM faculty, perhaps providing one more way for "old-timers" at ECU to provide scaffolding to newcomers as they navigate the communities of practice in which they work and how their identities fit within them.[21]

Listening to Female STEM Faculty

Finally, it occurred to me during interviews that for many participants, few university leaders and faculty have asked them about their experiences, perspectives, and ideas about how they and other female STEM faculty might be better supported. There may be many reasons for this, including: a desire by leaders to not make those faculty feel uncomfortable sharing sensitive information; a lack of understanding that female STEM faculty may have unique experiences, perspectives, and ideas on this issue; a lack of time or resources to ask such questions in any level of depth; and not knowing what to do with what it is that female STEM faculty might say. However – and again, in the spirit of data-driven decision-making – it seems worthwhile to ask these talented faculty about their perspectives (whether they compliment the institution, its programs and policies, or not) so as to better support them.

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[i] ECU is a pseudonym.

[ii] CSM and COE are both pseudonyms.

[iii] Additional detail for each of the three recommendations is included in the report, but is not included here.

[iv] Excluded from the findings section are suggestions to support faculty that, while helpful, are broadly applicable to male and female faculty and unrelated to work-life balance issues. For example, some participants others would like to have more clerical support (in general) and have fewer burdens when it comes to administrative responsibilities. Karin and others struggled with issues of time management common to assistant professors (e.g., how to balance demands of research, teaching, and service). Also not addressed are supportive features for faculty such as start-up packages, graduate student or summer salary funding provided by some departments, lab space, helpful reductions in service during the assistant professor years, etc.

[v] Along with inappropriate comments such as these, overt comments may also include sexual harassment. Participants did not volunteer that they had personal experiences with sexual harassment. However, as one participant argued, it is unlikely that sexual harassment will ever completely cease no matter the percentage of or level of support for female STEM faculty.

[vi] Little more can be said here so as not to reveal participants' identities.