CS in the "College of Arts and Crafts": How Discourses of Gender and Prestige Shape Career Goals for Women in Computing

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A Capstone Project

Presented to

The Faculty of the School of Education and Human Development

University of Virginia

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Education

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by

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May 2023

Abstract

For decades, women have been underrepresented in computer science (CS) majors and careers. Existing research points to several structural and cultural barriers that prevent women from entering or persisting in the field. CS pathways through college must be better understood to fully support diverse participation in computing careers. Much of the literature to date has focused on individual-level factors, rather than on cultural and contextual variables that influence student participation in computing. Using a cultural-organizational approach combined with feminist theory, I conducted a qualitative case study in a Bachelor of Arts in CS program to learn how women's career aspirations were shaped by computing culture and the college environment. Findings reveal that the organizational structure of college computing, discourses around gender and prestige, and competitive norms influenced students' college experiences and career goals. Furthermore, the findings illustrate the ways that women/nonbinary students developed career goals in the male-dominated and prestige-laden environment of college computing. Implications for policy and practice around broadening participation in computing majors and careers are presented, and directions for future research are discussed.

Keywords: women in computing, cultural-organizational framework, feminist theory, computing career pathways, gender in higher education

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APPROVAL OF THE CAPSTONE PROJECT

This capstone project, CS in the "College of Arts and Crafts": How Discourses of Gender and Prestige Shape Career Goals for Women in Computing, has been approved by the Graduate Faculty of the School of Education and Human Development in partial fulfillment of the requirements for the degree of Doctor of Education.

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Dedication

This work is dedicated to the generations of women, past, present, and future, who have shaped me and who I am becoming. To my great-grandmothers, Anna, Helen, Mary, and Victoria; my grandmothers, Bertha and Mary; my mother, Joan, and mother-in-law, Caroline; my aunts Helen and Marianne; my sisters, Eva and Claire; my nieces Olivia, Amelia, and Simone; my daughter, Zahra; and to all her daughters and their daughters. May all girls and women live in a world where they are free to become the best version of themselves.

Acknowledgements

First, to the students who participated in this study: I am inspired by your resilience, and I thank you for sharing your stories with me. I hope that you continue to use your voices and your power as intelligent, creative, thoughtful humans to make the world a better place. As you make your way forward in your careers, I look forward to cheering you on from the sidelines.

To my committee chair, Brian Pusser, thank you for believing in me, even when I did not believe in myself. You continually push my thinking forward and our myriad discussions have greatly improved the quality of this work. To Christian Steinmetz, thank you for your unwavering support and for helping to guide the qualitative methods for this study. In particular, I appreciate you encouraging me to add intersectionality as a critical aspect of this work. To Juan Garibay, I owe my pursuit of the EdD to your *Politics of Difference* course in the Fall of 2017. Once I had a taste of the Higher Education program through your course, I was intent on continuing the journey. To Rachel Wahl, I cannot thank you enough for stepping in to see this project through the finish line. I am also indebted to Tom Horton in the CS Department at UVA for spending many hours with me, discussing ideas for this paper, and encouraging me to pursue this work. I would not have pursued the EdD at all, had it not been for the UVA Ed Benefits program and the support of my supervisors at UVA Engineering. To all of you: I am grateful.

Finally, thank you to my family, whose devoted love and support over the past five years has enabled me to keep pushing forward. To Zahra, I hope I have served as an example for you that moms can also be students, leaders, and doctors. I look forward to all the things we can do together in the future! And to Sam, thank you for encouraging me to pursue this degree, and for giving me the freedom to think, write, and create. I love you, and I am eternally grateful for you.

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Chapter 1: Introduction

Over the past several decades, there has been much research focused on the underrepresentation of women in science, technology, engineering, and mathematics (STEM) careers. Women comprise approximately 34% of the STEM workforce, whereas 52% of the non-STEM workforce are women (National Center for Science and Engineering Statistics [NCSES], 2021)). In computer science (CS), a sub-discipline of STEM, the gender gap is more pronounced than in most other fields, with women comprising only 26% of computer and mathematical scientists (NCSES, 2021). According to the NCSES (2021), women's underrepresentation in STEM careers is only partially explained by women's underrepresentation in STEM education, creating an imperative for career development practitioners to understand how women's educational pathways lead into professional careers.

As the technology industry has grown, so has the need for technology-literate college graduates and, especially, the need for students with backgrounds in computing. It is no surprise, then, that CS leads to some of the highest paying occupations for new college graduates, with a projected average starting salary of $75,900 for CS bachelor's degree graduates in 2022, along with graduates in engineering ($73,922) (National Association of Colleges and Employers [NACE], 2022). In contrast, the projected average starting salaries for social sciences and humanities majors are only $61,173 and $50,681, respectively (NACE, 2022). With the disparity in pay between STEM and non-STEM careers, increasing the representation of women in computing careers has strong implications for closing the gender pay gap.[1] In addition, including

[1] See Lapan, J. C. (2018). Equal opportunity, unequal outcomes: Exploring gender inequality in post-college career outcomes. *NACE Journal.* National Association of Colleges and Employers. www.naceweb.org

more women in the research, development, and implementation of new technologies is important to developing equitable technological solutions for society.

Prior research on women's underrepresentation in STEM implicates structural and cultural barriers that close STEM fields to women, either by preventing them from entering STEM majors or occupations, or by pushing them out of the field (Corbett & Hill, 2015). Patitsas (2019) noted that CS has had a long history of being cast as a masculine domain, which is likely to have a detrimental effect on recruiting and retaining women into computing majors and occupations. Much of the literature over the past several decades has focused on increasing women's interests, rather than on improving the culture of CS academic environments, although research in the latter area is starting to grow (Main & Schimpf, 2017; Meiksins, et al., 2021). While it is important to identify ways to attract women to CS majors, especially in the pre-college years, and to strive for more inclusive learning and work cultures, the role of higher education in shaping students' career pathways has been under-researched. Specifically, little research has been done on how college students who major in CS form career aspirations and how their experiences in pre-professional activities such as internships and the campus recruitment process may shape their career decisions.

A recent study of elite college students' attitudes around careers investigated the role of campus culture in students' career decision-making (Binder et al., 2016). The researchers found that on two elite college campuses, discourses around prestige were a strong driving force in shaping students' career goals and ultimately, their post-college career pursuits. More specifically, the narratives emanating from peer culture and the strong campus recruiting climate were powerful forces that "funneled" students into a narrow set of occupations, occupations which students might not have otherwise chosen given a more expansive career culture (Binder

et al., 2016). While the study did not examine gender as a factor in students' career decision-making, it does provide evidence of the powerful ways in which campus culture influences students' career trajectories and underscores the need for further research into the role of college campuses in shaping students' career pathways, particularly in the highly gendered field of CS.

Considering that gendered culture might interact with other career funneling mechanisms to influence students' careers leaves unanswered questions about the role of campus contexts in shaping women's career pathways in CS. It is perplexing to see the number of studies that focus on individual factors such as self-efficacy (or women's lack thereof) as reasons for the gender gap in computing. For example, in their review of literature on women in computing, Main and Schimpf (2017) note that "women's lower levels of computer self-efficacy compared to men is well-documented, and this gender difference is often associated with women's lower participation in computing fields" (p 300). While this may be empirically true, this view positions women within a deficit framework (Harper, 2010) and places the locus of women's marginalized conditions on women themselves.

Critical theory, with its emancipatory aims (Bohman, 2021) can help address this deficit perspective. In a review of engineering education research studies that employed critical approaches, Mejia et al. (2018) noted that some studies focused more on "individual reflexive process and differences between individuals…rather than looking at systems of oppression" (p. 9). The authors underscore the need to examine "how engineering education may reproduce specific discourses that perpetuate deficit models through deficit-oriented questions and practices" (Mejia et al., 2018, p. 9). To have an impact on this problem, it is important for researchers and practitioners to avoid taking a deficit approach, and to look to cultural and contextual factors that may influence women's academic and career pathways.

In this study, I endeavor to illuminate how women's career pathways are shaped by campus computing culture, with a focus on gendered practices and discourses relating to the processes inherent in career exploration, participation in pre-professional experiences, and job searching. Thus, my research question is as follows: How do the career interests, ambitions, and goals for women in a CS program evolve from major selection to graduation? More specifically:

- What aspects of women's college experience are important contributors to their career aspirations?
- In what ways does the campus environment and culture of CS shape women's career aspirations?

By integrating a cultural theoretical framework with a critical (feminist) lens, I examine how campus computing culture shapes women's career aspirations through a case study of women in an undergraduate CS program.

Background

CS as Gendered Discipline

The field of CS has a complicated relationship with gender. Patitsas (2019) traced the gendered history of CS back to the mid twentieth century in the United States, during which the field morphed from one that took advantage of women's labor as human "computers" with the goal of bolstering national defense efforts, to one that employed gatekeeping measures and gendered discourses to keep women out of the field. In the 1980s, the percentage of women studying CS in post-secondary institutions peaked, and then has steadily declined over the past three decades (Institute of Education Sciences, National Center for Education Statistics, 2021). Patitsas et al. (2016) noted that each time there has been an enrollment boom in CS, the percentage of women majoring in CS has dropped. Patitsas (2019) blames gendered gatekeeping

polices and discourses that push women out of computing. For example, she cites a "brilliance discourse" (Patitsas, 2019, p. 66) that elevates technical skills and perpetuates the notion that men are naturally good at math and science (rational activities) and that women are naturally good at the arts and humanities (emotional activities). To succeed in CS, according to the dominant narrative, one must be brilliant at math, science, and technology. This discourse promotes a masculine ideal of technical prowess and rationality and positions women as either not interested or not capable of being successful in computing careers.

Some people have argued that women's underrepresentation in CS is a matter of choice, or that they aren't interested in coding work because of innate gender differences between women and men (Long, 2018; Musil, 2017). However, as Eddy et al. (2017) point out, "reducing problems to a 'woman's' issue focuses solely on agency of individual women and not on the structures or discourse that bind women in higher education settings" (p. 2). And what is lacking from the choice narrative is any discussion about how *power*, overt or implied, might shape women's preferences. In the third edition of his book, "Power: A Radical View," Lukes (2021) describes "adaptive preferences" (p. 139) as the result of pervasive societal norms and discourses, including those that reflect hegemonic patriarchal values around gender and occupation. Lukes considers the nature of power to be three dimensional, including not only the capacity of one person or group of persons to dominate others, but also "the capacity to secure compliance to domination through the shaping of beliefs and desires, by imposing internal constraints under historically changing circumstances" (p. 148). Power is, therefore, an elemental concept in my examination of the cultural factors that influence women's perceptions around careers in computing. An underlying assumption is that power operates at not only a societal

level, as in gendered occupational norms, but also on an institutional level, shaping the way that women enter computing majors and move through their academic programs toward a career.

Gendered narratives about who belongs in computing position CS as what Cheryan and Markus (2020) refer to as a "masculine default" in the occupational status structure. They define masculine defaults as,

> a form of bias in which characteristics and behaviors associated with the male gender role are valued, rewarded, or regarded as standard, normal, neutral, or necessary aspects of a given cultural context. Masculine defaults include ideas, values, policies, practices, interaction styles, norms, artifacts, and beliefs that often do not appear to discriminate by gender but result in disadvantaging more women than men. (Cheryan & Markus, 2020, p. 1024)

Cheryan and Markus (2020) argue that understanding masculine defaults as hidden cultural biases is a critical step in addressing the underrepresentation of women across a variety of fields, including STEM fields (also see El-Hout et al., 2021). These researchers demonstrate the power that gender norms have in shaping individuals' preferences, choices, and behaviors, and contradict the claims that women's underrepresentation in fields like STEM is simply a result of personal choice.

Sadly, the problem of women's underrepresentation in CS and other STEM fields has largely been viewed as "intractable"; for forty years, researchers and educators have not been able to move the needle on women's participation (Stout & Camp, 2014, p. 5). Despite efforts to encourage women to enter the field and to promote their success, these efforts have largely failed. Patitsas (2019) believes this is because institutions have been focused on "low-leverage" changes (such as women-in-computing lunches) that have little to no impact on increasing

women's participation (see also Patitsas et al., 2015). The problem is compounded by what Khwaja et al. (2017) consider "the persistence of male hegemonic norms and entrenched gendered organizational structures" in higher education (p. 325). Acknowledging the gendered norms and organizational structures embedded in computing higher education, Patitsas (2019) believes that institutions should focus on high-leverage efforts, namely gatekeeping practices (policies) and discourses that steer women away from the field. Considering this, researchers may have been asking the wrong questions; instead of asking, "why do so few women choose CS?", perhaps we should be asking, "what role do CS departments play in perpetuating gender segregation in CS?".

In addition to the overall field of CS being gendered, it appears that there may be additional sorting mechanisms that steer men and women into different occupational roles *within* CS that subsequently yield unequal career outcomes (Bizot, 2019; LaBerge, et al., 2022). Hayes (2010) noted that "women have comprised the majority of many low-status, low-paying segments of the computing workforce such as data entry and word processing…[and] have persistently been underrepresented in high-status, high-paying segments such as hardware design and upper level management" (p. 265). Unless these sorting mechanisms are addressed, the culture of CS will remain unwelcoming to women and may lead some women to pursue lower-status roles within CS, or to leave the field of computing altogether. Khwaja et al. (2017) envision the future of "higher education as a place where change can take place to not just add more women, but to rethink practices and policies to include parity and equity perspectives" (p. 327). Thus, I assert that what is needed is not simply to recruit more women to CS majors, but to reimagine the practices and policies embedded in computing higher education that will allow all students to thrive and flourish in computing majors and careers beyond college.

CS as Prestigious Discipline

Binder et al. (2016) found that students at elite institutions were "funneled" into a small range of careers associated with specific industries, job roles, and career paths they saw as prestigious. The jobs that many of these students actively sought – and were recruited for - were driven by the demands of certain sectors of the marketplace that fuel American capitalist systems. Sectors such as investment banking, consulting, and technology currently have a huge demand for college-educated talent and pay top salaries for students, especially for those from elite institutions. At the same time, Binder et al. found that careers outside these three sectors were seen as less prestigious, paid lower salaries, were less sought after by students, and seemed to carry less status than other career options.

Slaughter and Leslie (1997) and, later, Slaughter and Rhoades (2004) wrote extensively about the concept of *academic capitalism*, "the process by which universities integrate with the new economy" (Slaughter & Rhoades, 2004, p. 14). The academic capitalist framework acknowledges the increasing alignment between higher education and a neoliberal state, "shifting from a public good knowledge/learning regime to an academic capitalist knowledge/learning regime" (Slaughter & Rhoades, 2004, p. 28). Institutions, programs, and departments that align themselves with the new economy – which has increasingly been dominated by technology companies - have claim to legitimacy and status. For example, Slaughter and Rhodes (2004) point out that some fine arts colleges "have redefined themselves so that they train art students in graphic design, digital animation, and web design, therefore connecting directly to the new economy" (p. 27). This move to align with economic demands has powerful implications for the careers that students are hired into, how much those careers pay, and who gets hired into what occupations.

In my experience as a career advisor in higher education, jobs in CS rank high on the status hierarchy with students and jobs at FAANG companies (Facebook, Amazon, Apple, Netflix, and Google) are especially coveted. Starting positions at these big, multinational tech giants often pay more than computing jobs at smaller, less well-known companies, and their recruitment practices are often more competitive. While there has been little research exploring the impact of these recruitment practices on student development[2], acknowledging the academic capitalist nature of universities and STEM programs is important to the discussion of computing culture. Furthermore, as research has indicated the existence of gendered hierarchies among CS subfields (Bizot, 2019, LaBerge, 2022), a more nuanced understanding of the various career pathways in CS and how they are perceived by college students could be helpful for CS educators and career development practitioners in fostering a more inclusive pipeline into CS careers.

CS: Science, Engineering, or Art?

In the milieu of academic disciplines – each with its own status, stereotypes, and discourses - CS does not have a fixed place. The name, computer *science*, suggests that CS should reside among other scientific disciplines, especially the so-called "hard" sciences (physics and mathematics) as opposed to the "life" sciences (biology and chemistry), which are often housed in a college or school of arts and sciences. At many institutions, however, CS resides in a school of engineering; in others, it has a college or school all to itself. For example, at Carnegie Mellon, CS resides in the School of Computer Science, and at MIT it is housed in the College of Computing. At State University (State U.), the site of this study, students can pursue one of two CS degrees: a Bachelor of Science (BS) degree granted by the School of Engineering, or a

[2] See Davis and Binder (2016) for an interesting study on the rise of corporate partnership programs in university career centers.

Bachelor of Arts (BA) degree granted by the College of Arts and Sciences. There are implications for the gendered composition of these majors, as well as their location in the institution. For example, at State U. the BSCS program is comprised of approximately 20% women, while the BACS program has close to 40% women.

In addition to BS and BA degrees in CS, joint CS programs, in which CS is combined with another discipline into a single major (CS + X), seem to be growing in popularity. These joint or blended programs reflect the unique nature of an institution, its student body, and employer demands for the region in which the institution is located. For instance, in addition to a BS in CS, Carnegie Mellon offers a Bachelor of Computer Science and Arts, an intercollege degree program with its College of Fine Arts. University of Illinois at Urbana-Champaign offers several blended CS + X programs, including a unique CS + Crop Sciences program that prepares students for "career fields related to crop genetics, agricultural IT, bioinformatics, and web programming for agricultural companies, computational biology, data analysis, and precision agriculture" (University of Illinois Urbana-Champaign, The Grainger College of Engineering, 2022, General Information, section 9). Table 1 shows examples of various CS programs and their locations in their respective institutions, as well as the array of alternative CS programs that are offered.

The fact that CS can be positioned as engineering, science, or art – sometimes all within the same institution - exposes the ubiquitous nature of computing in American academic and occupational structures. But are all computing-related majors created equal? While reported data for new graduate starting salaries is not typically disaggregated by BA/BS distinction or joint degrees, examining starting salary data for Computer and Information Sciences and Support Services (CISSS) majors can provide some clues. Table 2 shows median starting salaries for

CISSS majors from the Class of 2020, according to NACE (2021). In 2020, there was more than $10,000 difference in the median starting salaries between the two most popular majors: Computer and Information Science ($72,456) and Computer Science ($85,000). Across all majors in the CISSS grouping, there was a huge spread; from Data Processing ($44,124) to Computer Programming ($90,507), it seems as if all computing-*related* majors are not valued equally, or at least that despite being closely related, graduates from these programs get hired into very different jobs.

The gendered nature of CS-related academic programs coupled with unequal starting pay calls into question the legitimacy in the labor market for majors that fall outside the rational, technical realm of the BS in CS. As academic capitalism has afforded more prestige to fields that align with science and engineering, where does that leave a CS program that is aligned with the arts, such as a BACS program? On Reddit, an online community discussion forum, there are dozens of conversations debating the merits of the BA vs the BS degree in CS. The overwhelming narrative is that it doesn't matter to one's career whether one earns a BA or a BS in CS. However, in looking more deeply at the discourse, it is evident that a BS is held in higher regard by the technical community.[3] The combination of who applies and who gets admitted to these programs, along with the career trajectories of students in these programs seems to lead to two distinct "tracks" in CS: a more rational, technical track, and an alternative track. The discourse that there is no arguable difference to individual students and their careers warrants further investigation, especially considering the gendered participation in BA and BS programs at State U.

Theoretical Framework

[3] This meme posted on a university's sub-Reddit illustrates the prestige discourse around the BS/BA distinction: https://i.redd.it/z3gxn98o17x41.png.

The women-in-computing literature is rife with narratives about the "leaky pipeline" that refers to the many women students who have left the field, either transferring to a different major or pivoting away from computing occupations upon graduation. Unfortunately, decades of research have not led to a solution to the low numbers of women in CS (Patitsas, 2019). Meiksins et al. (2021) lament that much of the prior research on women in engineering (which often includes CS) has focused on "identifying ways either to persuade women that they are mistaken in seeing engineering as 'not for them' or of combating social-psychological barriers that discourage women from entering or remaining in the field" (p. 447). The authors advocate for new research that focuses on the culture of engineering and identifying the factors that either promote or hinder women's participation. In that sense, it is not enough to know that women are deterred by the culture of CS; rather, we must understand *how* that process occurs, specifically in the context of CS higher education. Furthermore, we must understand the ways in which women in CS actively resist gendered narratives and overcome gendered stereotypes to persist in a field that is hostile and unwelcoming.

Much has been written about the culture of CS and its hostility or "chilliness" toward women and students from minoritized groups. Yet few studies explore the ways in which this culture, including the culture of CS in higher education, acts upon and shapes college students' career development. To understand how the collegiate environment of CS shapes women students' career aspirations, I will use a sociological approach and feminist theory to scaffold my study. A sociological approach provides a framework for exploring how students' behaviors and choices are influenced by the context of the collegiate environment and how, in turn, students' behaviors, discourses, and ideas shape the culture of their academic and social environments. Feminist theory provides a lens through which to view women students as situated in a

patriarchal structure wherein gendered cultural norms are produced and reproduced through interactions with the collegiate environment. By integrating these two approaches, I aim to explore women's career development in CS from a sociological standpoint, as viewed through a feminist lens.

Sociological Approaches to the Study of Higher Education

Amy Binder, a sociologist who has studied college student career aspirations, invokes several early political and social thought leaders as having provided the foundation for the work of contemporary sociologists of education (Binder, 2018a). Specifically, she credits the ideas of Durkheim, Marx, and Weber (the "founding fathers" of sociology, according to Robson, 2019) as having strong influences on the sociology of education, including the modern-day study of inequality in education. Durkheim (1858-1917) recognized "education as a socialization process" and saw people as both "individual and social beings" capable of influencing and being influenced by their educational environment (Barnes, 1977, pp. 216-217). Marx (1818-1883) saw education as a means of reproducing the inequalities between capital and labor, whereas Weber (1868-1920) described the ways in which social class is actively reproduced through the mechanism of "social closure" (Robson, 2019). These early thinkers set the stage for modern-day research on education, social class, and society.

More recently, Clark's notion of the *organizational saga* has been reflected in the sociology of higher education literature. Clark defined an organizational saga as "a collective understanding of unique accomplishment in a formally established group" (1972, p. 178). These collective understandings create a distinct culture and influence the ways in which an institution develops its own character, as well as the ways in which individuals form their identities within an institution. Clark believed that research into the "cultural and expressive aspects of

organizations" (1972, p. 178) was necessary to better understand the ways institutions of higher education and their key stakeholders behave and develop. Contemporary sociologists have drawn upon Clark's ideas to frame their research on the influence of campus culture on student outcomes including major choice, career decisions, and political views (see Binder, 2018a, and Mullen & Baker, 2018, for instance). These scholars believe that college influences students in powerful ways that cannot be fully understood through rational analysis, and they advocate for the use of research frameworks that take organizational culture and local contexts into account.

Binder (2018b) recognizes institutions of higher education as "central socializing agents" that have a strong influence on students' ideas and behaviors (p. 220). She observes that the traditional approach to higher education research has been to measure individual student progress to determine what effects college may (or may not) have had on their success. Binder considers this traditional approach to be limiting because it fails to account for the contexts and environments of an institution as driving forces in shaping students' ideas and behaviors. She argues that with the traditional approach, "we are left guessing about the mechanisms, processes, and details of [student] socialization" (Binder, 2018b, p. 221). Thus, Binder advocates for new approaches to studying higher education that allow researchers to examine how institutional contexts exert their influence on students. Sociological theory, in turn, can provide an important framework for considering institutions of higher education as socializing agents in shaping student career outcomes.

Evolution of Institutional Theory: New Institutionalism and Inhabited Institutionalism. Binder's approach to research in higher education has roots in New Institutional Theory (also known as new institutionalism and institutional theory), a "groundbreaking theory that points away from a purely rationalist basis of action in

organizational behavior and toward the crucial role that meaning plays in the production and reproduction of organizational practices" (Binder, 2018a, pp. 375-376). Meyer and Rowan (1977) developed new institutional theory in the 1970s to reflect their understanding of how an educational institution's "myths and ceremonies" (p. 349) came to comprise an institution's culture, shaping its inhabitants' beliefs about the institution and their norms and behaviors. Some scholars (Binder, 2018a; Hallet & Gougherty, 2018) have critiqued new institutionalism for its lack of attention to the ways in which an institution's inhabitants not simply reflect, but also shape organizational culture. These scholars suggest that a more useful approach to the study of higher education is the "inhabited institutions" model, in which researchers look not only at the structures, policies, and norms of an institution, but also how inhabitants shape those facets of an institution: "One question we should always ask is how organizational actors…reshape the policies (or scripts) they are subjected to" (Binder, 2018a, p. 378).

Hallet and Gougherty (2018) conceptualize inhabited institutionalism as a combination of new institutionalism and symbolic interactionism, the latter defined as "a theory that asserts that the world is constructed through meanings that individuals attach to social interactions" (Robson, 2019). The inhabited institutions model extends new institutionalist thinking about organizational structures as "myth and ceremony" (Meyer & Rowan, 1977) toward understanding the shared meanings and interactions between an organization and its inhabitants. In other words, higher education researchers who use an inhabited institutional approach must consider not only how institutional contexts (including their respective myths and ceremonies, as well as organizational language) exert their influence on students, but also how students contribute to institutional contexts and cultures.

Cultural-Organizational Approaches. Informed by new institutionalism and inhabited institutionalism, Binder (2018a) has cultivated a "cultural-organizational approach" to studying how college shapes students' attitudes, perceptions, and behaviors. A prime example of this approach can be found in Binder et al.'s 2016 study on career funneling, in which the researchers utilized a cultural-organizational approach to examine the ways in which elite universities channel students into a narrow range of select occupations. The researchers found that the influence of campus recruiting culture, peer discourse, and student self-perceptions had powerful effects that shaped students' career aspirations and pushed them to pursue high-status occupations and to eschew what they perceived to be lower-status occupations. The importance of Binder et al.'s career funneling research is that it demonstrates that students' career aspirations do not develop individually and rationally; instead, students' attitudes about themselves and the world of work are influenced by the campus environment, their peers, the organizational recruiting structure, and the dominant societal narratives inherent in job searching and career development. In another study, Binder and Wood (2013) used a cultural-organizational approach to research college students' political formation and found similar connections between campus cultures and students' political views.

Binder (2018a) notes that several other scholars have employed a cultural-organizational approach to researching college's effects on students, including students' career choices. For example, Mullen (2010) conducted interviews with 100 undergraduate students at two different universities in New England (Yale University and Southern Connecticut State University) and found that each institution's distinct culture led to vastly different outcomes for its students based on their socioeconomic status and gender. In another study with undergraduate women at a large, public midwestern university, Armstrong and Hamilton (2013) found that college pathways

differed significantly for women from different socioeconomic backgrounds. The subcultures into which these women entered college and subsequently lived, worked, studied, and played together created vastly different outcomes, essentially magnifying the socioeconomic disparities that were present when students entered college.

While several of the studies that use a cultural-organizational approach have relied on qualitative methods (primarily case study methodologies), some scholars have used the approach with quantitative methods. For example, Mullen and Baker (2018) analyzed student data at over 1400 institutions to investigate gender gaps in undergraduate majors. They found that institutional contexts, including the prevalence of intercollegiate football programs, gender representation among faculty and students, and curricular focus all correlated with varying levels of gender segregation across college majors. The authors contend that gendered choices in college major are not only a result of students' pre-college experiences, but also their experiences of and within college culture. This insight disrupts the traditional college student development paradigm as a simple individual "input plus environment" equation and shifts our attention to the potential that an institution's culture may have on entire groups of students.

Binder (2018a) contends that "critical to a cultural-organizational approach is the focus on the *meso*, or organizational, level of universities, to show how campuses' unique cultural reputations and structural arrangements influence the ideas and possibilities for actors' choices on the ground" (p. 375). In a similar way, I seek to use a cultural-organizational approach to understand the ways in which the institutional context of CS and the campus environment shape, channel, and mold women students' ideas about the field of computing and their own self-perceptions, perhaps in gendered ways. In framing my study, I conceptualize college women CS majors as the "actors", and the CS program in which they study to be the "meso" level of

organizational inquiry. As this meso level is inherently gendered due to the masculine culture of academic CS and computing workplaces, I will employ feminist theory to aid in understanding how women navigate their careers within this gendered culture.

Critical (Feminist) Perspectives in Higher Education

Higher education scholars have used a critical approach to explore the experiences of students, faculty, and staff, and have included race, class, gender, ethnicity, parental status, sexual orientation, nationality, and the intersectionality of multiple marginalized identities in their analyses (Martínez-Alemán et al., 2015). These scholars have employed critical theory to "analyze inequities in organizations, social relations, and actions in higher education in ways that traditionally functionalist, rational, and increasingly neoliberal approaches have not" (Martínez-Alemán et al., 2015, p. 4).

"Feminism" and "feminist theory" are broad terms that span a wide range of social and political perspectives and can be challenging to untangle. Many branches of feminism have evolved over the past century and do not fit neatly into distinct categories, nor can they be easily or succinctly defined (Tong & Botts, 2018). In the fifth edition of the book, "Feminist Thought: A More Comprehensive Introduction," Tong and Botts (2018) describe the myriad established branches of feminist thought, including: liberal feminism, radical feminism, Marxist and Socialist feminisms, women-of-color feminisms, psychoanalytic feminism, care-focused feminism, ecofeminism, existentialist, poststructural, and postmodern feminisms, and third-wave and queer feminisms. By their own admission, Tong and Botts posit that the way they have categorized branches of feminist thought is "incomplete and contestable" (2018, p. 1). They concur that "feminist thought resists categorization into tidy schools" and that

"'interdisciplinary,' 'intersectional,' and 'interlocking' are the kinds of adjectives that best describe feminist thinking" (Tong & Botts, 2018, p. 1).

The Department of Inclusion and Multicultural Engagement at Lewis and Clark College embodies this intersectional way of thinking in the way they define feminism on their website: "the pursuit of the social, economic, and political equality of all people, regardless of sex, gender, sexuality, race, geographical location, body size, socioeconomic status, physical and mental ability, and religion" (n.d., p. 4). Despite all the different branches of feminist thought and the different lenses through which feminists see the world, what all forms of feminist thought have in common is a commitment to "focus on the causes of and explanations for women's subordination to men worldwide" (Tong, 2009, p. 7) and to provide a corrective to the imbalances and inequities produced by such subordination.

While there is a dearth of explicitly feminist theory in higher education research (Ropers-Huilman & Winters, 2011), one could argue that a feminist approach, by its very nature, is a critical approach, since the definition of critical theory is one that "provides the descriptive and normative bases for social inquiry aimed at decreasing domination and increasing freedom in all their forms" (Bohman, 2021, para. 1). Hesse-Biber (2014a) wrote that "research is considered 'feminist' when it is grounded in the set of theoretical traditions that privilege women's issues, voices, and lived experiences" (p. 3).

Mejia et al. (2018) posit that "critical researchers do not only describe an event or experiences; they ask questions of power, privilege, and oppression" (p. 10). Therefore, a feminist approach must be accompanied by an analysis of power dynamics. Allen (2016) wrote a thoughtful and thorough analysis of "feminist perspectives on power" in which she described "three main ways in which feminists have conceptualized power: as a resource to be

(re)distributed, as domination, and as empowerment" (para. 1). The various ways that feminists have acknowledged and dealt with power in their research, scholarship, and activism has varied widely, and Allen acknowledges that "[power] is not often explicitly discussed in feminist work" (2016, para. 1). Taking a feminist perspective on power, then, would allow us to see that individuals affiliated with the technology industry – individuals that are overwhelmingly men - are the ones that increasingly maintain and reproduce power in their organizations and in society writ large. In addition, taking on Lukes' (2021) three-dimensional view on power can illuminate how gendered cultural norms have the power to shape individual actors' decisions in subtle but powerful ways, as in the case with adaptive preferences.

Feminist Theory in Engineering Education Research. Beddoes and Borrego (2011) observed that feminist theory -and theory, in general- has been underdeveloped or absent from much of the engineering education literature. Through interviews with 15 scholars pursuing feminist initiatives in engineering education, Beddoes (2012) identified several challenges to integrating feminist theory into engineering education research. Of note is the strong influence of engineering culture, which tends to place a high value on quantitative and positivist research methods, while devaluing qualitative inquiry and reflexivity. Beddoes argues that the positivist paradigm pervades engineering education publishing norms and institutional research agendas, thereby limiting the ability of scholars to perform and publish qualitative research, a tradition commonly associated with feminism. Moreover, she acknowledges that the term "feminist" is often seen as problematic for both engineering education researchers (who risk being labeled as overly political) and for the research itself, which is typically viewed as less legitimate than research on the technical aspects of engineering.

The feminist scholarship that has been published in the engineering education literature, according to Beddoes (2012), has most often drawn on liberal feminism, which the author critiques as being "characterized by an interest in equal rights, opportunities, and treatment of women, rather than examinations of gender construction" (p. 209). Beddoes notes that prior research "has largely failed to produce the desired outcomes in terms of the number of women participating in engineering" and calls for "a broader and deeper engagement with different veins of feminism" in engineering education research (2012, p. 209). In a similar way, Patitsas (2019) observed that despite decades of research and a multitude of efforts to make the field of computing more inclusive to women, those efforts have produced mostly low-leverage changes that do not scale. Patitsas et al. (2015) attribute this to a "paradigm of positivism" (p. 68) in CS education research that tends to focus attention on individuals, rather than on the structural and cultural aspects of computing that encourage or constrain women's participation. Indeed, as Misa (2010) wrote in the book *Gender Codes: Why Women are Leaving Computing*, "all reform efforts must confront the distinctive culture of computing" (p. 11), which is inherently gendered.

In an analysis of feminist scholarship in three different engineering education journals, Beddoes and Borrego (2011) categorized articles into five branches of feminist theory: liberal feminism, standpoint feminism, intersectional feminism, interactional feminism, and masculinity studies. (It is interesting to note that several of these branches were not explicitly named in Tong and Botts' 2018 book touting "a more comprehensive introduction" to feminist thought, underscoring the complexity of categorizing and naming the wide range of feminist theories that exist.) Beddoes and Borrego (2011) acknowledge that "since few publications explicitly labeled feminist theories and perspectives, and because of overlap between the branches themselves,

some articles were considered to be examples of multiple branches of feminist theory" (p. 290), demonstrating the complex intersectional nature of feminist theory.

Interactional and Poststructural Feminism. One branch of feminism that Beddoes and Borrego (2011) categorized is *interactional feminism*, which they define as being "concerned with the processes in everyday life that create and re-create gender" (p. 286). In contrast to liberal feminism, interactional feminism acknowledges gender as being socially constructed and characterized by power dynamics that are inherent in interpersonal relationships and everyday interactions. According to Beddoes and Borrego, interactional feminism exemplifies postmodern or poststructural feminism, which "provide[s] a lens through which to analyze what has come to be taken-for-granted as 'normal' everyday practice" (Allan et al., 2010, p. 2).

In writing about feminist poststructural perspectives in higher education, Allan et al. (2010) emphasize the salience of gendered discourses that both reflect and reshape reality as a central tenet of feminist poststructural research and practice. Martínez-Alemán (2015) described the process of critical discourse analysis (CDA), a method in which researchers and policy analysts "determine the relationships between text and discursive practices and the social circumstances that informs each" (p. 21). Therefore, to take an interactional or poststructural feminist approach to research with women in CS requires uncovering and challenging gendered discourses that are present in women's interactions within the culture of CS higher education. It also requires an inquiry into the ways in which these gendered discourses shape women's aspirations and how women resist and navigate these gendered discourses.

Beddoes and Borrego (2011) reviewed two studies that took an interactional feminist approach to researching engineering culture. In the first, Ingram (2006) explored the connection between engineering culture and career pathways for women students across three different

decades. Ingram explains that in her theoretical framework, "the concept of culture plays a central role, in that it represents the point of convergence for both structural and interactional processes" (p. 291). With an explicit focus on gendered structures and interactions within engineering culture, Ingram conducted in-depth interviews with three women who studied at the same university in three different decades to understand how engineering culture affected their career pathways. She found that engineering culture had a strong influence on women's career paths, albeit in different ways for different women at different time periods, reflecting the change in engineering culture at the university over that span of time.

The second study Beddoes and Borrego (2011) reviewed for its interactional feminist approach was Tonso's (2006) ethnographic study with engineering design teams. Tonso utilized a "situated learning" perspective to research "how campus cultural expectations filter into social interactions among peers, and…how cultural expectations are used both to make sense of everyday life and to shape it" (p. 27). Through direct observation of engineering student teams, Tonso noted the existence of status hierarchies within the engineering campus culture that affected the teamwork experiences of both women and men students. More specifically, she found that students organized themselves into three distinct categories: Nerds, Greeks, and Academic-Achievers, categories that reflected both Engineering culture and the larger campus culture. Intersecting these categories were the constructs of gender and a status of "belonging as engineers" (p. 29) as reflected through academic achievement. Tonso laid out the following example:

> Jessica fit into one of the few female-marked identity terms, sorority woman, a way of belonging that only certain kinds of women could hold, women known for social affiliations and not engineering. She was thus visible as belonging, but others were not.

> Carol was "smart," so ostensibly an Academic-Achiever, though no one saw her as really fitting there as an engineer in the same sense that men fit. (2006, p. 34)

In another example, Tonso shows how academic achievement, as reflected by grade point average, trumped engineering design experience in the job search process for two women engineering students:

> Both Marianne and Pam performed engineering work that fit the form of engineering practice associated with Nerds, but neither was considered as belonging among Nerds, which raised questions about their being engineers. Neither had a job when they graduated in spite of demonstrating considerable engineering expertise of the sort preferred by industry employers. Though both had some on-campus interviews, neither was invited to take any plant trips. The central reason behind their lack of success finding jobs seemed not coming to the attention of employers; their grade-point averages were moderate. Once again, the evidence of status that accrued to those meeting academic criteria for achievement, rather than engineering criteria, was evident. (2006, p. 34)

These examples illustrate the confluence of gender, engineering identity, and status as mediated by campus culture, with powerful implications for students' post-college career plans. As Sax (2008) argues, research on the impacts of college on students would benefit from the use of feminist theory "by revealing ways in which interpersonal relations shape the college experience of *both* genders" (p. 218). While Tonso did not explicitly name her approach "interactional feminist," her approach to studying student interactions with a sensitivity toward gender and power dynamics in engineering teams is an example of interactional feminism as a theoretical perspective. An important concept to emerge from Tonso's work is the idea that taking a feminist

approach does not simply mean looking at women's issues in a vacuum, nor does it mean lumping all men into a monolithic category. Tonso (2006) reflects,

> attempts to explain teamwork circumstances solely through male-female comparative analysis overlooks the considerable power differentiation the campus culture produced among men student engineers…Similarly, women's circumstances could not be explained merely by the fact that they were women, though being women provided the first phase of the explanation of whether they were considered engineers or not. (p. 34)

Frost and Elichaoff (2014) claim that "poststructuralism provides a useful conceptual foundation for feminist research practice [because] it provides ways of examining dominant male constructions of realities that emerge from and serve male power interests" (p. 43). Maintaining CS as a man-dominated field, along with the feminization of computing sub-disciplines and the creation of gendered pathways into CS degrees and occupations all serve male power interests when women are continuously excluded from "man's" domain. Furthermore, the narrative that CS is open to all through various pathways and that the best careers are secured through a meritocratic process crowd out any notion of discrimination or bias, making it difficult or nearly impossible see that what is truly going on is a replication of masculine power and privilege. Poststructuralism "recognizes the social construction of realities" and gives researchers the tools to dismantle discourses of power and privilege and to illuminate "the power of patriarchy and its role in constructing social structures" (Frost & Elichaoff, 2014, p. 43).

Caputi (2013) calls for the application of critical theory in examining feminism and power. She argues that "there is so much to unpack in the blanket recommendation that we interpret empowerment along time-honored, masculinist lines" (p. xiv). She goes on to say,

> the manner in which so many young women today interpret their power in fact reproduces the elements of an older, more traditional reading of things that, in the twenty-first century, we must move beyond. Taking their cues from the toughened stance of power feminism, young women today rehabilitate a masculinist version of power that does not answer to the needs of a world that is more demographically interpenetrated, economically asymmetrical, and unevenly affected by the influence of global capital (pp. xiv-xv).

Caputi is referring to *power feminism*, the inclination of women to rationalize their own oppression by adopting neoliberal discourse and assimilating into dominant male culture as means of empowerment, rather than by reimagining an entirely new culture (2013, p. xiii). She decries "instrumental rationality" (p. 31) and "American rugged individualism" (p. 65) as pervasive cultural norms that reproduce the existing social order, including the subjugation of women worldwide. Caputi's antidote to power feminism is critical theory, which involves listening to the voices of the oppressed, a "listening" that she describes as "a feminine practice" (p. 167).

Despite acknowledging the limitations and challenges to integrating feminist theory into engineering education research, Beddoes (2012) provides recommendations that can be seen as a hopeful path forward. Beddoes recommends that to integrate feminist theory more effectively into research in engineering education, researchers should move beyond a liberal feminist perspective and challenge the notion that women need to change to fit into the existing educational and occupational structures. Rather than focusing on what is different or unique about women that makes them less likely to enter CS fields, a deeper inquiry into CS culture is necessary to understand and address the problem of women's underrepresentation. Beddoes

advocates for qualitative research methods and researcher reflexivity to challenge the positivist approach that many prior researchers have taken in studying this issue.

Integrating Feminist Theory with a Cultural-Organizational Approach

Both Ingram's (2006) and Tonso's (2006) studies are examples of research that uses a cultural-organizational approach and interactional feminist theory to frame studies dealing with engineering students. Although neither study explicitly mentions feminist theory, both take a feminist perspective by paying attention to students' interactions with and throughout a cultural ecosystem that positions women as subordinate to men. Nor does Ingram or Tonso use the term "cultural-organizational" in describing their frameworks; however, their focus on illuminating students' actions, attitudes, behaviors, and choices within the context of engineering culture is a notable characteristic of cultural-organizational approaches. In this section, I discuss how I plan to integrate feminist theory with a cultural-organizational approach in studying how women form career ambitions in the context of college computing culture.

Returning to the concept of academic capitalism and the ways that market demands drive the culture of higher education, I argue that the gendered culture of CS is intertwined with capitalist market structures. I draw inspiration from scholars who have written about the connections between academic capitalism and women's position in higher education. For example, Metcalfe and Slaughter (2011) argue that academic capitalism serves to perpetuate male hegemony in higher education. They write, "academic capitalism can therefore be seen as a gender theory because it explains how patriarchy is becoming further entrenched in higher education institutions by a rational, economic agenda, despite the modest or significant gains of individual women" (p. 17). They note academic capitalism's role in creating a discipline hierarchy that elevates fields closer to the market, like science and engineering, that tend to be

dominated by men. They observe that the lack of funding for fields such as social sciences and the arts, along with the "feminization" of these fields coupled with lowered status and prestige, has led to lower salaries in these areas (p. 18). Metcalfe and Slaughter therefore advocate for integrating the theory of academic capitalism into feminist theoretical frameworks.

In a similar vein, O'Hagan et al. (2016) posited that academic capitalist forces perpetuate women's underrepresentation in STEM careers. Through interviews with STEM faculty at four European institutions, O'Hagan and colleagues investigated three academic career practices connected to academic capitalism: achieving visibility, cultivating political connections, and managing time. The researchers found that "academic capitalism was seen as fostering individualistic and competitive behaviours" (p. 218) that put women faculty at a disadvantage in comparison to their male counterparts. Other scholars have researched the link between labor market forces and the gendering of occupational fields. England and Li (2006), for instance, have discussed *devaluation theory*, which posits the more women that enter a field, the less value that field has in the market, resulting in lower wages and fewer men entering that field. More recently, Valentino (2020) conducted research on occupational prestige and found a "segregation premium" that values men-dominated fields more highly than fields that are comprised predominantly of women. Valentino argues for the "need to better integrate insights from cognitive and cultural sociology when examining how gender operates in the occupational hierarchy" (p. 32).

As studies on the connection between academic capitalism and gender equity imply, women's underrepresentation in computing is more than a gender issue; it is also an issue of the value society has placed on computing careers and computing's proximal position to the technology market. A cultural-organizational approach to studying women's career development

in the context of computing culture in higher education, coupled with feminist theory, allows exploration into the intersection of gender and prestige in relation to women's career development. It should be noted that feminist theory and feminist approaches are often critiqued for only referring to white women or white women's concerns, and for excluding Women of Color, including Black, Indigenous, Asian, and Latina women (Eisenstein, 2019; Tong & Botts, 2018). This is a valid critique, and I am mindful of this as I prepare to undertake my study. As I begin to untangle the concepts of computing culture and its relationship to capitalism and patriarchy, I must not lose sight of the fact that the field of computing is dominated by white people. As Eisenstein writes in her book *Abolitionist Socialist Feminism* (2019):

> Why are the issues bifurcated? Race or class? Sex or race? Class or sex? Why not ask how they relate and combine with each other? Why do progressives not wonder more about how multiple interlocking power structures operate simultaneously? (p. 12)

"Intersectionality" in higher education research is typically understood as Crenshaw (1991) defined it, as the intersection of multiple identities (such as race and gender) within an individual that produce unique lived experiences and outcomes (along with unique oppressions). In my study, I also conceptualize a sort of cultural intersectionality which refers to the combination of multiple structural, cultural, and systemic forces that operate *on and within* higher education to produce different opportunity pathways for different types of students.

In this study, I aim to explore the ways that women students experience CS culture and how college computing culture shapes career aspirations. My integrated cultural-organizational-feminist framework (Figure 1) informs my entire study, from the literature review to the study design and research methods. For example, in addition to reviewing the literature on women's underrepresentation in CS (a feminist perspective), I also review literature on the culture of CS

and, in particular, elements of CS culture that may help or hinder women's career growth (a cultural perspective). Through a case study research design, I weave in the organizational aspect by focusing on a single organization and collecting multiple sources of data to provide a multi-dimensional view on organizational culture. Through interviews with women students, my primary source of data, I will inquire about the everyday interactions that occur within their learning and working environments (the micro-level), as well as the discourses and narratives that are present within the CS ecosystem (the meso-level) (Binder, 2018a). Through examination of interview data, along with archival and institutional data, I will be looking for ways that cultural factors drive the development of students' career goals, including academic capitalist practices that shape individualistic or competitive behaviors (O'Hagan et al., 2016) and narratives around gender and prestige. Specific narratives and discourses that I will be listening for include:

- discourses around who belongs in CS and which kinds of jobs are suitable for different kinds of students;
- language indicating how the BA and BS degrees are positioned, especially narratives around gender and prestige;
- women's narratives around the evolution of their career goals, and what they perceive shaped those goals (salient experiences and interactions);
- women's perceptions of the elements of CS culture that feel supportive or challenging with regard to career development;
- evidence of status hierarchies within CS, and the presence or absence of CS occupational subcultures; and

- how women perceive the dominant career-related narratives and discourses in CS, and how they embrace or resist those narratives.

To summarize: interactional feminist theory provides a lens through which to investigate how the culture of CS education "both reinforce[s] masculine biases and (re)produce[s] gendered identities" (Beddoes & Borrego, 2011, p. 297). Cultural-organizational theory allows for the examination of power, status, and prestige in the form of cultural narratives. Integrating these approaches, I will pay close attention to the ways in which women students' interactions with the masculine, capitalist culture of CS shape their career ambitions. In addition, I will look for ways in which gender and prestige norms and discourses might be disrupted through women students' own actions and behaviors. Using both a cultural-organizational approach and feminist theory to frame my study, I hope to come to a deeper understanding of the ways that women students in a BACS program develop their career aspirations in a highly gendered, overtly masculine environment.

Chapter 2: Literature Review

While the literature having to do with women in STEM is vast, research specific to women in computing has, until recently, been relegated to a much smaller subfield. Since CS is a component of STEM and shares many characteristics with other STEM fields, I will review the literature dealing with women's underrepresentation in STEM, more broadly defined. Then, I will review literature on computing culture, with a focus on computing culture within higher education. I will conclude with a brief discussion about how prior research informs my study by identifying aspects of computing culture that are worthy of further exploration into the development of women's career aspirations.

Women's Underrepresentation in STEM

Researchers have studied numerous explanations of women's underrepresentation in STEM, many of which focus on individual preferences or demographic factors as inputs (see, for example, Joy, 2006; Ma, 2011; and Zafar, 2013). These explanations are problematic, however, as they focus on the women themselves, rather than on the culture of STEM. Furthermore, inherent in these explanations is the discourse around "individual choice," as if the production of societal conditions could be distilled to the individual decisions made by a plethora of independent actors. Cheryan et al. (2017) conducted an in-depth analysis of gender balance in STEM fields, and they summarize their findings as such: "A key message from our analysis is that women's interests are fundamentally shaped by the culture of these fields" (p. 22). As Lips (2013) cautioned in her analysis of the application of human capital theory to explain the gender pay gap, "a focus on individual choices, rather than on the wider contextual patterns of constraints, leads to an oversimplified view of the problem" (p. 178). In their meta-analysis of

literature on women in STEM, Corbett and Hill (2015) found various "structural and cultural barriers" or constraints on women's choices including themes of social isolation, stereotypes and biases, disadvantaged social networks, sexism, and sexual harassment as contributing factors that steer women away from engineering and computing careers. Below, I briefly review some of the more common structural and cultural factors attributed to women's underrepresentation in STEM higher education.

Lack of Early Exposure

An oft-cited reason why women are underrepresented in STEM college majors is a lack of exposure to STEM projects and coursework prior to college. For instance, a study by researchers at Google (Wang et al., 2015) found that social encouragement and exposure to CS coursework prior to college were the two biggest predictors for women in pursuing a major in CS or a related field. The researchers suggest interventions focused on parental encouragement and pre-college coursework as ways to get more women into computing majors in college.

Main and Schimpf (2017) reviewed literature on women's underrepresentation in computing and found three main research themes concerning girls' pre-college experiences with computing: the "digital divide", or gender differences in computer access, use, and skills; middle school computing interventions, many of which were focused on increasing girls' interest in and knowledge of computing; and gender differences in course taking behaviors and career outlooks in high school. While it is outside the scope of this paper to conduct an in-depth review of pre-college participation factors, it is clear that much of the research has focused on themes of exposure to and participation in computing-related activities as factors relevant to women's participation in college computing.

Gendered Stereotypes

According to Corbett and Hill (2015), women students in male-dominated majors may be more susceptible to stereotype threat, a condition that is "triggered by cues from the environment that alert an individual to the possibility of confirming a negative stereotype about a group to which she or he belongs" (p. 45). Main and Schimpf (2017) found that "stereotypical images" in computing was a much-researched theme around women's choice of major in college. These gendered images and stereotypes can impact women's sense of belonging in the field. According to Main and Schimpf (2017), belonging and self-efficacy were common research themes associated with women's persistence in college computing. As Dasgupta & Stout (2014) explained:

> Once women make it to college, they are bombarded with subtle (and not so subtle) messages that signal they do not belong in STEM career tracks, especially physical sciences, computer science, engineering and mathematics. Doubts about belonging, in turn, hinder women's achievement, engagement, and persistence in STEM majors by making them question whether their abilities, interests, and aspirations are compatible with STEM. (p. 24)

Consistent with the above description, Lapan and Smith (2023) found that women CS majors at a mid-sized public research institution experienced a sense of self-doubt during their internships, a phenomenon that led women to feel the need to prove themselves in terms of their technical ability. In that study, some participants referred to comments made by instructors, teaching assistants, or peers who suggested that women students were only given certain opportunities because they were women. These comments made women question their own competence and sense of belonging in the field of CS.

Mentoring/Role Models

The lack of same-sex role models in STEM academic environments is another factor that may contribute to an unwelcoming climate for women, according to researchers. For example, Dasgupta & Stout (2014) posited that the lack of role models for women and the uneven gender distribution of the STEM educational environment are among the primary barriers for college women to continue in STEM professions after graduation. Similarly, Smith and Gayles (2017) interviewed undergraduate women in engineering and computer science and found that the feeling of being minorities in a male-dominated environment was palpable. The sense of isolation and the lack of role models and support prompted many of the women in their study to seek gender-balanced environments in their professional careers. These examples demonstrate the impact that same-sex role models, or a lack thereof, can have on women's career decisions.

Sexism and Microaggressions

Leaper and Starr (2019) investigated the effects of sexual harassment and gender bias for undergraduate women in STEM and found that women who experienced sexism from faculty and peers had lower motivations to persist in STEM than students who did not report sexist experiences. In addition, they found that encouragement from certain friends and family members increased STEM persistence among their participants, despite having experienced gendered microaggressions[4] from faculty and peers. In a similar study, Naphan-Kingery and Elliott (2018) sought to determine the relationship between gender microaggressions in academic settings and undergraduate women's intentions to persist in engineering majors and careers. They found that exposure to gender microaggressions predicted lower expectations of

[4] For an in-depth description of gender microaggressions, see Capodilupo, C. M., Nadal, K. L., Corman, L., Hamit, S., Lyons, O. B., & Weinberg, A. (2010). The manifestation of gender microaggressions. In D. W. Sue (Ed.), *Microaggressions and marginality: Manifestation, dynamics, and impact* (pp. 193–216). John Wiley & Sons Inc. https://psycnet.apa.org/record/2011-12742-009

Engineering persistence among their participants. However, a strong engineering identity (the extent to which students see themselves as engineers) served as a buffer against the negative effects of gender microaggressions, and positively predicted persistence in engineering careers. Their findings suggest that gender microaggressions in an academic setting can have a negative impact on engineering persistence, but that a strong engineering identity and positive social support systems can help women weather those microaggressions.

The type of sexism that women students encounter in their academic programs can take different forms. Kuchynka et al. (2018) identified a unique form of sexism called, "protective paternalism" (2018, p. 73), in which well-intentioned men exhibit protective behaviors toward women, who are often seen as more vulnerable and less capable than men. While not intending to cause harm, protective paternalism and other "benevolent" sexist attitudes can negatively impact women and their self-esteem "by undermining [their] self-efficacy, sense of engagement, and performance" (Kuchynka et al., 2018, p. 85). The women in their study who reported experiencing more protective paternalism had lower STEM major intentions when they did not have a strong STEM identity. These findings are like the findings of Naphan-Kingery and Elliott (2018), who found that exposure to gender microaggressions was negatively correlated with Engineering persistence but had no negative effects when Engineering identity was strong.

Intersectional Computing Identities

Rodriguez and Lehman (2017) argued for researchers and practitioners to take an intersectional approach to understanding the myriad ways that women and other underrepresented individuals experience computing culture, and to acknowledge that individuals' experiences can differ quite significantly based on the intersection of their multiple identities. Rodriguez and Lehman stated:

> Understanding the computing experience as an intersectional identity development process means that stakeholders make a commitment to understanding and honoring the various identities that students bring with them and scaffolding computing experiences that develop computing identities. Rather than forcing students to assimilate into current computing cultures, which may be in toxic in multiple ways, this invites institutions to question their cultures, policies, and procedures to understand how those environments need to fundamentally shift in order to prevent marginalization. (p. 243)

Rodriguez and Lehman (2017) discuss the concept of *intersectional computing identity* and call for a revised approach to research and practice that acknowledges other marginalized identities, using intersectionality as a lens. As an outgrowth of this work, Rodriguez et al. (2020) proposed a conceptual framework for understanding computing identity development for Latina undergraduate students in computing. The model considers individual, cultural, environmental, and system level factors to frame understanding of how "multiple forms of oppressions" (p. 34) interact to affect computing identity for Latina students.

Several examples of intersectional approaches in research with college women in computing can be found in the literature. For example, Blaney and Stout (2017) studied sense of belonging for women who were first-generation college students, whom they describe as "a doubly disadvantaged group in computing" (p. 69). They utilized survey data from over 2,000 undergraduate students across 65 universities who were enrolled in an introductory CS course. They found that women first-generation college students' perceptions of instructor inclusivity were positively correlated with their sense of belonging in computing. Therefore, Blaney and Stout suggest that to increase all students' sense of belonging, CS instructors should strive to create inclusive classroom environments in which students are encouraged to get to know one

another and collaborate, and to encourage student-faculty interactions both in and outside of class.

An earlier study (Stout & Wright, 2016) examined sense of belonging for lesbian, gay, bisexual, transgender, and queer (LGBTQ) students in computing. The researchers administered separate surveys with around 850 undergraduate and close to 900 graduate students who were pursuing a degree computing in the U.S. They found that LGBTQ students who had considered leaving their major were more likely than heterosexual students to attribute their thoughts of leaving to a low sense of belonging in computing. Furthermore, they found that women who identified as LGBTQ had the lowest sense of belonging for all students studied (including LGBTQ men, heterosexual men, and heterosexual women). Their findings suggest that that students who identify as women and as LGBTQ might be doubly disadvantaged in computing.

Research with Women of Color also suggests similar disadvantages for Black and Asian women in computing. For example, through interviews with Asian women at a public research institution in the Pacific Northwest, Tari et al. (2021) found that women felt a sense of isolation in their introductory computing courses, primarily because of the gender imbalance, but also because of the competitive nature of the environment. The women in Tari et al.'s study also felt stereotyped by both their race and their gender. In another study, Charleston et al. (2014) conducted focus groups with Black women in computing and found similar patterns of isolation and marginalization due to both race and gender and, at times, the intersection of race and gender. More recently, Rankin and Thomas (2020) explored Black women's intersectional experiences in computing and found themes around "gendered racism" (p. 203) that impacted women's experiences, particularly at predominantly white institutions (PWIs). The Black women

in their study who attended historically Black colleges and universities (HBCUs) perceived the culture at HBCUs to be collaborative, rather than competitive, which was the case at PWIs.

"Chilly" Climate

Hall and Sandler introduced the notion of a chilly climate in 1982 to "describe classroom environments that disadvantage girls and women" (Allan, 2011, p. 67). A chilly climate for women in STEM higher education is a phenomenon that several scholars have explored. For instance, Smith and Gayles (2017) conducted a case study of ten women undergraduate engineering students and discovered that several participants reported an "unwelcoming and chilly" climate for women within their academic programs (p. 1210). In a similar way, Seron et al. (2016) found that women engineering students experienced gender bias in both group projects and in faculty interactions throughout the course of their studies. Seron et al. (2016) posited that "initiation rituals" (p. 185), such as team projects, are often women's "first exposure to not-so-benign gender stereotyping" (p. 206) and can cause them to question their sense of belonging in the field. The women in their study shared a sense of "exclusion", in which they felt "relegated to a helping role" when participating in teams that were dominated by men (Seron et al., 2016, p. 187).

STEM Workplace Experiences

In addition to STEM academic environments, several researchers have indicated that students' experiences with STEM careers during college may play a role in shaping their post-college career decisions (Powers et al., 2018; Samuelson & Litzler, 2013). In a recent review of literature on women in engineering, Meiksins et al. (2021) note that "there is disappointingly little research on the work experiences of female engineers" (p. 447). However, a few studies shed light on internships and other workplace experiences that women often have before they

graduate to a full-time career. Smith and Gayles (2017) identified several "critical undergraduate and field experiences" (p. 1207) that contribute to students' post-graduation career plans. These experiences include "internships/co-ops or research, engineering-related involvement, and utilization of campus resources" and are often rife with gendered interactions (Smith and Gayles, 2017, p. 1207). Smith and Gayles noted that internships and co-ops had a particularly strong impact on students' career decisions, in both a positive and negative way. For many of the women in their study, internships led to a full-time job or greater insight into finding the right cultural fit. However, "all of the participants mentioned situations where they did not receive the same level of respect as their male classmates or colleagues, or where they were singled out for their gender" (Smith & Gayles, 2017, p. 1211).

Kuntz's (2009) doctoral dissertation on the effect of a mandatory co-op program on women Engineering students' persistence at the University of Texas revealed that women in her study endured, along with sexual harassment, various kinds of gender microaggressions during their co-op experiences. The types of microaggressions they experienced include a palpable lack of women in the workplace, being the target of sexist comments, and having to perform inferior tasks that their men colleagues were not asked to perform. While the co-op program had an overall positive effect on women's Engineering persistence, Kuntz observed that "sexual harassment and sexual innuendos are commonplace and many of these [women] have become conditioned to this phenomenon" (2009, p. 89).

Seron et al. (2016) described student participation in engineering internships and summer jobs as a process of "anticipatory socialization" (p. 185) whereby students gain experience and begin to develop perceptions of the profession. They note,

> women's experiences in internships or summer jobs are, in many respects, a continuation of the gender stereotyping they experienced with peers through school projects. This second round of gender stereotyping in the workplace, coupled with the somewhat greater isolation from supportive peers, faculty…lays the foundation for a revised interpretation and questioning of whether engineering is really what these women want to do. (p. 200)

Cech et al. (2011) also discussed the importance of women engineering students' professional socialization experiences in their introduction of the term "professional role confidence" that encompasses both expertise and career fit (p. 646). In other words, professional role confidence is having confidence in one's ability to do the job, enjoy the job, and identify with the role. Cech et al. argue that having negative experiences during professional training – such as the kind women engineers may have when they encounter the masculine culture of professional engineering – are likely to result in fewer women going into these occupations.

Palmer (2017) developed a model of women's attrition in systems engineering and blamed the *workplace environment effect* – including a lack of gender balance in the workplace- as having a negative impact on women's internship experiences, resulting in women leaving the field (p. 3). In a recent study with women CS majors in computing internships, Lapan and Smith (2023) found that women interns often felt uncomfortable at technology companies when they were on men-dominated teams, even when the company had large-scale diversity efforts. This sense of wanting a more gender-balanced environment and more people who shared their identities prompted several women to look for a job with a different company, or with a different team at the same company. In a similar way, participants who found camaraderie with other women with whom they shared something in common felt more hopeful about their future

careers in computing. Whereas comments (or internal thoughts) questioning their belonging or fit within the field of computing hurt women's self-confidence, having the opportunity to participate in internships where they were able to demonstrate success served to build women's sense of confidence and self-efficacy.

Computing Culture

As Mejia et al. (2018) argued, critical researchers must strive to not only describe the experiences of marginalized people, but also to dismantle the systems that oppress and marginalize them. In this section, I review literature on computing culture, with a focus on the aspects of computing culture that oppress and marginalize women.

Masculine Culture: A Global Problem?

The issue of computing culture as it relates to gendered participation in CS resonates globally. Rasmussen and Håpnes (1991) conducted a case study of CS culture at the Norwegian Institute of Technology (NIT) and, through interviews with students and professors, showed how the masculine culture of computing marginalized women and reinforced gendered stereotypes at that institution. From the perspective of the women in their study, the researchers identified three groups of men students: "normal male students," "dedicated students," and "hackers" (p. 1109). Normal male students made up most of the CS population, while the dedicated students and the hackers were minority sub-cultures. The researchers found that although the hackers were in the minority, they held certain values that were integrated into the dominant culture. Those values, which include a fascination with machines, a playfulness toward computers, and addition to work, were reinforced by "the powerful group of actors, the professors and teachers and also their disciples, the dedicated students, who through their attitudes and actions make these values dominant within computer science at NIT" (p. 1117). Rasmussen and Håpnes concluded that it

was through the adoption of values by the dominant group – and the inability for alternative values to flourish in that environment - that perpetuated male domination in the culture of that department, effectively marginalizing the values of the women students and even those of the "normal" male students.

In another European study (Bjorkman et al., 1998), a team of researchers investigated the influence of male dominated computing culture on women students in a CS program at Uppsala University in Sweden. Through surveys and interviews with students, the researchers found that men students generally did not acknowledge there was a gender problem in their CS program. The men exhibited "non-sexist" attitudes, placing blame for the problem of women's underrepresentation in CS on the individual choices of women. Half of the women in the study also presented this view, while the other half espoused "anti-sexist" beliefs. The researchers also identified differences in students' attitudes toward quantitative change (increasing the number of women in CS) and qualitative change (changing the culture of CS to become more welcoming to women). Most of the students favored quantitative change (increasing the number of women), which the researchers ascribe to being less of a threat to the dominant culture than qualitative change (changing the culture). The women who did advocate for qualitative change were a minority within a minority. Finally, the researchers found contradictions in the ways that students talked about gender differences. On one hand, students (especially men students) reported that there were no differences in ability between men and women, but some students' comments contradicted this view and positioned men "as more rational, focused, mathematically-minded and curious…and women as more creative, disciplined, and socially able" (p. 68). The researchers surmised that a culture of political correctness influenced students to say they saw no differences, even though some of their comments revealed essentialist beliefs.

Bjorkman et al. (1998) viewed men's power dominance as "an ever ongoing process where certain values and interests constantly are discredited in favor of others" (p. 65).

In 2002, Margolis and Fisher published their findings from a large-scale case study at Carnegie Mellon University (CMU). Their book, *Unlocking the Clubhouse*, was a seminal inquiry into the culture of computing education in the United States. Margolis and Fisher viewed powerful cultural and societal forces as responsible for shaping women's and men's participation in computing: "At each step from early childhood through college, computing is both actively claimed as 'guy stuff' by boys and men and passively ceded by girls and women" (p. 4). Like Rasmussen and Håpnes (1991), who found that cultural norms were set by a minority group of men with an inordinate interest in computing, Margolis and Fisher (2002) found that "a subset of boys and men who burn with a passion for computers and computing…mark the field as male and enshrine in its culture their preferences for single-minded intensity and a focus on technology" (p. 4). Thus, Margolis and Fisher concluded that the way to improve women's participation in computing is to effect cultural change, both in the narratives around computing and the way computing education is structured.

It is important to note that despite all the scholarship dealing with the masculine culture of computing, not all societies experience computing as masculine. Through a comparative case study of women in computing in India and the U.S., Varma (2009) showed that computing culture is not universal but is shaped by social, political, and economic contexts. Varma observed that computing is not seen as a man's domain in India, in sharp contrast to the dominant view in the United States:

> The image of CS in India is of a lucrative and woman-friendly field. People who enter the CS field are seen as smart and intelligent, without being antisocial. In contrast, the image

> of the computing field in the United States is of a White male, who is a geek and antisocial, which makes many female students rethink whether they truly belong in the CS field. (p. 220)

Varma's depiction of the distinct nature of computing culture in two different countries serves as a reminder that culture can be shaped by macro-level forces as much as it can be influenced by local and organizational contexts. While it is important not to over-generalize the characteristics of computing culture, below are several features of computing culture that have been studied within U.S. higher education.

Geek Culture

Margolis and Fisher (1997, 2002, 2003) used the term "geek mythology" to describe cultural practices at CMU that revolved around a singular focus on computers. They describe students' inculturation process this way:

> Students are initiated into the school's culture soon after they arrive. At a raucous introductory lecture for new undergraduates, students hoot and holler as one instructor teases another about playing computer games until 2 a.m. During another lecture students hack into the professor's computer, change the wallpaper of his computer screen, and send him messages. This is a world in which humor seemingly mirrors adolescent male sensibilities. (Margolis & Fisher, 2003, p. 17)

An interesting finding is that most of the women in Margolis and Fisher's 2002 case study rejected the identity of "geek", as did a good number of the men. However, for women, the fusion of geek culture and masculinity caused them to question whether they belonged in CS, whereas for men it did not have the same effect. The researchers concluded that women were more negatively affected by geek culture than were men students who did not identify as geeks.

Varma (2007) conducted in-depth interviews with 150 computing students at seven minority-serving institutions to investigate the effect of geek culture on women in these programs. Varma defines geek culture as the "high-tech, androcentric, sub-cultural milieu often associated with computing" (2007, p. 359). Unlike the women in Margolis and Fisher's (2002) study, who were primarily white, the minoritized women in Varma's study were less likely to be driven away from computing by geek culture. Instead, their attrition from computing majors had more to do with practical concerns that were related to "their familial, social, and economic conditions" (p. 373). "For them certain benefits accruing from a CS/CE career – such as social prestige or a good paying job – outweigh the stigma [of geek culture]" (Varma, 2007, p. 373). The researchers surmised that being associated with the "geeks" was preferable to being labeled "working class" for this group of women. Varma's study showed that geek culture, inextricable from masculine values, reflects a privileged position in the status hierarchy of computing that can be perceived differently by different groups of women, depending on their race and socioeconomic status.

The ways that technology companies recruit students for full-time jobs also provide clues to computing culture and may have significant implications for women's post-college career choices. Wynn and Correll (2018) conducted a study into this process in which they observed 84 technical recruiting sessions at one university to better understand the ways that companies present themselves to prospective job candidates. They found that recruiters often presented a gendered view of their companies and portrayed a hostile environment for women within those sessions. Four themes emerged from their study: "the presentation and discussion excluding women, the pervasive use and enforcement of gender stereotypes in content, extreme technicality, and references to masculine geek culture" (Wynn & Correll, 2018, p. 153). While

their study did not assess students' reactions to these sessions, the researchers concluded that these behaviors would "systematically decrease women's interest in pursuing tech careers" (p. 161). Therefore, including the recruiting process in an examination of women's career decisions may yield insights into why women decide to stay or leave the field of computer science.

Brilliance Discourses

Metcalf et al. (2018) conducted a ten-year case study of computing culture at the University of Illinois and found "widespread beliefs and messages that innate talent and intelligence are required to be successful in computing" contributed to "feelings of isolation, lack of success, abnormality, and, at times, overt hostility and ostracization in the department" (p. 614). The researchers note that these traits – largely espoused by white men – "create a parallel expectation that computing and the coursework should come easily, with grades and high profile internships as the primary metrics of success" (p. 614). Metcalf and colleagues emphasize the importance of addressing these types of messages and beliefs (what Patitsas (2019) refers to as "brilliance discourses") in the culture of computing as a critical step in fostering a more inclusive environment, especially for women and racially minoritized students.

Competition vs Collaboration

A team of researchers from University of Colorado Boulder and Stanford University (Waite et al., 2004) conducted an ethnographic study of student group work in undergraduate CS courses, after hearing from employers that their graduates possessed strong technical skills but lacked group work skills. Early attempts to improve students' group work skills by increasing opportunities to work together failed because the underlying problem – an *aversion to collaboration* – was not addressed. The researchers realized that the problem was rooted in the student culture around group work and collaboration, rather than in the lack of opportunities to

work with other students. Furthermore, they surmised that this anti-collaboration bias was reinforced by faculty and the curriculum: “The students had an inherent bias against collaboration, and this bias was reinforced by the way in which assignments were posed and assessed” (p. 12).

Garvin-Doxas and Barker (2004) explored defensive classroom climates in CS and found that faculty perpetuated discourses around competition. For example, despite welcoming all students into a course initially, students with prior experience, who were referred to as “rocket scientists,” were “accorded special status later in the same class period when the instructor enthusiastically explain[ed] that [students] will often compete with themselves and one another for the sheer pleasure of it” (p. 9). Garvin-Doxas and Barker also found that students often reinforced discourses around status and experience (where being experienced was equated with being “smart”, and therefore high status) through posturing and defensive communication tactics in the classroom.

Larsen and Stubbs (2005) conducted surveys and interviews with graduating students at CMU to understand their perceptions of CS culture. They found similarities in perception of CS culture among women and men students, implying that features of computing culture that stymie diversity (such as geek culture) may not only be a gendered problem. Like other researchers who found that computing culture was created and reinforced by students and faculty (Garvin-Doxas & Barker, 2004; Waite, et al., 2004), Larsen and Stubbs found that students perceived the atmosphere within CS at CMU as being created by both student and faculty behaviors. Larsen and Stubbs conclude that “a more open and inclusive understanding of CS can illuminate barriers that may not be specifically tied to gender” (2005, p. 164).

Powell (2008) conducted an ethnographic case study of CS students at the University of Pennsylvania and found that women's sense of isolation, a direct result of being a gender minority in a man-dominated major, was compounded by the expectations of faculty and restrictions on student collaboration. Collaboration on homework assignments was considered cheating and students were prohibited from seeking help from anyone other than the instructor or teaching assistant. Powell says that as a result, women were further marginalized by missing out on opportunities to build an informal network with their peers; in addition, it gave students a misguided view of computing jobs, which are often done collaboratively.

Ten years after Margolis and Fisher published *Unlocking the Clubhouse*, Frieze et al. (2012) conducted a cultural case study in the CS department at CMU, which had undertaken intense efforts to change the culture of computing education. Those efforts included improving the gender balance; increasing the "breadth" of student personalities in the program; and providing professional support for women (p. 427). Through surveys with women and men students, Frieze et al. studied "a range of cultural factors including faculty approachability, environment, social fit, academic fit, and ingredients for success" (p. 424) and found that both women and men students described the culture to be positive and inclusive, contrary to earlier studies. Frieze et al. consider "culture as a *synergistic* process for change", acknowledging that "we are shaped by the cultures we occupy while also being active contributors to those cultures" (p. 425) and argue that by making structural changes to their program, CMU was able to effect cultural change. Frieze et al. maintain that by taking a cultural approach to investigating participation in CS, researchers and educators can take factors other than gender into account and better understand the problem, thereby inviting better solutions.

Focus of Current Study

Based on the literature, it is clear the culture of computing in higher education is created and sustained through interactions among and between students, faculty, and perhaps also technology companies and those who recruit for them. Much of the literature has focused on conditions that sustain women's persistence in computing through college, but there is a dearth of literature about how those college experiences translate into post-college career outcomes. As the focus of my study is on the evolution of women's career aspirations, I aim to explore how features of computing culture evident in day-to-day interactions, discourses, norms, and expectations shape women's career development. While my focus is on women's experiences, Cheryan et al. (2017) warn that "women's underrepresentation could get *worse*—if the culture of those experiences is not taken into account" (p. 21). Therefore, I will pay close attention to the culture in which women study, work, and develop plans for their futures.

Chapter 3: Methodology

Following the examples of other researchers who have used case study methodology to explore women's experiences in higher education (Armstrong & Hamilton, 2013; Mullen, 2010), the culture of computing education (Margolis & Fisher, 2002; Metcalf et al., 2018; Rasmussen & Håpnes, 1991) and college students' career decisions (Binder et al., 2016), I conducted a qualitative case study to examine how women in a BACS program make career decisions within the context of campus computing culture. A cultural-organizational approach requires researchers to consider not only the larger culture or context in which a phenomenon is situated, along with the actions and behaviors of individual actors, but also the meso-level culture, that is the organizational culture specific to an institution (Binder, 2018a), making a case study design appropriate to my theoretical framework. Using a cultural-organizational framework and feminist guiding principles, I have attempted to answer the following research question: How do the career interests, ambitions, and goals for women in a BACS program evolve from major selection to graduation?

Guiding Principles

Before I delve into the specifics of my study, I present five "guiding principles" for feminist research methodology adapted from Bailey (2011), that infuse my study design, sampling procedures, data collection and analysis, and reporting of findings. These principles will be important to keep in mind as I progress through my study:

1. The ways that gender and gendered power relations operate in social structures and institutional settings are central to feminist research.

2. Qualitative research is not value-free; rather, a researcher's background, experiences, and beliefs influence all aspects of the study, from the phenomenon under investigation to the data collection, analysis, and interpretation of findings.
3. Since research is not value-free, it is imperative that feminist researchers practice reflexivity and continuously reflect upon their own values, biases, and assumptions and how those assumptions influence the research process.
4. Feminist research must be action-oriented and focus on initiating social change.
5. Feminist researchers must be attuned to the ethical implications of their work, including power dynamics between researchers and participants.

Study Design

I employed a single case study design to explore the ways in which women in a BACS program develop career ambitions. According to Merriam and Tisdell (2016), case study is one of the most used designs in qualitative research. Jones et al. (2022) assert "what primarily distinguishes case study methodology from other [qualitative] approaches is the intensive focus on a *bounded system*" and the "assumption that there is something significant to be learned from a single case" (p. 107). The integration of a cultural-organizational framework is particularly well-suited to case study design in higher education because it compels researchers to situate the research in the context of a specific organization or institution. In the case of my study, the bounded system I am examining is State U.'s Bachelor of Arts in Computer Science (BACS) program, as I believe that there is much to be learned by examining how women students in an "alternative" CS program develop their career aspirations.

Schwandt and Gates (2018) acknowledge that social scientists "continue to encounter strong belief in the power of a universal rationality in the service of objectivist, theoretical (i.e.,

generalizable) knowledge as the only real form of knowledge worth taking seriously" (p. 354). They claim that case-based knowledge can provide a "corrective" to pervasive rationality by presenting "context-sensitive research that unearths situated meanings in complex social settings and thereby contributes to the body of knowledge indispensable to our capacity to interpret and navigate the social world" (p. 354). In this vein, a case study design is appropriate for my research topic, as it is context-sensitive and aims to explore participant meanings in a complex social setting – the university.

In this work, I drew on Tonso's definition of campus culture: "the way of life preferred, sanctioned, and otherwise promoted by the institution and made evident in individuals' actions" (2006, p. 28). More specifically, I looked at aspects of computing culture that were present in women's interactions across their experiences in the BACS program, acknowledging that gender and status/prestige are inextricably linked in computing environments. I purposefully chose to research the BACS program, rather than the Bachelor of Science in CS (BSCS) program, for several reasons. First, the BA program has a higher proportion of women (40%) than the BS program (20%), and I was interested in women's experiences in CS when they were not so severely underrepresented. Second, I was interested in learning about a population (Arts and Sciences students) that seem to enjoy less status than their Engineering counterparts. Third, as Smith and Lapan (2021) found in our study of women CS majors, BA students were less likely to have been exposed to CS prior to college and decided to major in CS later in college than women in the BS program. I was interested in learning about how these "newcomers" to CS think about and develop their career ambitions. Finally, I was interested in understanding how discourses around what is considered legitimate or "real" CS (BA vs BS, non-technical vs technical, etc.) impact women's experiences and career development.

Research Site

I conducted my research at State University (State U.), a highly selective, mid-sized, public research university in the southeastern United States. While State U. students come from all over the world, about two-thirds of the undergraduate students hail from within the state. The CS program at State U. is housed administratively in the School of Engineering and offers two pathways to a CS degree: a Bachelor of Science (BS) through the School of Engineering, and a Bachelor of Arts (BA), which students earn through the College of Arts & Sciences. According to the 2018 U.S. News & World Report rankings, the CS program at State U. ranked among the top 40 Computer Science programs. The admissions process into the BA and BS programs in CS differs quite significantly. When students are applying to State U., they apply either to the School of Engineering or to the College of Arts & Sciences. Once admitted, all students enter their first year as "undeclared" and then choose a major either by the end of their first year (Engineering) or the end of their second year (Arts & Sciences). Since all Engineering students are required to take an introductory CS course, BS students typically experience earlier exposure to college CS coursework than BA students. While students in the College of Arts and Sciences are not required to take CS, they have the option to take the same introductory CS courses as the BS students, and if they successfully complete two CS courses with a grade of C+ or higher, they are eligible for admission to the BACS degree program.

The BA and BS programs in CS at State U. also differ in terms of student demographics, experience levels of matriculants, program curricula, and career outcomes. Specifically, the BA program has more women (40%) than the BS program (20%); students in the BA program tend to have little to no prior experience with CS, in contrast to students in the BS program who are more likely to have had a CS course in high school; and the BSCS students typically have higher

starting salaries than BACS students. For example, the median starting salary for BACS graduates from State U. between 2018 and 2020 was $80,000, whereas for BSCS graduates in the same period the median starting salary was $99,000 (see Figure 2). These data imply the existence of two tracks within CS at State U. that may perpetuate inequalities between students from underrepresented backgrounds, like women and students of color, and students from more traditional backgrounds (i.e., white and Asian men). Taking a critical approach to this work means that I intend to center students in the less privileged (BA) track due to the higher percentage of women and non-white students and because, anecdotally, it does not carry the same cache or legitimacy as the BS program.

Participants

I incorporated interview data from two cohorts of students in the BACS program at State U. into this case study. Prior to recruiting any participants, I obtained approval from the State U. Institutional Review Board for the Social and Behavioral Sciences (IRB-SBS).

2020 Student Cohort

The first student cohort, assembled from a previous study on women in computing internships (Lapan & Smith, 2023; also see Smith & Lapan, 2021), consists of seven women who completed their BACS degree in 2020. Interview data from these participants were collected in the spring of 2020 when participants were in their final year of their undergraduate program. Interview data were re-analyzed using the conceptual and theoretical framework of the current study. These data constitute prior literature, but nevertheless inform the current study as part of the case context.

2022 Student Cohort

The second student cohort included 11 women and one nonbinary student in their 4th year in the BACS program at State U. in the spring of 2022. I used *purposeful sampling* (Creswell & Poth, 2018, p. 100) to identify participants who were willing to discuss their academic and career experiences in computing. In feminist research it is important to select participants who can offer insight into the ways gender impacts their experiences (Parson, 2021). As such, it was important to make my positionality as a feminist researcher transparent in the recruitment process and to specify the nature of this study as relating to gendered experiences. Martínez-Alemán (2015) says that researchers must make participants "knowledgeable social agents" and "center their interpretation of phenomena" (p. 19), and in this way, participants' subjective knowledge comprises the primary data for my study.

To recruit participants, I obtained a list of names and email addresses for female students from State U.'s CS department and sent personalized emails to each individual on the list. In the recruitment email I stated that the criterion "woman" is broadly defined as any student who self-identifies as woman including queer, trans, bisexual, and lesbian persons. I encouraged Women of Color and international students to participate by being explicit about diversity in my recruitment communications and by partnering with State U.'s Engineering diversity center to distribute messaging about my study. I sent one follow up email to non-respondents and asked the CS department to send an email. See Appendix A for the initial recruitment email, Appendix B for a copy of the Qualtrics survey participants were asked to complete to indicate interest, and Appendix C for follow-up messaging. Students were given a $20 e-gift card to Amazon after completion of the interview and member checking process.

In total, 12 students participated in the study (A 13th participant completed the initial intake survey, but subsequently withdrew prior to the interview, saying she was too busy to

participate in the study.) In terms of the race and ethnicity of the student participants, four identify as white/Caucasian; one identifies as Middle Eastern; and the other seven identify as Asian/Pacific Islander. Among the students identifying as Asian/Pacific Islander, three participants specified their ethnicity as Vietnamese American, and one is an international student from China. In terms of gender identity, 11 participants identify as a woman. One participant identifies as nonbinary and volunteered for the study because they feel "solidarity with women in CS" and felt they could offer insight into the topic being studied. Indeed, their participation was most welcomed and important to the study, as it shed light on power dynamics and cultural issues present within the institution that marginalize and oppress those who do not fit the dominant gender demographic. Several participants offered additional identities during the interviews, which are presented in Table 3. I will discuss these identities in more detail in the Findings.

CS Department Faculty

I identified six key faculty in State U.'s CS department (four men and two women) as having knowledge of the BACS program and/or diversity efforts within the Department of Computer Science and emailed them requests to interview. The women faculty did not respond to my request for interviews; the four men faculty responded and were interviewed during the summer of 2022. Each of the faculty members interviewed is white. See Appendix D for a copy of the faculty recruitment email.

Data Sources

My primary sources of data derive from interviews with students and faculty. As case study designs typically include multiple data collection procedures (Creswell & Creswell, 2018), I collected supplementary data, shown in Figure 3, and outlined below.

Student Interviews

Individual interviews with students served as the primary source of data in this study. As mentioned previously, I collected interview data from the first participant cohort in the spring of 2020 for a study on women's internship experiences. Questions for the initial cohort focused on how participants chose their major, their academic and internship experiences, participants' thoughts on gender in CS, and their future career plans. For the 2022 student cohort, I designed a new interview protocol (Appendix E) that invited participants to reflect on the following topics: career goals coming into the BACS program, culture of BACS program, thoughts on gender balance in computing program, current and future career goals, how their goals have evolved, and what has shaped their career goals. I conducted the interviews with this cohort between April and July 2022. The interviews yielded rich data around the students' experiences with career development throughout college and surfaced several themes that provide insight into the campus environment and culture of CS at State U., and how women's career aspirations evolved.

Faculty Interviews

Between May and July 2022, I conducted semi-structured interviews with four faculty members in State U.'s BACS program. The purpose of these interviews was to learn about the history and evolution of the BACS program and its cohorts, clarify curricular requirements, and understand the nature and purpose of the program. These conversations also provided an opportunity to learn how key faculty in the CS program understand student career development and compare how their perspectives align (or misalign) with students' perspectives. See Appendix F for a copy of the faculty interview protocol.

Documents

These include website information about the BACS program and other publicly accessible print and online data on State U. and its CS department. I also asked students in the 2022 cohort to share a copy of their resume to help guide the interviews.

Archival Data

These include student demographics, student experience and perception surveys (conducted annually with CS students), Summer Plans surveys, and First Destination surveys (career outcomes for graduating students). These data were either publicly accessible via State U.'s website or obtained upon request from State U.'s Department of Computer Science. (See Hays & Singh, 2012, pp. 288-289 for more on the use of archival data in qualitative research.)

Data Analysis

Document Analysis

Creswell and Creswell (2018) encourage case study researchers to include "a detailed description of the setting or individuals, followed by analysis of the data for themes or issues" (p. 198). As part of this study, I analyzed documents and archival data, including school, department, and program information, CERP surveys, and First Destination data for insights relating to the career development context for students in the BACS program. This satisfies Creswell and Creswell's first requirement of providing a detailed description of the organizational setting. These data are presented at the outset of my Findings section.

Interview Analysis

I sequentially analyzed the interview data from the two student participant cohorts. I coded interview data from the first cohort prior to interviewing the second cohort, as an exploratory method of *provisional coding* (Saldaña, 2016). See Table 4 for examples of provisional or *pre-determined codes* (Creswell & Creswell, 2018) based on my theoretical

framework, literature review, and prior data. While provisional codes helped organize my data around specific themes and focus my initial analysis, it was important to not become too attached to those preliminary codes; Saldaña reminds researchers that "as qualitative data are collected, coded, and analyzed, Provisional Codes can be revised, modified, deleted, or expanded to include new codes" (2016, p. 168).

As I interviewed my second participant cohort, I employed an iterative process of coding and memoing (Hesse-Biber, 2014b), keeping in mind my cultural-organizational-feminist framework. My *first cycle* (initial) coding strategies included a combination of *narrative coding* (participant stories), *in vivo coding* (codes taken verbatim from participants), and *concept coding* (various levels of meaning) to deeply explore participant narratives (Saldaña, 2016). Below are some examples of the richness of data that I found in the interviews, based on a very preliminary analysis of the 2020 interview cohort:

- Textual descriptions of participant interactions that shaped their thoughts and feelings about their career goals. For example, this quote from a participant in the 2020 student cohort described the "competitive" and "hostile" nature of securing an internship (in vivo codes):

> Maybe there's a little *hostility* when you applied for internships, right? Because you have this barbecue picnic thing from one or two people from each of the companies come and you have a picnic and all the interns and all the people in the company and you mix and mingle and that's *really competitive and pressuring and stressful.* And then each company ranks who they want as an intern. The instructors, they mentioned that this company ranked this girl as their top pick and this company ranked this girl as their top pick and you were third pick for this

> company. But they didn't always mention it, they just sometimes brought it up. This company really, really wanted [specific student] or this one company or three companies all put this girl as the top of their list or something like that.

- References to culture of CS, BA program, culture of institution/department/program/ internship. For example, a participant in the 2020 cohort initial study explained how she switched from Bio/Pre-Med to the BACS major, due to her perception that CS was more collaborative than her former major (narrative coding): "I think I was more interested in computer science, not only as a domain but also as a community. I found it *more collaborative* than working in the pre-medical track. I just felt like that was more competitive and I felt less connected to my peers there."
- Themes related to prestige/power/positioning, especially regarding gendered cultural and occupational norms (concept codes). For example, one participant in the 2020 student cohort talked about the gender balance at her internship: "My West Coast University internship was pretty close to 50/50 and I think I have peers who would look at that and be, 'Well of course, it was human computer interaction. It was *girl CS.* No wonder it was 50/50.'"
- Focus on participants' language and discourse: For example, almost all participants in the 2020 student cohort referred to themselves and other women students as "girls" rather than "women." Also, references to "voice," "speaking up," and "being heard" insinuate the power dynamics evident in gendered spaces.

After coding the transcripts for the 2022 student cohort and faculty interviews, I used separate analytical approaches to organize codes into categories, and then into themes for the student and faculty interviews, respectively. As themes began to emerge from each set of data, I

grouped narratives from individual participants into the themes and observed the emergence of several subthemes. With feminist research it is important to allow the voices of the marginalized to be heard, so I use in-depth description and multiple quotations to center student participants' (women and nonbinary) voices in the write-up of my findings. While I used a similar analysis and reporting process for the faculty interviews, I intend for their narratives to provide context for the student voices, but not necessarily be upheld in their own right, as faculty are not the focus of this study.

Trustworthiness

I employed several measures of trustworthiness during the data collection and analysis phases of my study. As I conducted interviews, I practiced deep listening, which I referred to in earlier chapters as a feminist practice (Caputi, 2013). For me, deep listening meant deep breathing, deep reflecting, and being present in my body as I let participants share their stories. During interviews I made written field notes and immediately following each interview I engaged in reflexive memo-writing to capture my immediate thoughts, feelings, and perceptions about the interview. Taking field notes (also called "memoing") is recommended by many experts on qualitative research (see, for example, Creswell & Creswell, 2018; Creswell & Poth, 2018; Hays & Singh, 2012; and Jones et al., 2022). Unfortunately, due to time constraints and my own naivete, I did not engage in thorough memo writing following the interviews I conducted for my first study in 2020. What resulted was a loss of my initial impressions and an increased possibility for my positional bias to influence data analysis. This was an important lesson that I made sure to take with me into the current study.

After the interviews were transcribed by a professional transcription service, I read each transcript line-by-line while listening to the audio recordings of the interviews, correcting the

transcripts for accuracy (as I have found that transcription services sometimes incorrectly type words or acronyms, which can alter the meaning of an entire statement). In some cases, I added emphasis to match participant tone/affect. This deep reading of the transcripts while listening to the audio recordings aided in refreshing my memory of the interviews, helped ensure accuracy of the transcriptions, and assisted in understanding participant meanings. During this process I also noted comments and questions on the transcripts before sending them to participants for *member checking* (Hays & Singh, 2012). Member checking allows participants to reflect on their initial statements and perhaps add more detail or redact something they wish not to have on record. In my experience, interviews move quickly, and it was often the case after the interviews that I wished I had probed more deeply into certain responses. As part of the member checking process, I asked participants to read the transcripts, correct any errors, redact any statements they did not want on record, and add detail/explanation to any statements that might require further clarification. I made it clear that participants did not have to answer my additional questions, or to respond at all, in order to complete the study. While not all participants responded to my questions on the transcripts, many did share more insights post-interview, thus enriching the data. Once I received edits from participants, I finalized the transcripts with their edits included.

Another measure of trustworthiness I employed in my study was to simultaneously conduct data collection, reflection, and analysis. Experts (e.g., Merriam & Tisdell, 2016, and Saldaña, 2016) suggest that qualitative researchers code data immediately after each interview, rather than waiting for all interviews to be complete to start coding. This preliminary coding allows for early emergence of themes and a chance to explore these themes with other participants. It also prevents too much time from passing before analyzing the data, and thus losing any initial impressions. While I didn’t formally code interview data immediately

following the interviews, my field notes and reflexive memos served as a sort of "pre-coding" analysis of the data so that I could immediately begin to make sense of it.

Hesse-Biber (2014a) says that "[feminist] researchers practice reflexivity, a process by which they recognize, examine, and understand how their social background, location, and assumptions can influence the research" (p. 3). Using reflexivity and intuition as my guides, I tweaked my interview style as I moved through the interviews. For example, during my first interview I realized the way that I asked the first question, which was aimed to elicit identity and/or intersectionality (How do you describe yourself? What do you consider your salient identities?), felt awkward and vague. As I moved forward, I revised the question to provide a thread between the interview questions and the intake survey, on which participants indicated their gender and racial/ethnic identities, by inviting participants to share any additional identities that they felt were relevant to the conversation of being a woman (or nonbinary person) in CS. I realized that asking that question pushed the boundaries of my tendency to put participants into neat little "identity boxes" and compelled me to remain open to their responses. That question ended up eliciting several refreshing and unexpected responses, which in turn led to a deeper and more nuanced conversation of participants' intersectional identities and experiences in CS.

Positionality

In qualitative research, the researcher serves as the instrument of data collection (Jones et al., 2022). It is through the researcher that questions are formed and communicated to participants. It is also through the researcher's senses – eyes, ears, mind, and heart - that participant responses are recorded and interpreted. Therefore, it is important to make my positionality and my biases transparent. I am a white, cisgender, heterosexual woman in my late 40s. I am married and am raising a young daughter. Throughout my career, which has included

work in such male-dominated settings as Silicon Valley technology companies, college athletics departments, and engineering schools at two universities, I have experienced and witnessed gender bias in academic and workplace settings. I believe that sexism is endemic to higher education, the corporate technology sector, and society at large. I also believe that much of this sexism is covert, and perhaps even invisible to many students, employees, and stakeholders of higher education.[5] Through my research I seek to illuminate the processes through which women are oppressed, and to dismantle patriarchal systems and practices in CS higher education. Thus, I do not approach this work in an unbiased way, but rather in a way that acknowledges my aim to root out gender oppression in CS higher education.

Given my positionality as a feminist mother-student-practitioner-researcher, I strive to allow my participants' voices to be heard and to be open to hearing things that might surprise me. Even in the research process itself, feminist researchers must "balance power and authority" between researcher and participant (Hesse-Biber, 2014a, p. 3). Rather than looking for confirmation of my biases, I aimed for "epoche" (Jones et al., 2022, p. 103), which is the openness to new data and information. I conducted this research not to prove a theory or hypothesis, but rather to learn about how my participants experience a phenomenon, with the goal of using my findings to make organizational change and to communicate what I learn to the wider higher education community. Thus, while my background experiences and my beliefs undoubtedly shaped how I approached this study, I have had to set aside those beliefs (also referred to as *bracketing* – see Jones et al., 2022, p. 103) while listening to participants as they

[5] In a Jan. 21, 2022, NPR segment about the late Andre Leon Tally, a queer Black man who grew up in poverty and became an editor at Vogue, poet Saeed Jones remarked, "You know, the problem is gender and misogyny in this country is still so retrograde that we can't even get to these higher-level complexities." The idea that misogyny is "retrograde" resonates with me and my worldview and thus, informs my positionality regarding this study.

shared their own experiences and beliefs with me throughout the research process. In this way of listening to others with an open mind and heart, I have attempted to weave together the subjective knowledge, experiences, and meanings of my participants into a rich narrative that exposes the ways in which CS culture impacts women's career aspirations.

Limitations

A limitation of this study is that I collected data over a relatively brief, three- to four-month timeline (Spring/Summer 2022). Creswell & Creswell (2018) say that case study data collection typically occurs "over a sustained period of time" (p. 14) to fully examine a case. If I'd had several years to conduct this study, I might have chosen to interview students every year for three or four years, or I might have asked them to keep a journal of their career reflections over time. While those procedures would certainly yield insightful data, I had to balance in-depth data collection with practical time constraints as a student and a professional. Another limitation is that in conducting my study at State U., a predominantly white institution (PWI), I almost certainly limited the racial diversity of my sample. Finally, a case study is not intended to be generalized to other populations, although it can provide insights into what might be occurring in other institutions. My findings will remain localized to State U. and to the specific program I chose to study.

Chapter 4: Findings

To gain insight into the ways women's career goals evolved through State U.'s BACS program, I conducted interviews with 12 students who graduated from the program in May 2022 and with four faculty in the CS department. While interviews with students and faculty serve as the focal point for my findings, I first present a brief case background to provide context for the organizational culture in which State U. students choose a major, learn, socialize, and form career goals. The case background draws from institutional and archival data to provide a more robust understanding of the institutional context.

Case Background

State U. is a highly selective public research institution in the southeastern United States with a strong tradition in the liberal arts. There are more than 1000 undergraduate students enrolled in computing majors, including the BA and BS in computer science and a BS in computer engineering. According to State U.'s website, these numbers represent a 50% increase in undergraduate computing majors over the past five years. The cost of tuition is higher for students studying in the School of Engineering. For example, for the 2018-2019 school year (the first year for most of the participants in the 2022 cohort), in-state tuition for the College was $13,682 and for Engineering it was $18,872; in 2020, those costs rose to $14,188 and $19,566, respectively.

History of the BACS Program

The BA program was started as an interdisciplinary major in 2006 to meet enrollment challenges faced by the CS department. After the dot.com bust in 2000, the number of CS majors in Engineering started to decline, and the department sought to enroll students through new

pathways. The department also sought an interdisciplinary major that would be rooted in the liberal arts for the following reasons:

1. To distinguish the degree from the current BS degree.
2. To encourage students to take advantage of the many opportunities for combining computing with arts and sciences fields.
3. To fit into the mission of the College.

The inception of the BACS major (originally a BA in interdisciplinary studies) opened the doors to more diverse students, including women and racial/ethnic minorities. The program started small, and then grew exponentially, now equivalent in size to the BS program in Engineering.

2020 Student Interviews

For the current study, I re-analyzed interview data that I collected in the spring of 2020 for another study on the internship experiences of women in CS. In that study, seven of the original 13 participants graduated from the BACS program and were interviewed about their academic experiences at State U., in addition to their internship experiences. I wanted to see what this cohort might have in common with the 2022 cohort, or whether different themes arose.

Like prior literature, I noted themes having to do with the gendered culture of computer science. Themes around collaboration and competition, geek culture, and prestige were all salient in the 2020 student cohort's narratives. Other themes that emerged provide insight into how dominant discourses both reflect and shape the culture of computing workplaces. For example, themes around the dominance of white men, quotas, and affirmative action for women, as well as intersectionality were all present among the 2020 cohort narratives.

Student Experience and Perception Surveys

The Computing Research Association's Center for Evaluating the Research Pipeline (CERP) conducts annual surveys with CS students for their partner institutions. State U. has been a CERP partner for several years and, with IRB and the CS department's approval, I obtained State U.'s survey reports from the Fall of 2018, 2019, and 2020, respectively. All data were reported in aggregate, and I did not have access to any of the raw data. While I have no way of knowing whether my interview participants completed the survey, I include some of the key findings from the surveys to better understand the overall context in which my participants completed their degrees. The CERP surveys yielded several insights into State U. CS students' reasons for entering the field, their experiences in the program, and their future career aspirations.

In terms of entering the field, the top reasons for CS students were 1) "the job market for this field is promising" and 2) "I like learning about this field". In the 2020 survey, women in the BA program were more likely than men in the BA program to cite "family influence" as a top reason for entering the field, in addition to the job market and interest factors.

In 2019, CERP began asking about students' activities. That year, BA students were less likely than BS students to be involved in computing-related student groups. And in both 2019 and the 2020 surveys, women CS students were more likely to have participated in other student groups (outside computing) than men were.

In all three years of the survey, women scored lower than men on several confidence items, including confidence in getting admitted to and/or being successful in a graduate computing program. In 2019, CERP added items related to self-perceptions to the survey. In both the 2019 and 2020 surveys, women were less likely than men to agree with the following statements: "I see myself as a computing person," "I feel like I belong in computing," and

"Computing is a big part of who I am." Women were more likely than men to agree with the statement, "I feel like an outsider in computing." Interestingly, there was no significant difference between men and women students in their level of agreement with the extent that a career in computing would allow them to serve humanity, be in a position of influence in society, or spend a lot of time with family.

With regard to career interests and future plans, BA students, and often women (except for 2018 report), were more interested in non-computing careers than BS students or men students.

Career Outcomes Data

I retrieved career outcomes data that is publicly available on State U.'s website. The data is from almost 1700 self-reported surveys of graduating CS students from the classes of 2016 through 2021 (n=798 BA graduates, 892 BS graduates). The data show that during this period, the overwhelming majority of CS students reported "working" as their primary outcome after graduation (84% for BA graduates, 88% for BS graduates). Slightly more BA graduates (8.5%) reported "continuing education" than BS students (7.5%). There were more BA students (7.5%) who reported "still seeking" work or education than BS students (3.4%).

BA and BS students went to work for similar employers in similar industries; in fact, both of their top eight employers were the same companies. However, there was more clustering in the top three companies for BS students; 30% of BS graduates went to work for the top three employers (Capital One, Amazon, and Microsoft) as opposed to only 20% of BA graduates. Furthermore, there were some differences in the job functions between BA and BS graduates. Whereas 54% of BS graduates landed in Engineering – Web/Software roles, only 42% of BA

graduates started in those roles. And whereas only 6% of BS graduates were working in consulting and data analytics, 16% of BA graduates were in those roles.

In terms of how students heard about their full-time role, more BS students (21%) reported learning about the role through a career fair, as opposed to only 14% of BA students. More BA students (19%), on the other hand, reported learning about their job on Handshake as compared to only 12% of BS students.

Summer Plans Surveys

According to State U.'s Summer Plans Surveys 2018-2022, women in the BACS program participated in internships at similar rates to men in the BSCS program; approximately 80% of BACS women and 80% of BSCS men did internships in the summer between their third year. This is more than men in the BA program (77%) and less than women in the BS program (90%). The employers for these internships all mirrored the top employers for full-time career outcomes (Capital One, Amazon, and Microsoft), and the majority of roles were in Engineering, Web, and Software sectors.

CS Department Website

On its welcome page, the CS website emphasizes "people," "research," "teaching," and "community." There is a page for diversity, equity, and inclusion in CS at State U., with a statement reflecting the department's values to DEI and a list of faculty members who serve on the department's diversity committee. The undergraduate CS website primarily provides information about the curriculum. The site outlines the differences between the BA and BS programs as having different general requirements and mostly the same CS requirements (the department over the past few years has been converging the CS requirements for both the BA

and BS programs, such that they are almost identical). There are links to undergraduate research opportunities and employment opportunities, the latter of which does not appear to be up to date.

Student Interview Themes

I conducted semi-structured interviews with students from the BACS Class of 2022, asking about their entry into CS, their experiences in the program, and how their career goals had evolved throughout college. As organizational culture and interactional feminism were central to my approach, I also asked students for their thoughts on gender and culture in CS and at State U., and about their interactions with other students, faculty, and other significant individuals. I invited students to share their most salient identities as they relate to their experience in CS. Notably, of the 12 students who participated in the study, 11 identify as women and one identifies as gender nonbinary. That individual reported that they feel "solidarity with women in CS" and added a rich and complex viewpoint to the study. Going forward, I use the general term "women" as an inclusive term to represent individuals who are marginalized by the male-dominated and heteronormative nature of computing. That editorial decision is not intended to erase the identity of the nonbinary participant, but rather to show the solidarity that individual feels with the other participants in this study. I have attempted to represent the nonbinary participant's intersectional identity and viewpoints around being further marginalized within the CS computing community by articulating key narratives that were salient for that individual, in the same way I treat narratives around other intersectional identities (including race, ethnicity, first-generation college student status, etc.).

The interviews yielded rich insights into the ways that women's career goals evolved through participation in the BACS program at State U. and uncovered themes around prestige and white and male domination as defining features of participants' experiences in the program.

Furthermore, the interviews shed light on the competitive nature of computing culture at State U. and the ways that women navigated their journeys and found community both within and outside of CS. To make sense of the participant narratives, I have organized the findings according to five themes: (White) Male Dominance; Prestige Discourses; Computing Culture; Finding Community; and Evolution of Career Goals. These themes and their corresponding sub-themes represent the salient ideas that were present in participants' accounts of their college experiences and career goal formation. The themes, while presented categorically, are not mutually exclusive and share many overlapping and intersecting ideas. Since my goal is to ground this research in participant narratives, I refrain from commentary in this chapter and will provide my interpretations of the data in Chapter Five.

To protect their confidentiality, I created pseudonyms for all participants, derived from several sources. I first searched the internet for the names of women and nonbinary global technology leaders. I then turned to Time Magazine's *Women of the Year* article for inspiration. Finally, I created a few pseudonyms based on my repertoire of personal and professional connections. Throughout the pseudonym generating process I attempted to honor cultural and ethnic traditions, although that was quite a subjective process due to my positionality as a white, English-speaking American woman. See Table 3 for a list of student participants.

(White) Male Dominance

Male dominance was a salient theme running through participants' experiences with CS. Almost all participants used a form of the word *dominate* to articulate the social and psychological over-representation of men in CS. Gender dynamics were present in faculty-student interactions, group project and classroom interactions, recruiting processes, and the social sphere. While the gender imbalance was palpable and, for most women, oppressive,

several participants also mentioned feeling marginalized by other identities, including race/ethnicity, religion, disability, and first-generation college student status. Participants talked about white/male spaces, and there was a sense of being perceived as "less than" their male classmates. I have identified three sub-themes relating to male dominance, including experiences in male dominated spaces, self-protective behaviors, and navigating/resisting male domination.

Experiences in Male-Dominated Spaces. Male dominance manifested most frequently in classroom and group interactions during which students worked together on academic projects. Gina shared, "you can see it when you walk into the CS classroom." Stephanie, who identifies as Vietnamese American and a first-generation college student, shared that "white guys" typically have strong opinions, talk the most in class, feel the need to lead, and provide the most input. She perceives "guys in general" as having more confidence than women: "they just seem very comfortable in this space." Leila referred to interactions with "cocky males" who she felt engaged in "mansplaining." Kerry, too, experienced men students who "mansplain" and "talk over everybody in class."

Rose, a white woman, said she felt intimidated in male-dominated spaces and shared that her "hackles" are raised "any time I enter a fresh classroom and there aren't a lot of women, or anytime I meet new men." She shared one memorable incident when she felt like "an outsider": "I wore a pink raincoat into the Engineering school once and I regretted it so much because I felt so out of place. Maybe it was just in my mind, or maybe people really were staring at me."

Ty, who identifies as Asian and gender nonbinary and uses they/them pronouns, shared their experience of starting out in the Engineering school, where the dominance of white male voices was most palpable:

> Those [engineering] spaces were dominated by white, male student voices, not only because they made up the majority of the class but also because they spoke up, were called on, and sometimes spoke over others the most; this left little space for other voices in the conversation with differing perspectives, such as women and people of color, who dealt with issues such as misogyny and racism that white male students didn't encounter or acknowledge. This happened when we had to work in groups, had class discussions, or had time for students to ask questions. Almost all teachers I had were white or male, too, and didn't acknowledge opposing perspectives because they didn't have to face racism or sexism because of their privilege.

Ty talked about how hard it was to connect with their CS professors: “they're mostly all white men. So, I really couldn't feel like I could talk about some of the things that I was going through.” Ty would have wanted to talk about how they

> struggled with imposter syndrome and feeling like I wasn't smart enough as students compared ourselves to one another, how being perceived as a woman has been difficult in being heard in classrooms, how to navigate careers as a trans person, [and] how my family affected my career decisions.

Ty cited examples of their professors not acknowledging diverse perspectives. For instance, one had a policy that if students had a foreign name and wanted a reference from him, they should change their name to something more westernized. Ty was also repeatedly misgendered by a faculty member, even after sharing their pronouns with him. The intersection of Ty’s nonbinary gender identity and Asian ethnic identity contributed to their sense of marginalization and fear in spaces like the Engineering school. Because of this, they were often hesitant to speak up or to “be noticed” in spaces that were overwhelmingly white and male:

> I feel like I will be argued against or spoken over if I have a differing opinion, so I don't want to draw attention to myself. I always feel overlooked or belittled in some way because I'm perceived as an Asian woman, whether that be white male students interrogating my work because they think I'm less smart than them, or white male professors asking more questions during class introductions for Asian or women students than our white male counterparts.

In a similar vein, Gina felt annoyed, and sometimes intimidated, by interactions with men students. She felt the men in her project team saw her as “less capable” because of her gender. She shared:

> There was one specific situation where we were going over homework answers and they both have the same answer. And I was like, "No, that's not right." And I was trying to explain why it wasn't right. And they just weren't listening. And we ended up arguing for an hour. And I finally, I was just like, "Okay, whatever we'll go with your answer." And then once we got off the Zoom call, I texted two of my friends. I was like, "If you were to do this problem, what would you do?" And just to see where maybe the misconceptions were, or if I was wrong.

After talking through her idea with friends, Gina felt more confident in putting her solution forward:

> Then finally I sent along explanation to the two people in my group. And I was like, 'I'm right. Trust me, I'm right. I'm putting my answer down," and it ended up being right. But yeah, situations like that, I feel like sometimes the guys think the girls are less capable. I don't know, maybe because it is more male dominated.

The notion of having to work harder to get their ideas recognized was echoed by several of the women. Rose described her experience with (men) group members who ignore others' contributions and talk over people; she says, "I definitely notice when they do it to me and not to other guys." Kerry described:

> The men in engineering school hold themselves to such a high standard and they're so proud of themselves and they all just think they're geniuses. You definitely get that vibe. When they talk in class, it's like, "I'm the smartest person in this room." That's what they're saying indirectly and just by the way that they say things. And the thing is when it comes to group projects, they are not carrying their weight. I see them leave a lot of the organizational things, the communication, meeting deadlines to the women in the groups, which I've always thought was super annoying.

Stephanie also noticed a hierarchy in project teams, according to those who had more experience with CS, which typically were the men students. Her response, in those cases, was to sit back and let others lead, rationalizing, "I'm just here to benefit the team."

Daphne, who double-majored in CS and economics, noted that both fields are male-dominated. She described how being a gender minority within two majors at State U. affected her interactions with other students: "I found my smaller bubble in terms of the people that I surrounded myself with and tended not to interact as much with the people who identify as male, just because I felt like there was an implicit dominance." When asked to say more about this "implicit dominance" in CS, she explained:

> I guess it wouldn't inhibit my career path or anything like that…it's just a stigma in my head…I think I maybe had one or two female professors over the entire four years. So, I felt like it was mostly male professors, so this is a more male-dominated major and I

> don't think it impacted me in any way, specifically, but I think it's just in my head. The thought in the back of my head that was there.

I asked Daphne if there were certain values or behaviors present in more male-dominated settings, and she struggled to describe the dynamics:

> I'm trying to find the right words to describe it, but I guess more pragmatic or straightforward in terms of just those interactions. They're very, I don't want to say if it was maybe more emotional with females, but just more a softer side to balance out the nature of computing. If you're programming, there's a process to everything and it's more rigid, in the sense that I think those interactions that I had with the people in the [CS] major, they're also that same sort of rigidity that I see within the actual major itself with the programming, and things like that.

Beyond a general sense of male dominance in CS, several participants were subject to direct comments about women being hired just to fill diversity quotas. For Kerry, who identifies as Asian/Pacific Islander, a comment made by a male acquaintance was very upsetting:

> He like was, “Oh, women in computer science have it so much easier because there's less of you and that just means that people want you more.” It's kind of giving affirmative action. They just need to be diverse. And it [implies that] you don't really earn your titles or your accomplishments. They're giving it to you because you're a woman. You kind of get this free ticket. But I'm like, “have you ever thought about every single day when you go into a class that is predominantly men, the professors are predominantly men communicating things in a way that is very engineering male mind?”...This is harming me every day.

Kerry drew a parallel between that narrative and racist “replacement” conspiracy theories:

> I just thought it was really shocking because I think that this also goes into the idea that, it's kind of similar how a lot of white Americans might think, “oh, immigrants are taking our jobs.” I think that a lot of men might, even if they don't consciously recognize it, think that women in computer science may be a threat, if they believe that women in computer science have better chances of getting a job, they definitely to some level think that women in computer science are a threat to their career.

Sherrilyn, who identifies as Asian/Pacific Islander and plans to pursue a career in finance, compares the narratives about women and minorities getting access to finance clubs and career opportunities to the same narratives about women in engineering and CS:

> This is probably more applicable to me and my finance recruiting specifically, just because finance is also known to be a very male-dominated industry. As a girl, and I imagine it's the same for engineering, you'll hear remarks, even if it's for clubs, where there'll be guys are like, “Oh the girl got in,” and the guy will be like, “Oh, it's because she's a girl, they need more diversity. Everyone's trying to pump up diversity, that's why they got in.” I feel like it's a pretty unanimous feeling that, I don't want to say all girls, but all minorities have probably heard remarks like that at some point.

It seemed that having another marginalized identity, other than or in addition to being a woman, made participants more keenly aware of the impact that male dominated spaces had on their experience in computing.

Self-Protective Behaviors. Participants shared specific examples of how they adapted their behavior or, in some cases, observed the behavior and characteristics of other women and minorities in reaction to male dominated spaces. For instance, Rose shared that “it's so intimidating to enter this male dominated space” that most of the women she has met in CS have

a high level of "implicit confidence": "You only [enter CS] if you've had a strong track record, because being an outsider is already such a disadvantage." Rose explained how her deployment of "protection mechanisms" to "avoid the embarrassment of failure" shaped her career trajectory:

> I think I had pretty low goals for myself. It was always sort of a constant game of catch-up or getting a foot in the door, which I think has fortuitously led me to a lot of opportunities that have helped me grow as a learner and a problem solver.

Stephanie shared how downplaying her skills in group projects worked as a protection mechanism: "maybe it's a way of protecting myself in those situations…I don't want people to overestimate my skills and me not being able to perform to that extent." Ty explained how refraining from sharing their pronouns in very white male spaces is a form of "self-protection," "just in case someone doesn't vibe with or might respond in a hostile way to that."

Several participants felt the need to prove themselves or overcompensate for what others might see as deficits due to their gender or another marginalized identity. In her first software internship prior to college, Miriam felt like she had to "prove herself every day" since she was one of the only women: "I was therefore representing women, in a way. And I didn't want them to not think that women were capable in the space they were in."

Leila, a Muslim woman who wears a hijab, feels that she must work twice as hard to overcome the stereotypes related to her intersectional identities:

> When I wear the hijab, I'm more clearly identifiable as Muslim. I think it makes a difference … when you can visually see what someone's religion is versus not knowing. And being a woman, as well, sometimes it feels like you have to work twice as hard to get the job you want, versus a white Christian male.

During her internship, Leila was the only woman on the team, and that made her feel alone and prompted her to be more assertive: “Everyone was a white male in his 50s…I felt like I had to be more assertive than normal to make a point.” Throughout her job search Leila wondered if her Muslim identity might impact her ability to land a job, especially when her interviewers were white and male, which was almost always:

> Maybe the reason it was so hard for me was because I needed to build more experience in interviews, but then also, there were a lot of interviews that I would feel like they went really well, and then it would be a really small factor that would make the difference between [me] getting the job or someone else getting the job. I would always wonder if anything related to my identity would have any effect on that. The only times when I would wonder that is when I have only white male interviewers, which is 90% of the time. I'm always happy to see more diverse interviewers.

Leila’s description of her experience with job and internship searching reveals her insecurity that she wasn’t experienced enough and her belief that she had to be “perfect” to be successful in interviews. These feelings appeared to stem from the white and male dominated spaces in her internship and during the recruitment process. When asked how State U. could better support its women in CS, Leila responded that she would like to see “advising about navigating a CS career as a woman in a man-dominated field.”

While participants like Leila talked about how they navigate male-dominated spaces, Ty shared their strategy for “center[ing]” their “gender and difference as an asset” in their career development:

> Since I'm perceived as a woman, I also face sexism and gender discrimination in job opportunities and career development because I am a minority in a male dominated

space. Because of this, I wanted to engage in career development that centered my gender and difference as an asset at conferences (Grace Hopper), peer mentorships, and job opportunities (resume books, career fairs) geared toward women and nonbinary people.

Ty's example is striking because it reflects a different kind of coping strategy, which is to free themself from male dominance altogether by engaging in spaces that support and promote opportunities for women and nonbinary people.

Navigating/Resisting Male Domination. While almost all participants felt some level of discomfort with the gender imbalance in CS, several reflected on those feelings and either questioned or downplayed them. For example, Stephanie shared that "there was a lot of times when I felt discomfort, but I'm not sure if it's because of the environment that I was in, or if I just place that on myself." Aside from Rose, who spoke pointedly about her feelings of intimidation in male dominated spaces, the three other white women in this study downplayed the male-dominated nature of CS. For example, Gina said that she was "used to" male dominance and claimed she "doesn't mind it" and that she's "accepted it." Along those same lines, Helen shared that being a (white) woman in CS was "not a big deal" to her. She acknowledged that CS is a "masculine-centric industry," one that she was "conditioned" to accept and never questioned until recently. Helen has been called a "unicorn" for not conforming to the stereotype of a typical CS student. She claimed that "everyone is respected equally" and hesitated to use the word, *sexism*: "I don't want to say, 'sexism'…I never experienced discrimination, I'm not aware of bias." Miriam, also a white woman, couched her perceptions of the CS environment: "I don't feel isolated as a woman in any of my classes or groups. All the men have been very nice to me. But I guess those are just the ones that I choose to associate with."

Several participants expressed contradictory narratives; on the one hand, they claimed to have “accepted” male dominance, and on the other hand they were taking steps to interrogate or “counteract” it. For instance, in sharing her observation that “dominant” men were more likely to ask questions in class, Fan reasoned that was simply because there were more of them. However, Fan is also keenly aware of how her gender might impact her future in the field as she matriculates into a PhD program, and desires to “talk [with other women] about the social pressures and feelings of working in a male-dominated field.” Despite claiming to have “accepted” male dominance, Gina took steps to “counteract the mostly male-dominated field in computing” by co-founding a Girls Who Code chapter at State U. She asserts, “I won’t back down” as a gender minority in the field. Although Helen claimed that being a gender minority was not a big deal to her and that she does not “look for the gender divide,” she acknowledged it is “important to break down barriers” for women in the field, and that it is important to “feel like everyone is the same.” After an internship where she was the only woman on the team, Helen is on “high alert” for gender imbalance in future jobs and has been asking about the gender ratio in her job interviews.

Allyson offered her perspective on being a woman and a first-generation college student in CS:

> Two of my closest friends are both guys, and I know they acknowledge that it's very hard for women in computer science, but I don't think they understand how much of a pressure it really is, … basically, they would have all these opportunities and they're like, "Oh, you just apply. It's not that hard." I'm like, "It's kind of hard," and especially since I was also first gen, I have never known how to ask for help. I've always done everything on my

> own too… even just putting myself through college was just my own efforts, but my friends have had the help of their older siblings or their parents.

Many participants were unaware or misinformed about the history of women in computing fields. Gina "assumed men were there first" and believed that "technology and science roles have always been male dominated." Miriam believed that "men have been doing it longer": "men have been engineers, men can be engineers." Men are good at "building stuff, creating stuff." She admitted to having "preconceived societal thoughts": "engineering is a man's thing; it's ingrained in me; planted in my brain" yet these ideas "haven't deterred me." Kerry was the only participant to acknowledge that "programmers were originally women" and believes that was "taken away from us by men."

While Fan feels she has not seen or experienced gender discrimination at State U., she has talked with other women in the field and is concerned about the potential for facing discrimination as she moves into the workforce after she completes her PhD. On one hand, she acknowledges there is gender discrimination in STEM fields, and thinks age and marital status might compound her challenges:

> It's mainly due to the expectation of having children. HR doesn't want to hire a woman who will start pregnancy shortly after she starts a job because of the impact on working efficiency (tired, maternal leave, etc.). Also, most people expect mothers to be the major caregiver and thus be distracted from work. Based on my research, HRs are more likely to hire middle-aged women who had young children (not babies) because they assume at this point the woman has already found the balance between work and family. I think it's ridiculous and it's a violation of privacy to ask for this information, but I heard it a lot from people who work as HRs.

On the other hand, Fan recognizes that being a woman might be to her advantage, but this also comes with some conflicting feelings:

> I also heard from males saying that 'oh, you're getting this job because you're a female, because the company just need[s] you as a token to show that they don't discriminate against female or to add diversity to the company.' And I don't know how should I think about this.

On the whole, participants demonstrated resilience in the face of being a minority in the male-dominated world of computing. Sherrilyn tries to not let disparaging comments like the ones above affect her: "It's not like I can change an entire culture…literally don't let it affect you and keep moving forward."

Prestige Discourses: BA vs BS

Interviews with students revealed that a distinct hierarchy exists with computing at State U., with the BS program ranking more highly than the BA in students' collective value judgments. This hierarchy was reflected in discourses that position the BS as more "rigorous" and the BA as "easier," and students in the BSCS (and engineering, in general) as "smarter" than students in the BA. Participants largely internalized these value judgements and described themselves as "not as smart" as their peers in engineering. The prestige distinctions as well as the organizational structure of CS having two academic tracks in two separate schools impacted participants' career trajectories.

Pathways to the BACS. Participants entered the BACS program through various pathways that were largely related to experiences and interests that were formed prior to college. Many discussed choosing the BA for its flexibility and for the ability to explore coursework outside of CS, which is more difficult to do in the BS program due to the number of required

STEM courses in addition to CS requirements. Several participants did not proactively *choose* between the BA and the BS program; rather, they *discovered* CS during their first year in the College of Arts and Sciences, and since they had not chosen Engineering, they automatically sorted into the BA program in CS. A few participants considered switching to the Engineering school to pursue the BSCS - but felt by the time they knew they wanted to major in CS, it was too late, citing the many course requirements in the BS program. Gina, a double major in mathematics and computer science, offered insight into her decision-making process:

> I started as an astrophysics major at State U. And then I decided I liked math better than physics, so I switched to just math. Well, I took two AP computer science classes in high school, so I was already interested in computer science, so I thought I would always just minor in it. And then eventually I got far in, and then I was like, "I might as well just major in it." And then I just stuck with it after that.

Later in the interview, she reflected on the path not taken:

> I feel like there's always been a part of me going throughout State U, like, "I could have been an engineer, maybe I should have done electrical engineering, or computer engineering." So, I know I'm capable. I guess part of me is just like, "I feel I should have been in the engineering school from the beginning." And I just didn't do that because it was too late.

Like Gina, Kerry initially enrolled in the College of Arts & Sciences and when she decided to major in CS, considered switching to the School of Engineering. However, Kerry was concerned she might struggle in the Engineering school due to her learning disability. She also realized she would have to pay more in tuition if she switched to Engineering. Ultimately, she

saw successful students in the BACS program and figured she could be just as successful as they were, so she decided to stay in the College:

> [Differential tuition] wasn't the biggest factor because let's say that career opportunities have a stark difference between BA and BS. I think that in the end, the BS would've been worth it, at least to me personally, if the kind of opportunities or the kind of salaries that you're making have a huge disparity between them. I would've not considered that additional cost as much, but it seems we would get the same opportunities except I would have to pay a little bit more, take more rigorous and focused classes maybe in things that I wasn't necessarily interested in. And I guess just the fact that I was already in the College of Arts and Science, I had a lot of friends, and I didn't really see the need to go to BS.

In contrast to Gina and Kerry, Ty and Allyson both started at State U. in the School of Engineering and then transferred into the College of Arts & Sciences. Ty made the switch in order to have more flexibility in their schedule to take studio art classes. Ty had heard from other students that there were “different things out there I can do” outside of Engineering. Ty also wasn’t entirely comfortable in the Engineering school; the big classes, feeling set apart because of their gender identity, and not feeling like they could speak up in Engineering spaces all played a factor in their decision to transfer to the College. In a similar way, Allyson switched to the College to take art classes and to avoid the math and physics requirements of the BS program. Allyson transferred to the College with some of her friends; she says what really “sparked” the switch was talking with an upper-class friend who had been successful in making the switch herself.

BA "Easier"? BS More "Rigorous"? While participants viewed CS coursework in the BA and BS programs as similar, they all portrayed the BACS program as "easier" than the BSCS, and the BSCS program as more "rigorous." This idea seemed to stem from not only the number of requirements for the BS program, but from the technical nature of such requirements, and the fact that students felt like they would have to invest more time and energy into completing the BS curriculum. However, it was clear that this prestige hierarchy was also rooted in deeply held beliefs that participants, and State U. students in general, had about engineering coursework and that was largely unquestioned.

Participants felt that the BA program allows more room for students to take humanities, liberal arts, and social science courses, which were overwhelmingly labeled as "easier" than the engineering requirements. When challenged on that point, some participants reflected that while the largely accepted viewpoint among CS students at State U. is that the BA is easier than the BS, participants acknowledged that their course of study was not necessarily easier. As Stephanie shared: "I think it's just perspective, because math and science may be hard for me, and writing and language might be hard for you. We all have strengths and things that we are not as good at."

Several participants (Stephanie, Gina, and Kerry) reported that Engineering students refer to the College of Arts & Sciences at State U. as the "College of Arts and *Crafts*," implying that academic disciplines in the College are not taken as seriously as those in the Engineering School. Stephanie explained:

> Well, when you think about some of the classes College students take vs what the Engineering students have to take …[e.g.] *Calc 3* and *Physics*, and I'm taking *Human Sexualities, Art in Buddhism*, it doesn't seem like it's as rigorous, or like, we take classes

> that I guess sound fake, in such niche areas, *Learn to Groove*, *Dracula*…Maybe people see that we're taking classes that are easier, or they seem that they're not as rigorous; maybe that is why we are called the "College of Arts & Crafts", to them.

Stephanie says she doesn't take the moniker personally and feels that other students intend it as a joke: "I think it's kind of funny, but I can also see why that separates the [BA and BS]." Upon further reflection, she shared how this discourse affects her:

> I think even if I use it as a joke, it might take away my worth and value within the [BACS] major…even if it is just a joke, maybe inside I do see that the Engineering school kids worked harder for their degree and I didn't as much, because I got to take these fun classes.

Kerry also perceives the Arts and Crafts narrative as "a joke, to put you down for not being in the Engineering school." She says, "I just kind of roll my eyes and like, 'oh, it's another man in CS with a ginormous ego. We're just going to brush it off.'" She feels the narrative symbolizes a sense of pride among Engineering students, which reflects the nature of the BS program and the type of student it attracts, rather than the program itself that cultivates that way of thinking:

> I would say [men with big egos] are more common in the BS program. And I don't think that's necessarily because being in the BS program gives you a big ego, but I think that maybe if you already have a big ego and you're like, "oh, one of [the programs] is called *Arts and Crafts* and one of them is the Engineering school, I'm going to lean towards the one that seems more prestigious." I think it's more about that than the actual program that's cultivating these behaviors.

Participants almost unanimously stated that there was no difference in the types of internship or job opportunities that BA and BS students could pursue, but several expressed doubt. For instance, Gina had also heard the "Arts and Crafts" narrative and, like Stephanie, initially said she views it as a joke and doesn't take it personally. However, she clearly grapples with how this narrative reflects her career positioning:

> I know that I'm getting the same education, so I don't really care, but it's also interesting, because in terms of jobs…a BS looks better than a BA and I'm always like, "Well, I'm getting two BAs [CS + Math]. So, it's basically the same," but it definitely hasn't deterred me. It's worried me a little bit because some jobs for the requirements will just post "BS in computer science" and I'm like, "so am I even qualified for this, even though I know that I took all the same classes as a BS student (besides the engineering requirements)?" So, it has worried me in my career sense, but when people make fun of that, I don't care.

Miriam also wondered if some jobs prefer a BS degree. She shared that prestige discourses around the BA versus the BS could feel demeaning: "There's always like, 'Oh, you're *just* in the College of Arts and Sciences.' I mean, I feel like they don't really say it in a demeaning way, but sometimes it feels demeaning." Like several other participants, Miriam has grappled with this narrative and tried to brush it off; even though it might be said in a joking or lighthearted way, it appears to have students questioning whether their BA degree would carry as much weight as the BS on the job market.

Daphne described the prestige narrative more directly: "I think the BA gets discounted a little bit like, 'You don't have to take some of these really hard classes…you're a bit lower than the BS because you didn't take these classes, so we're superior to you.'" She feels that "rigor" is the reason the BS is seen as more prestigious than the BA. She surmised that "big tech" might be

more interested in hiring BS students than BA students and wondered if it might be more difficult to find a job with a BA degree. However, she – like several other participants – noted the benefits of the BA program as granting access to a broader set of courses that provide a "more well-rounded education":

> I define "rigor" as being academically challenging. I see the BS degree as being more rigorous than the BA due to some of the classes that the students pursuing the BS degree are required to take that the BA students don't. However, I also see the BA degree providing students with a bit more of a well-rounded education since not all of the required classes are strictly through the CS department.

Indeed, several participants felt that having a more well-rounded educational experience would be advantageous to their careers. For example, Rose shared, "In the workforce, I'd rather have someone on my team that can communicate clearly, onboard quickly, and think of a creative solution than someone who's an expert in a domain that will be out of date in two years." Despite any prestige disparity between the BA/BS programs, a couple of participants felt that State U.'s overall "blanket prestige" (Helen) would position them for career success simply because it's a "named school" (Rose). While participants were aware of the BA/BS prestige distinction, and often struggled with it, reflecting on the benefits of the BA and the breadth of coursework they had exposure to through the College of Arts and Sciences provided a counternarrative to the narrowness of the "Arts and Crafts" discourse.

"I'm Not as Smart as BS People." Despite the sentiment that the well-roundedness of the BA program prepares students well for the workforce, several participants saw themselves as "not as smart" as students in the BSCS program. This idea seemed to be linked to the notion that

the BS program requires more math and science, as well as stereotypes about students in the BS program being more "into" programming. For example, Helen said:

> I'm not as smart as BS people… my brain isn't wired for science and math. I really struggle with these topics. I would also say that the BSCS students are typically more intensely into programming languages. With all of this, I definitely feel less smart compared to them. BUT I realize that we play to our strengths. So I could be better in other topics. I think one of the shocking parts of college is realizing you're not the smartest person in the room anymore. AND THAT's OKAY! [sic]

Ty described the BACS program as "baby CS" in comparison to the BSCS program. According to Ty, the prestige hierarchy between the BA and BS is so ingrained in the culture at State U. that it often goes without saying:

> I think definitely there's some tension between the BS and BA…[they're] like, "Oh, we're doing all this hard stuff that you don't have to." Sometimes I kind of feel that sentiment. It's not enacted by the people I'm with, but I think sometimes that sense is out there. So sometimes I feel I'm not as CS as them.

When, during the member checking process, I asked Ty to share more about the feeling of not being "as CS" as students in Engineering, they responded, "My life isn't just CS, it's CS and humanities (which is somehow less legitimate), or I'm not as technically smart/experienced/confident as [the BS students]."

Stephanie felt "uncomfortable" in her lower-level CS classes because she perceived that everyone else was learning and understand things faster than she was: "It made me feel bad that other people could just do [their homework assignments] alone in their rooms, and I have to sit there in office hours and just get help all the time." She said that in those lower-level courses

there's "only one way" to understand the material whereas once she started taking advanced classes, "there's so much diversity in the way that you can express your knowledge", and that diversity made her feel more motivated and confident in her CS skills.

Daphne avoided going to her professors because she was afraid they would perceive her questions as being "dumb"; she also got a sense of CS professors as being not very friendly or inviting, so instead she went to her peer teaching assistants with her questions, who she said, "never made you feel like it was a dumb question." Allyson described posturing by some students who were part of a clique who had graduated from the same prestigious, STEM-focused high school, which is a feeder for State U. Engineering:

> It's like they know they're smart, they know they had these opportunities because they had a lot of capstone projects… But [they] don't realize the kind of privilege that they had that I didn't really get to experience, and they always talk about it.

Several participants mentioned that students who study more technical subjects, and subjects that are more closely related to math and science, are seen as smarter than students who study the liberal arts and humanities. Gina shared, "people assume you're smart if you're in a technical major", and that often includes how students in non-STEM majors view her as a CS major. However, she doesn't buy into that narrative: "[CS] is just what I like."

Computing Culture

I told participants that I was interested in understanding how the culture of computing at State U. may or may not have influenced their career pathways and invited them to share their observations and experiences within CS and at State U., more broadly. Their responses echoed several themes in prior literature on computing culture, including aspects of "Geek" culture and

an atmosphere of intense competition, with an emphasis on software engineering as a career destination.

The "Typical" CS Major. Participants described what they saw as differences between CS students at State U., citing "the stereotypical engineer" or CS person as their point of reference. Collectively, participants described the typical CS major as someone with the following characteristics: white, male, introverted, super technical, speaks up class, is confident, works on CS projects outside of class, completes course assignments quickly, and wants a career in software engineering at a big tech company.

Gina described the "typical CS major" as "people who want to work for Big Tech companies or start-ups in very technical roles [and] who work on CS projects for fun." She made a point to tell me that she does not see herself as the typical CS major. She explained:

> I never really had intentions of going into a CS field and just did it because it's needed in the world, I guess…I've never done a CS project outside of school, but there are some topics that I really do enjoy, but not something that I would probably want to pursue as a career.

Gina described a friend who she saw as the "typical" CS student: "[He]…had internships with Amazon and now he's working for Facebook and would do coding outside of class and have his own projects [and] be able to do the assignments really quickly." She went on to say:

> And they tend to be more introverted, I would say, which is how I can probably guess from the beginning, if people are more introverted or extroverted, because I feel there's people... I don't really consider myself an extrovert, but I feel like I'm an extroverted introvert, but I think there are some people who are super into computer science, but they

are always doing that. When I'm not in school, I like to be doing stuff with my friends and not technical stuff at all.

Gina shared that certain CS students possess an air of confidence: “There are some people who are more confident in their abilities. I'm not as confident in my abilities because [CS] is not something I work on outside of school and I haven't had a real internship in that realm.” When I asked what she considers a “real” internship, Gina described, “an internship that was more structured for a larger company, like a big tech company.” Rose also reflected this dynamic, expressing her perception that a typical BS student “had six internships and worked at Facebook,” a commentary on both the quantity and prestige of internship and job opportunities she sees the BS students pursuing.

A Culture of Competition. Almost all participants described a competitive culture at State U., which they felt even more intensely in CS. Stephanie described Engineering culture as “intense” and likened it to other competitive spaces within State U., including the business major and pre-med. She also noted competition between girls and described “two types of girls” in CS: those that are like her and generally go along with others and let others lead, and then those “who are really aware that they feel talked down to…and compensate by being very opinionated.” Leila also described the environment in CS as “very competitive” and felt that people are just there to “get their requirements and leave.”

Sherrilyn described layers of competition at State U. where students must compete not only for jobs and internships, but also to get into student clubs. As a member of the executive board of one of the competitive student business clubs, she agrees that “something definitely needs to change, but no one's really sure how to approach that process.”

Participants contrasted the culture in CS with that of other majors or disciplines. Daphne described the nature of computing as a "pragmatic, straightforward, rigid, a less welcoming environment, and OK to leave people behind." She mentioned the CS department's non-collaboration policy, in which students are required to cite all conversations they have with other students about their homework assignments and problem sets, as discouraging collaboration with other students. Her interactions with faculty felt uncomfortable, rough, and at times, accusatory. She felt that faculty in CS were "less inviting, less friendly, and busy." Fan, a double major in Psychology, contrasted the culture of CS with that in Psych. She described that to get through CS coursework, students must attend office hours, which often have frustratingly long lines. She said that in Psychology courses students and faculty brainstorm ideas together, whereas in CS the professor more or less lecture. Allyson shared how competition culture prevented her from seeking help from her professors and contrasted that with art history: "with CS, I was too scared to ask for help sometimes, because that competitive spirit just always came back. But with art history, I was like, 'Okay, well, if I can't figure it out, the only way to ask for help is from my professors.'"

A few participants detailed the mental health ramifications of such a competitive culture. Ty described the culture of State U. as "toxic." Allyson shared that "mental health isn't very talked about in any STEM career, because nobody's doing well" and said that mindset is normalized and even joked about:

> I feel like it's very normalized. I didn't really realize it, until I would talk to people outside of computer science… It's just the constant joking around of stress or being in bad situations. They're like…joking around about wanting to die or something, and I'm just like, "This isn't a good joke to make, in my opinion."

Kerry had described earlier the “harm” she felt when professors “go about [teaching CS] in such a specific perspective that only applies to a select group of students.” When asked to elaborate, she shared how she experienced this culture on a daily basis:

> I do think that it is an everyday thing if you have to work on computer science every day in a group or go to your classes just like every day. I would definitely say some days are worse than others when they make direct comments that are specifically about women in computer science. I'm like, oh great, here we go again. But I just think even sometimes- I think this also plays into having a learning disorder- but sometimes when I go into the classroom and I see that there's just a certain culture to it, they're going over it super fast. There's a male professor who assumes that all the students have this kind of mentality like them. And then the guy sitting next to you is just unsolicitedly talking about some random STEM concept to you and it's completely wrong, but you're just going to let them be on their soapbox or whatever. Okay, fine. I'm not even going to try and argue with you about what you're saying is totally incorrect….But at the root of it, it definitely comes from a condescending nature or just like, I'm so much better. I guess I could take time to laugh at it, but it is definitely still a culture of harm to treat your peers in that way.

Allyson described how double majoring in art helped her to cope with the competitive nature of the CS program: “It’s very competitive; there’s a lot of pressure to do just as well as everyone else. That’s why I branched off to do art history, too, because it was taking time at my own pace, rather than following everyone else.” She found it difficult not to compare herself to others: “My friends are getting Amazon and Microsoft and it’s very hard to not compare yourself, just because everyone has a different experience, which I had to come to terms with.”

Ty actively resists the "competitive nature" of CS because they believe it does not come from "a genuine place." They explained: "I personally don't share State U.'s or CS' competitive nature, and when I do hear people being competitive about academics, it doesn't come from a genuine place, [rather] from a sense of wanting to do what everyone else is doing." Ty says this sense of wanting to do what everyone else is doing manifests in students' academic behaviors ("working harder than others"). This dynamic also seemed to instill a sense of constantly having to "catch up" with other students. As Rose shared, she dealt with this through ultimately deciding to focus on her own path:

> On my resume, or talking to others, it's pretty obvious that I haven't had a lot of internships or flashy hackathon victories or things like that. During my second year, I came to the conclusion that I just wasn't going to be able to catch up in that way and that instead I should focus on a path that brought me joy and prepared me, in my own way, for the workforce. So, I focused a lot on opportunities that challenged my ability to learn quickly, to work with a range of people, and to constantly change how to think about a problem.

Overall, within CS at State U. there seemed to exist a pervasive culture focused on individual achievement which influenced how participants felt about themselves and their future careers.

A Focus on Software Engineering Careers. Several participants described an almost exclusive focus on software engineering career pathways at State U., often eclipsing the many other career pathways in computing. Participants felt this narrative was prevalent among their peers and reinforced by professors and career services professionals who promote software engineering employers and alumni. Participants perceived a lack of training, education, and resources for other career pathways in computing at State U. Stephanie shared:

> The way the classes that are offered, the professors that are hired here, they all just focus around [software] development which I don't think necessarily is a bad thing, but I definitely think they could do more to help people who are more interested in other realms of tech[6] that also want to apply this knowledge in a different way.

Stephanie, who is interested in user experience (UX) design, said that UX designers often get alienated and are seen as "[they] just can't code." Referring to the culture at State U., she said that design is a "type of thinking that people don't appreciate here," and she feels that "both sides" (creative and technical) are valuable and that there's "so much room" to introduce students to other fields in computing. "I went on my own route just because the career center didn't offer. Even in the newsletters where employers are coming to talk to people. They always had software engineering roles."

Starting out in the Engineering School, Allyson says she had "software engineering tunnel vision;" but upon transferring to the College, her eyes were opened to other opportunities, like product management and UX design. Kerry also described an interest in UX and user interface (UI) design but perceived that a design career path was seen as less prestigious than software engineering careers. She described how design careers are seen as more feminine than software development:

> At first, I was just interested in being a software developer/software engineer, because that is the first job that comes to mind when you think about computer science as a subject. But then as I started to explore fields a little bit more, I started to get interested in UI/UX design, which I feel relates to being a woman because a lot of software engineers

[6] Other realms of technology Stephanie would like to see career resources for include: "UX Design, Product/project management, UI Design, SCRUM master/Agile leadership roles, tech consulting, copywriting for apps/websites, and Tech accessibility careers."

> have this idea that all people in UI/UX do is make things pretty. And I feel there are a lot of women who are UI/UX designers, and I feel that just kind of correlates….So I do feel that was one thing I did notice related to women in terms of the different kinds of fields that you do. If you're more front end, I definitely feel that reinforces a stereotype in people's head. They're like, "oh, of course, this woman in computer science wants to do things related to aesthetics." And I feel there's definitely this notion where that's not "real" computer science, even if you use the exact same programs and coding languages to build it.

Stephanie shared,

> Having that mindset that software engineering is top tier work compared to other fields within tech is doing a disservice to the people going out into the world because …at the end of the day, when you're working on real world projects, it's not only engineering priorities, it's not only having to make it run faster, having it easy to build. It's all these business needs.

Leila feels that software engineering is oversaturated:

> [Software engineering] was what everyone knows the most about when they start off in CS. It's oversaturated. I feel like a hypocrite because I'm doing software engineering, but I think maybe that's how we're primed. That's what we're primed to want to do in college. We do have elective classes like cyber security and things like that, but essentially, it's where everything's focused on the path towards something related to coding or software engineering.

Leila relates this to the culture at State U.:

> I think it's more the university culture. When you see more people doing software engineering, it makes you feel like you want to do that, or you have to do that, to do well. I think a lot of it is related to State U.'s culture that is very focused on a specific path.

Finding Community Within, and Outside of, CS

Most participants in this study reported a lack of community within CS at State U. For some, the lack of community reflected the white and male-dominated nature of their courses and project teams; for others, the culture of competition was a barrier to forming community in CS. Some felt that it was the CS department's responsibility to foster a sense of community among students and faculty. Several participants felt that career resources for them were lacking, and despite the fact that there is a career center for the Engineering school that welcomes all CS students (BA and BS), most of them did not take advantage of that service. In response, all participants in this study forged strong communities outside of computing.

Rose shared: "It's a little embarrassing, but I haven't made any friends through my major or being in my major classes…I met [my friends in CS] outside in some other capacity, either in my dorm first year or in Econ class." She thinks this is due to the competitive culture in CS:

> There is a bit of a competitive culture within CS. I know that I am usually a bit nervous during first meetings and self-conscious about my lack of experience. A lot of our classes also tend to introduce group work only in the back half of the class or make it optional.

Rose noted a "pressure on individual performance," which she feels inaccurately reflects "an underlying assumption that no one else needs help or wants a friend." Rose had a "gaggle" of male friends that were mostly studying in the business school. She experienced a sense of "isolation" in CS and felt she lacked the network that men students have:

> The disadvantage of being a woman in CS is that you don't have as much of that network that other students might have, that network of peers, that network of other adults who've talked to you or tried to push you in this direction. You're lacking a lot of that [in]tangible help that is really important.

Rose joined the Women in CS club where she has had the positive experience of meeting other women who will be moving to the same city as her after graduation.

Ty found community both in the BA and BS programs, saying that was helpful to know that they were not "struggling alone":

> The culture at State U. is kind of competitive; we'll brag about not getting to sleep because we're working hard and sometimes it can be kind of toxic, but it did help going to the office hours late night with [peers].

Although Ty found it difficult to connect with their male professors, they were able to build relationships with a couple of women CS professors and shared how helpful that it was:

> Having them teach me topics they're passionate about, growing a closer relationship, going out to lunch and kind of getting that behind-the-scenes or acknowledgement that even though we show up or just as good there are things that we've had to go through because of how we present. And so, I think that was really nice too, to hear more about it, because I think sometimes in class [gender and racial issues] don't really get acknowledged. "Everyone's equal," but that doesn't mean equity.

Ty talked about moving from a stance of "self-protection" at the beginning of college when they were first coming out, to one of greater confidence in their identity, especially regarding joining groups for women in CS:

> I feel comfortable enough in my identity that I'm like, "Okay, I'm non-binary, but these things also affect me, and I want to get that community [of women in CS] and maybe help even other people in them." So, I think because of that, self confidence in myself has grown. I've been able to engage with those communities more and register for conferences and do hackathons with them or go out with them.

Ty found a mentor at their internship who was a queer person of color, and that made all the difference to their experience. Daphne said that as an Asian woman, she closed herself off to interactions with students in CS: “I decided to stop interacting,” She said she “never clicked” with other CS students and instead, got to know people outside CS. While her interactions with CS faculty were “narrow,” she experienced positive interactions with econ faculty: “they tried to get to know students.”

Miriam found solace in the Jewish community through the university’s Hillel organization. While she said she never felt isolated, she attributed that to having one good friend in the CS program, and just “stuck with her.” Leila found community and support through the university’s cultural and religious organizations, particularly the Muslim Student Organization; she said she felt alone in CS and that “people don’t make friends in class.” Gina, a double major in math and CS, didn’t make connections to the math or CS community and shared that she felt “weird being a tech major in the college.” She made connections through her sorority and the student organization she helped start. It was through that organization, Girls Who Code, that Gina felt “connected with other girls” and “empowered to do the major.”

While one participant (Sherrilyn) enjoyed being around other students from her hometown and seeing “familiar faces” and having people with whom to “struggle together,” others noted cliques forming, especially among students who graduated from one particularly

well-known and prestigious high school. Kerry acknowledged how important it is for women to be friends with other women and for women students to have role models and mentors that can provide recommendations for classes and career advice.

Fan said she felt lucky to have had "smooth interactions" in her group work, as she heard from others about their negative experiences. She found that "meeting like-minded people" gave her a sense of community and support, and found that community through the Chinese student association, the fencing club, and hackathons. She found it especially helpful to have met and done research with a woman faculty member, who has served as a mentor and role model for her. Kerry said that her experience would have been "isolating" had it not been for the student organizations she joined, particularly the Asian Student Organization and Women in CS. She also found support in upper-class BACS students and other women of color, who offered "unconditional support." Allyson also found community through the Chinese Student Association, Women in CS, and hackathons.

An Asian woman, Daphne feels the intersectionality of her identities prompted her to "close herself off" to others in computing:

> I felt like that combination was not as well-represented as some other cultures, identities, races that specifically. So maybe it narrowed my interactions in general, looking back, I probably could have broadened my perspective and gotten to know more people if I opened myself up a little bit more, but I guess I chose not to, and ended up closing myself off a little bit in terms of looking back, just reflecting on the four years.

Daphne felt that her lack of confidence and a few "not so pleasant interactions" with CS professors prompted her to close herself off to additional interactions with both professors and students. She thought, "'Well, the [interactions] that I initially had weren't as meaningful as I

thought. So, I'll just cut my losses here and stop trying to pursue additional ones. It's more effort for me.' So, I decided to stop interacting." She cites a specific example of a time when she sought a professor's help with an assignment, and his response was to the effect of, "you're seeking out answers, why are you asking me this?" and she felt he was accusing her of trying to cheat on the assignment. After that "unpleasant" interaction, she assumed other professors would treat her the same way, so she stopped seeking help. In contrast, Daphne had a very positive experience with one of her Economics professors, which she said "boosted" her confidence.

Unlike many of the other participants, Allyson felt that most of her CS classes were very collaborative and enjoyed working with other people; she found the other students in CS to be fairly collaborative and helpful. Miriam shared her thoughts on how State U. could better support students in CS, in terms of their career:

> I feel like fostering more of a community in the CS major would be great…There's other majors who have banquets and who have meals or something. And I feel like, especially between the BA and the BS, there's nothing of that sort. There's no end of year celebration or anything, where there's some food and you can meet people and can schmooze with your professors. And there's no lunch and learn with professors or something. So, I feel like those could be really cool in fostering [a sense of community]. Especially when I saw my other friends and they were like, "Oh, I'm going to meet some of my friends for this." And I was like, "I don't even have many CS friends. I don't know how you meet them."

Some students wondered if the career training and preparation that students in the BA and BS programs were the same. Rose got the sense that BS students have more access to career resources than the BA students. Ty felt that the career resources for Engineering students are

"more obvious" because there are posters for career events on the Engineering school pathways. Despite career events at State U. being open to both BA and BS students, Ty was reluctant to attend engineering-branded events unless they went with a friend. Ty also assumed that Engineering career advisors would be unable to help them explore their creative interests, and therefore visited the general career center instead. What is clear is that all participants longed for community and made that happen wherever they could. However, the fact that computing culture made it difficult to form relationships was a further source of marginalization that exacerbated their sense of being outsiders as BACS students.

The Evolution of Career Goals

I engaged in a process of *journey mapping* to better understand participants' trajectories through college and the significant events and interactions that prompted their career goals to evolve, and how they made meaning of their career development. I observed three overarching trends among the 12 participants' career trajectories that reflect practical, relational, and circumstantial aspects. These trends were not mutually exclusive; indeed, many participants shared features of all three trends. However, for the sake of elucidating these findings I have broken them down separately here, with vignettes from various participants that illustrate each trend.

For the most part, participants navigated their career journeys with advice and support from their peers, their families, and a network outside CS. There was a general sentiment that while the BACS program prepares students for the same type of jobs as the BSCS program, participants felt they were lacking formal career guidance for navigating things like finding an internship, interviewing, and general career direction. All felt a strong pull (or push) toward software development, with few resources or connections for students interested in other career

pathways in computing. Participants often noted a lack of community in CS and having to pursue their career interests on their own. Furthermore, students who lacked confidence sometimes held themselves back from applying for positions they might otherwise be qualified for, due to a perceived lack of knowledge or experience.

"I Wanted to Have Job Security": Practical Considerations. Almost all participants pursued a major in computer science for practical reasons; they knew there were good jobs for college graduates with coding/computing skills and had heard the industry pays well. For a few participants, practicality was also a salient theme that was inherent in their choices of where to do an internship and what kinds of jobs to pursue after graduation. First-generation college students were especially likely to emphasize a stable job with good pay in their quest for post-graduation employment.

Kerry pursued the CS major because she saw that it was "in demand" and figured that no matter what career path she chose, it would be a useful degree. While she didn't start with a career plan; she "was thinking about where [her] career would go related to what kind of major [she] had" before she entered State U. Being the child of immigrant parents also influenced her major choice and early career goals:

> Being a second-generation immigrant, I'm thinking "college costs a fortune. I need to make sure that if I'm going to go to school, I should do something that will give me a direct line to a career." I wanted to have job security, as well. And I do really like CS as a subject itself, but the benefits of it, like job security and just being really in demand, is something that appeals to me, as well.

At first, Kerry was interested in software engineering because that was the first job that came to her mind when she thought about what she might do with a CS degree. As she began to explore

her career options, she grew interested in UI/UX design, but soon realized the perception of UI/UX designers is that all they do is “make things pretty”. At that point, she started to lose interest in UI/UX design: “I'm sure [that connotation] definitely played a part, but also, I think it was more about the fact that I wanted to do something a with more programming.”

Kerry also had a negative experience in a Human-Computer Interaction (HCI) course, where the professor denied her request for a disability accommodation (she has had to deal with a mental illness and a learning disability throughout college). These experiences nudged her to reconsider her interest in programming. Kerry was unusual for this cohort for not having completed an internship (she finished her BA degree in only three years, and the intervening summers her options were limited due to the COVID-19 pandemic). Thinking that her lack of internship experience would be a hindrance to some full-time opportunities, she applied only for full-time roles that did not require prior internship experience.

After she secured an offer to work as a data science analyst at a mortgage company, Kerry began to awaken to an interest in data science:

> But then I got a job offer for recent college graduates specifically. And in this program, we do very diverse things. There's software development and there's some front end, some back end, but also… data science. So, I am doing some software developing, but I am starting to get more and more interested in data science, just because of everything I've been hearing about it being really hot. And as I mentioned, I really like having a lot of job opportunities at companies that I would like to work for.

Kerry is excited about the prospect of being able to use this first job out of college as a springboard to other career opportunities in the future and is looking forward to exploring the “hot” field of data science.

Coming from a refugee family, Ty chose CS, in part, to satisfy their parents, who wanted Ty to have a financially stable career. Being able to switch from Engineering into CS in the College allowed Ty to have the best of both worlds:

> [My parents were] like, "Oh, if you're out of the E-school, then what are you going to do?" It wasn't a very technical one to one, right? Like with a job. So, they're like, “if you're not a doctor or an engineer I guess you could be a lawyer. Something concrete like that.” For me, that's also why I slotted into computer science, along with I like doing it, and also being able to see there's creative aspects I can pull in with front end work and things like that.

Ty talked about their internship with a large banking company being a “big shock,” particularly as a first-generation college student learning how to navigate the non-technical skills required in the workplace:

> Knowing how to talk to people, work with people, advocate for yourself, write a professional email, know how to research…to know your worth or salary/negotiate/manage situations, network! These are all things that aren't technical and aren't taught unless you know people who can and want to teach you, which can disadvantage people from first-generation and/or low-income students, or those with immigrant parents.

Despite the initial culture shock, Ty had a positive experience in their internship and found it affirming to their nonbinary identity. Ty will be returning to that organization to work full-time after graduation.

Helen, whose parents both have associate degrees, came to college wanting to pursue a major that had practical implications for her career:

> [My parents] are older so they've always tried to teach me the things that I might need earlier than most other kids…. when I was applying to schools and thinking about a major, they were like, “look, computer science majors and tech industry makes a lot of money.”

Initially she thought about teaching CS as a career, as the idea of integrating technology with education interests her, but her parents told her, "No, no teaching. Do that when you're retired. You need to make more money than that." After completing her bachelor’s degree Helen plans to spend the summer doing a software engineering internship before returning for her master’s degree in CS in the fall. The internship will pay her more than she’d ever imagined:

> As an intern, I'm going to make $45 an hour. That is more than my parents have ever made, individually. That's *wild*. I would say, I don't know if it's like an awakening to the adult things in life, but just everything is becoming a reality. It's obviously affecting me…It's definitely changing the way I feel about career moves.

Helen had the same internship for three summers with a government agency and feels a sense of disappointment that despite being on the technology team, she got no technical experience in that internship. She was the only woman on the technical team and ended up primarily taking notes for meetings. She said she kept going back each summer because the opportunity paid well and she got health insurance, which were important to her since her parents hadn’t completed four-year degrees and struggled with how far they got in their own careers. Going forward, Helen does not want to “get stuck like [her] parents.” She wants something practical, a “better career.” In reflecting upon her future, Helen is nervous about “botching” her career and is concerned about the practical implications of weaving together marriage, family, and a career.

"I Learned So Much More in My Extracurriculars": Relational Networks. Several participants' career trajectories were shaped primarily by the relationships they built and the social networks they engaged in throughout college. Oftentimes those relationships were created through networks that intersected with their CS program, but not through the CS program itself. For others, the lack of relationships – or the sense that they were on their own to chart a path forward - played a significant role in their career path.

An international student from China, Fan learned about State U. through a listing of "good schools in the U.S." and came to State U. eager to explore various majors. While she didn't have a clear career goal entering college, she loved her introductory CS course and decided to double major in CS and Psychology. During her first year she participated in a hackathon with some friends in which they built a website for course selection, an accomplishment she feels proud of. In her second year, Fan learned about a project through one of her friends' social media posts about an opportunity to work on technology development for a mental health startup. Since she was unable to return to China during the COVID-19 pandemic and was isolating and doing online courses at State U., Fan figured that working with the startup would enable her to get to know people and at the same time allow her to explore her interest in mental health.

Fan also began to seek out research opportunities in her second year, saying that "research is a big thing at State U." She reached out to her advisor/professor and secured a research position in her lab. Fan says that experience "opened the research world" to her. That initial research position segued into a second project that made Fan decide to pursue her doctorate in CS, rather than seek a job as a software engineer after graduation. Fran credits her advisor - also a woman of Chinese ethnicity- with serving as a support and a role model for her.

Fan also spoke about her parents as supportive in her career goals. They initially had some concerns about her pursuing CS as a career, but she "stood her ground" and persisted, despite their concerns. She feels fortunate that her parents do not hold traditional gender views around marriage, family, and work, and that they have given her space to pursue a career in CS. Still, she is seeking other women in CS, especially ones who have pursued their PhD, to "talk about the feelings of working in a male-dominated field." While she enjoys research, her career goals after her PhD are murky, and she is keeping the option of becoming a software engineer on the table. She reasoned, "it's never too late to pursue software engineering."

Although Sherrilyn comes from a family of computer scientists and majored in CS for that reason, the people she met through her extracurricular involvement prompted her to "shift gears":

> I come from a family of computer scientists, and so came into college with an idea of computer science but wanted to branch out. [I] ended up joining a couple clubs and falling in love with them, so at a certain point I kind of shifted gears.

She had an older brother who had graduated with his CS degree, so early on she figured she would do "big tech," because that's what her brother and all his friends talked about:

> I think the day that I stepped on [campus] I was still really heavily considering computer science. I think at that point I looked up to my brother a lot for inspiration and…at that time, he was doing an internship for Amazon, and him and all his friends were like, "Oh, big tech, that's where you want to be. The work/life balance is so great, there's so many benefits, you should really look into that." So, I think that was definitely on my mind when I first entered college.

But in her first semester, some of the other women in her residence hall were going to rush a professional business fraternity, so she decided to join them. Sherrilyn recalls:

> I didn't really have anything else going on and I wanted to meet new people too, so I was like, why not? This seems like it'll be really interesting. I had this idea of computer science, but I wasn't necessarily locked into it, and so I think that helped with my mentality of I really do want to try and branch out and explore everything that college and this opportunity has to offer. I didn't want to pigeonhole myself down one path.

After getting accepted into the professional business fraternity, Sherrilyn tried out and applied to a few other finance-specific clubs and was accepted. “From there I just got so much more exposure to finance. Just met a ton of great people, just got a lot of mentorship.” She recalls that within her finance circles, “everyone around you is recruiting.” By the fall of her second year, Sherrilyn was no longer considering CS as a career, and decided to apply to the undergraduate business major. Despite not being accepted to the business major, she has still been successful in securing finance-related internships and is planning to earn her master’s degree in commerce before she pursues a career in investing. Sherrilyn credits the professional business fraternity as the most important factor in her career development; she felt that through that fraternity she had an “entire web of people” supporting her. She summed, "I learned so much more in my extracurriculars compared to my classes."

Like several other participants, Allyson is a first-generation college student whose parents immigrated to the U.S. from Vietnam. When she was applying to college, she felt pressure from her family to “do well,” and to get a job right out of college. After talking with some upper-class friends who had switched from Engineering to the College, she made the switch to the BACS program so that she could double major in CS and Art History. During her

second year, she felt stuck. Her coursework felt hard, and she wasn't sure she wanted to continue in the CS major. But through her connections in the Chinese Student Association, she was inspired to stay because so many students in the CSA are CS majors. She says that's why she "managed to stick through" the CS major, telling herself, "if [other students] are able to do it, why can't I?"

Allyson didn't consider herself "someone who looked for internships" but learned about the importance of doing internships through talking to other students. Internship searching was a very scary and draining process for her, and she was "stressed constantly." Furthermore, lack of confidence and imposter syndrome kept her from applying to certain positions: "I had the mentality, 'I'm not going to get Amazon.'" Allyson struggled with mental health issues brought on by the COVID-19 pandemic. She found it hard not to compare herself to others and felt that she was going about things "later than everyone else." She did not reach out for help with career development; rather, she "just dealt with everything on [her] own." During her third year she landed an internship at a smaller company and really enjoyed the experience, and ultimately decided to stop comparing herself to other students who had internships with bigger, more established tech companies, reminding herself that "everyone's on a different path." She cites her own resilience, saying "I am doing it at my own pace" and "I'm hard-working, I should be proud." At the time of the interview, Allyson was still seeking a job.

Stephanie shared how her identity as an Asian-American woman and first-generation college student shaped her college experience and "confusion of navigating a career":

> I'm Vietnamese, specifically. And I guess that's a really big part of my identity because that was just how I grew up. I was really a part of the Vietnamese community back [home]. So, I went to Vietnamese school and went to a Vietnamese church and here at

> State U., I joined the Vietnamese Student Association. So that was a big part of my college experience as well, and it so happened that a lot of the people in that organization were also computer science majors.
>
> So that was I guess a connecting point when I hung out with the other Vietnamese students here, they were also doing CS work and stuff like that. And I guess more specifically, I also identify as first-generation college student because my parents were refugees when they came here. And I guess that also adds to a little bit of the confusion of navigating a career and knowing, I guess in terms of pay, if I'm getting paid fairly or if this is normal for other students because my parents never went through that.

Stephanie's parents have been influential, wanting her to have a secure path. Her older brother encouraged her to try CS, so she chose the BACS program because she is not fond of math and felt it would easier to switch out of, if she didn't like it, than the Engineering school would be. The BA also allowed her to explore other disciplines in addition to CS. Stephanie loves learning about people and chose to double-major in Psychology. During her first and second years of college she was not really thinking about a career; she simply "was just trying to survive." She assumed she would pursue a career in software development, because in her experience, "that was the only path that State U. really focuses on." However, she did not feel "super hyped" about software development, and felt like she was different than her peers in CS:

> I wanted to look for something still in tech and I wanted to tie in everything else about my personality. I'm a pretty creative person, and I [enjoy?] working with people and…the stereotype of working in a tech job or a computer science job is you don't talk to anyone. You just go on your computer in the dark and you just do your work by yourself. And I didn't really want that necessarily.

Her brother suggested UX “because it’s still in tech, but it works a different part of your brain, and you express your knowledge a little bit differently.” Stephanie then found a UX internship through a local matching program and really “clicked” with it. Stephanie recounts that she did a lot of “self-learning” through that first internship and gained confidence knowing she was the only one at her organization who could speak on the topic (she was the first UX intern at that organization). She recalls she had a “rough time” deciding whether to stick with that internship, or to find a new one the following summer:

> It was my first internship that paid me not minimum wage. It was $18 an hour which at the time I was like, "Wow, that's amazing." It's more than 10 [dollars], which I would get anywhere else. And - this is also where being first generation- not really knowing what is a good company and where I should stay or when I should leave because, "Oh, they're nice to me."

Stephanie’s brothers convinced her she could do more; but at that point, she felt on her own for interviewing, which felt scary, especially “the uncertainty of how to present myself, being unaware of what questions they would ask me, having to communicate/set up times for interviews and waiting for responses....general worries about whether I was fit for roles.” She says that is when she began reaching out to people on LinkedIn: “One of my biggest things is just making connections.” As she continued to reach out to people, she “started discovering more about the industry and what [she] want[s].” And then, some of those LinkedIn connections turned into interviews:

> That was the most fun part of trying to look for a job, and one of the most fulfilling… just talking to real UX designers for the first time even if it's through an interview. I was getting to talk to directors of design companies and then really higher up designers which

> I never had access to before, and the only reason why I could was because I put myself out there to interview with them and they gave me a lot of advice and I took advantage of asking them questions at the end just about their career and how they got there. So, it's just really putting yourself out there because the school wasn't going to do it for you.

Stephanie felt that she did not have anyone to turn to at State U. for career support. She did not think Engineering career services was for her; from what she could see, they only showcased engineering employers. She felt she had to go outside State U. for support; and feels that a lot of her success was from trial and error: “I went my own route.” She found support, instead, through alumni mentors and her older brothers, who had graduated into successful careers and could provide both career advice and connections. Ultimately Stephanie’s networking paid off in the form of a UX design internship at a software company, where she felt “validated in [her] experience of being a non-coder in an engineering world”:

> Being a part of that engineering team and feeling like I added something that other developers couldn't and listening to me wholeheartedly and just wanting to hear my opinions about things. It felt very validating of my experience because I feel [at State U.), UX design is seen as "Oh, you just can't code." …at Software Company [I] bring something different, just as valuable, and it's, “I want to hear from you, as well.” And that's what made me feel really confident in myself.

That positive experience led Stephanie to accept a full-time role as a UX Designer at that software company after graduation. Like other participants, meaningful interactions and relationships were instrumental in their forming and acting on career goals.

"Luck and Fortuity": Circumstantial Aspects. For some participants, the evolution of their career goals seemed to rely more on the circumstances in which they found themselves, rather than through proactive, deliberate efforts on their part to shape their future career.

Daphne came to college intending to major in biology, but quickly changed paths when she got to know an economics professor, who inspired her to major in economics. She initially had no interest in CS, but took a course at her mother's urging:

> Initially coming into college, I didn't think that I'd ever touch computer science. I was just leaning away just because I couldn't see myself as a programmer, but my mom wanted me to at least try it. I wanted to because I know it's up and coming. Everybody [said] it'd be useful whether I majored in it or not…but then it ended up manifesting into something that I enjoyed a bit more than I had anticipated going in.

Daphne's mother helped her secure an internship conducting research for a local organization during her first-year summer (2019). The following summer she had two internships lined up, but both were cancelled due to the COVID-19 pandemic. During her third year she struggled to find an internship, so ended up going back to the same place she interned her first year, this time in a software development capacity. At that time, she was expecting her career to lean more toward economics, but she wanted to give software development a try. Through the internship Daphne worked on a software application with her manager, and she credits this experience with building confidence in her CS skills:

> I think that was probably the biggest turning point for me … just seeing that process go from start to finish in terms of acquiring the requirements from the customer, doing the beta testing and actually coding application, both client and the backside and everything like that. I guess that opened my eyes to, maybe I don't want to fully become software

> development in terms of my career, but I can program. This is something that improved my programming skills, for sure.
>
> So, I felt a bit more confident in, maybe I don't need to focus *solely* on Econ anymore, maybe I can broaden it a bit more and potentially look at more careers that would be more computing based, which I don't think I would've accepted the position that I did in terms of my full-time job if I hadn't done this [internship] because I would've lacked confidence in my computing skills and I would've been like, "I can't do that. I'm going to steer maybe in a different direction, maybe more Econ focused." Just because I was more confident in that field. I think now that I had this, it was definitely helpful in realizing that I could pick a career that was computing based.

Despite having a 3.9 GPA, Daphne thought her "skills weren't good enough" to join computing-related clubs and feels if she'd had the software internship earlier on, she might have gained confidence sooner and joined a computing club. She did not use career services and shied away from asking faculty for help as she saw them as having only academic experience and assumed they couldn't help her with her job search.

After graduation Daphne will be working for a consulting firm in a role that is a hybrid between software and consulting, and she is grateful for her software development internship for helping her realize she could have a career in computing. However, she still feels less confident in CS: "If [company] hadn't picked that hybrid role for me, I would've probably picked the business analyst for Econ [role] because... I'm still a bit more confident in Econ…so I'm happy the company matched me with [the hybrid] role, instead." As for her future career plans, she says: "I'll just go wherever my career naturally flows."

Gina, a double major in CS and mathematics, came to State U. wanting a government career and felt the CS major could help with that. She started out taking a few courses and just "stuck with it." Gina felt out of place as a technology major in humanities classes and thought about switching to electrical or computing engineering. She never really liked coding and saw that there's "so much more" beyond software engineering and wasn't sure the CS major was for her. However, she had pressure from her dad and reasoned that "tech skills do help." The internship search felt hard to her, and she didn't apply to internships her first year because she felt underqualified: "I just wouldn't even end up applying because I didn't think I was qualified for it. And I've never been confident in my coding skills. So, if it was something like that, I just wouldn't apply."

Gina ultimate did secure an internship, which allowed her to gain skills and grow into a management position. Her senior year, she received got a lot of messages about consulting jobs through the school's career platform and that is how she connected with her full-time opportunity: "September of (senior) year I got a message on Handshake from [consulting firm] and I just looked into the opportunity… and it seemed interesting. So, I was like, "Oh, I might as well." Gina only ended up applying to that one position and plans to work as a cyber risk analyst at the consulting firm. Going forward she hopes she'll be doing a mix of technical and client facing work.

Leila applied to the College of Arts & Sciences at State U. because she knew nothing about the Engineering School. At that time, she had no interest in CS:

> I had a lot of interest in psychology. And I think the concept of CS came up, but I never had an interest in it in the beginning….In my first year of college, I wanted to major in cognitive science [and] one of the required classes was intro to programming. I just really

> liked it…Over time, I was like, OK maybe I'll take cognitive science with a focus on CS, because I also really liked psychology. But then I felt like I didn't really know what I would do with a cognitive science major, even though I could probably pursue similar things related to CS. Then eventually, I just said, 'I might as well just major in CS.' And I really enjoyed it.

In addition to enjoying her CS courses, Leila was heavily influenced by her family, who saw CS as leading to "a good career." By the time she knew she wanted to major in CS, she felt it was too late to switch to the BS program in the Engineering school so "just stuck with" the BA. She explored various facets of computing, trying out UX design, software engineering, and cyber security. She had two internships; the first was unpaid and not a great learning experience. The second, a paid internship, was an "impactful professional experience," but she was the only woman on the team and felt alone. The job search felt disheartening to her; she felt she had to be "perfect" to be successful in interviews. She worked with central career services but said they were not that helpful; she is not sure why she did not reach out to the Engineering career center. Leila received a return offer for a full-time position as a software engineer with the global retail company with whom she interned and considers herself "lucky." Leila feels that her career "just ended up how it did."

Miriam came to college interested in exploring psychology, cognitive science, and environmental science. She says she "kind of fell into" CS after taking Intro to CS:

> I feel like I kind of just fell into it once I started [Intro CS]. I was like, "I don't know if I'm going to want to do something with computer science in my career necessarily," at that time. But then I was like, "It's still a really good hard skill to have and to learn, and

> just the degree to have." It adds a lot of credibility to your resume. And I know I'm probably going to have to do something with coding in my career, so may as well.

She got involved in a couple of research projects; one was psychology related and the other CS related. It was her CS research experience that led her to an interest in UX design:

> That CS research …. was my first introduction into UX design. I had no idea what the field was before. And they were just having me choose colors for the website based on what these colors would mean, what these colors would show to the viewers of the website, or the users of the website. And making sure that they were accessible for everyone and people could read everything. And where you should put different buttons and things, so that it makes intuitive sense for the user. And I was like, 'This is really cool. I've never heard this before.'

That research experience led her to take a UX design course outside State U. (she had heard negative things about State U.'s HCI course) which led to her doing an "impact project" for a local company where she "finally got to blend that sustainability and CS passion." Like others, Miriam struggled with the internship search. She faced rejection, which was upsetting to her, and she wondered if she simply did not have enough experience. She cited tangible projects outside of class as helping her to build her portfolio. Her final summer before graduating she got a UX internship through an email she received from her pre-college network, which she considers "lucky."

Miriam described the job search process as "a grind" and did not find much help through career services. Her interactions with CS faculty were limited, partly due to COVID and Zoom fatigue, but also because she didn't think they could help her: "I haven't met a professor who is really interested in sustainability tech, and what connections do they have for me?" At the time

of the interview, she was still looking for a job and was not feeling very hopeful about State U.'s ability to help her find a job with a climate tech company:

> Ideally, I'd be a UX designer or a front-end engineer at a climate tech company…but State U. doesn't really have good connections in that specific field…they have CS, and they have science & sustainability, but most of the science and sustainability jobs that they present or are networked with are policy…and that's not what I want to do.
>
> And with CS, it's mostly jobs with banks…honestly, if I don't have a job by the summer, I'll probably just apply to those and get some experience under my belt. But I'd rather work for a company that has an impact on sustainability, because that's important to me.

Miriam seemed willing to pivot to a less desirable, but more easily attainable, career goal if she did not gain traction with her first choice of career by a certain point.

Rose considers her entry into CS "a winding story;" she was a strong student in high school and had been told she was "a successful STEM student" but had not been exposed to engineering or CS. When she arrived at the College of Arts & Sciences at State U., she was aware of her interest in "quantitative things" but says "I sort of thought that wasn't really a path for me." Initially, she leaned toward majoring in foreign affairs and economics but felt like something was missing: "I was looking for something that would be a bit meatier on my resume." So, she took an introductory CS course, and then "just liked it so much more than everything else" she'd been doing.

She was not really thinking about careers at that time but had several friends pursuing the business major who were talking about careers: "Once you enter college you start to hear about people's professional goals or the jobs they're going to have and you don't really know what any of it means, other than, 'wow, I know nothing.'" She credits a lot of her career path to "luck" and

friends with know-how: “A lot of it is just luck and fortuitous that I had friends who knew how to apply to stuff on Handshake or who told me about LeetCode, which gives you practice coding questions for interviews.” She also had a positive experience with a calculus professor who recommended her for a learning assistant position, which helped her “reinforce basic conceptual quantitative skills” and work on her non-technical skills.

Like several other participants, Rose felt a lack of career guidance and a network. She was confused, and her big brother ended up helping her. To prepare for interviews, she learned from friends who knew how to prepare. She was unaware of the career services in Engineering. Getting her first internship felt like a big deal. A double major in math, she felt that the math department was a “lifeline” and experienced it as a positive environment. She downplays her technical acumen and says that her career success to date has been through luck. She’s planning to return to her summer internship for a full-time job after graduation, saying it offers “unparalleled learning experiences.”

For the participants who were oriented to circumstantial aspects in their career development, what came to the fore were the ways they made meaning of their career journeys. While these students all displayed a sense of agency in working toward their career goals, their narratives downplay their own agency and instead attribute their career situation to “luck” and external circumstances. Whether they were oriented toward practical considerations, relational networks, or circumstantial aspects, all the participants in this study had a strong sense of where they wanted to go with their careers. While they did not always have a clear pathway to achieve those goals, those goals emerged clearly in the student interviews.

Faculty Interview Themes

I interviewed four faculty members in State U.'s CS department who possess in-depth knowledge of the BA program. The faculty I interviewed all have been champions of diversity efforts in the department in different ways. The primary objective of the faculty interviews was to gain insight into the formation of the BACS program and its positioning in the university's organizational structure. I also encouraged faculty to share their thoughts on how BACS students compared to BSCS students and what careers both programs prepare students for. Finally, I asked faculty to comment on the department's diversity efforts, particularly related to increasing women's enrollment in the program. The interviews resulted in contextual information about the CS program at State U. and yielded insight into how faculty view gender issues in the department. The findings below are organized according to five themes: Organizational Tension, Prestige Hierarchy, Gender Diversity, DEI Initiatives, and Student Career Pathways.

To mask their identities, I have created pseudonyms for each of the faculty members. Charles was hired as teaching faculty and has had numerous administrative and service positions, including CS curriculum committee coordinator and director of diversity, equity, and inclusion for the CS department. Adam was the founding director of the BACS program and served in that role until around 2012, when Bob took over from him. Bob is the current BACS program director and has been in this role for about a decade. Frank served as CS department chair for over a decade, stepping down in 2021.

Organizational Tension

Each of the faculty members I interviewed brought up the relationship between the Engineering School and the College of Arts and Sciences. Furthermore, they discussed the nuanced connections between computer science and other disciplines. While, by all accounts, the BA program originated for the institution to offer a liberal arts-focused CS degree, faculty voiced

strong opinions about the disciplinary status of computer science. Take, for example, the connection between CS and mathematics. Frank shared that in 1984 what was then the department of Applied Mathematics and Computer Science split into distinct Applied Mathematics and CS departments, causing some "acrimony." Adam reflected this historical connection to mathematics, saying that the field is nowadays more about language than about math.

Charles voiced disapproval about a more recent administrative decision by the School of Engineering and Applied Science to drop the "…and Applied Science" from the name of the school (perhaps not formally, but at least in everyday usage). He referred to this as a "marketing shuffle" by a former dean, who "dismissed any conversation about it." Charles felt this was an "insult to applied science" and emphasized that "CS is *not* an engineering discipline." Frank shared a similar sentiment, claiming that CS is "different than other engineering [fields]." Not only does Charles believe that discourse aligning CS with Engineering is insulting to applied science, but he is also concerned it might have a negative impact on students' sense of belonging in CS, especially for students in the BA program:

> I do think there's some incidentals…when we say, "we follow the Engineering School's add/drop deadline" and "we are at the School of Engineering"…And I think there's a lot of this messaging of State U. Engineering: "the E-School," "the E-School's deadlines," "E-School's policies are the ones that apply," "we're an E-School department" –and that has to have a cumulative negative effect if you don't identify with that.

Beyond the disciplinary boundaries, several faculty members cited internal politics between the Engineering School and the College, largely centered around budgetary concerns. Charles talked about messy internal politics, strained social relations, budget issues, and the

financial arrangement between the schools. He said it was a “complicated arrangement” and felt that stakeholders in the two schools were not communicating properly. He believed it was “easy to offend people” and that administrators in the CS department were working on trying to “smooth things over” with administrators in the College. Adam echoed a “political lack of comfort” with the BA program overtaking the BS program in size, as well as administrative pressures centered around competition for resources and the university’s budget model as the underlying reason for the strained relationship. Bob, who has had the most sustained interaction with the College of all my interviewees, cited “politics and money” as a primary source of “resentment” between the two schools. He described the relationship this way:

> The relationship between computer science and arts and sciences is tricky because this is a degree program that's in their school, that's not fully administered and not at all taught by their faculty. And so that's a very strange relationship with them. First of all, they feel like they're less in control and it's just odd. It is odd. It's unusual. There's a few things kind of like this here at State U., but nothing nearly as large. The other reason it's important is because there's dollars involved; the funding of tuition flows based on students' majors and who's teaching courses. And there's been changes in these formulas over the years. But the bottom line is because arts and science students are doing the computer science major with us. That is money that's coming to our department and not to the arts and sciences. And so, while they're glad the degree exists and they are happy to cooperate with us, some of them occasionally feel like this isn't good, <laughs> this isn't healthy, because we are so large.

In summary, the faculty described organizational tension between the school of engineering and the college of arts and sciences at State U. Moreover, faculty portrayed a sort of “identity crisis”

with CS as being "different than engineering" and yet included within the organizational structure and disciplinary discourse of Engineering at State U., possibly impacting the college experience for students in CS, particularly those in the BA program who do not identify with engineering.

Prestige Hierarchy: BA Students vs BS Students

I asked faculty to discuss differences they saw between students who entered the BA track vs the BS track. Faculty were quick to respond that they saw "no difference intellectually" (Bob) but did acknowledge that a prestige hierarchy exists – at least, in the students' minds - where the BS carries more prestige than the BA. As Charles described:

> Most of our faculty say they can't tell the difference between BA and BS students, either anecdotally in class or when they look at their grade distributions or other measures…The students seem to have a much higher understanding of a difference between each other…Part of that has to do with what they have outside of [class]. So, there's a sense that the engineering students get started earlier and have something of a cohort of other students in their first-year classes…[BA students] don't have that experience…they often have the sense that they're joining a club that's already established that they aren't really invited to socially, which is a thing we don't really know what to do about.

Charles saw evidence of prestige divisions in students' "small verbal qualifiers", such as the statement, "I'm *only* in the BA":

> Students will sometimes say, "well, I'm not sure if I can get an internship in my second year, because I'm in the BA." There's these little suggestions that suggest they have decided engineering is above arts and sciences and the BS is above the BA, despite the

> fact that we don't see any evidence of that, including when we talk to our industrial advisory board.

Frank said he was also aware of "friction" between the BA and BS students, as evidenced through "little comments" and an air of "superiority" assumed by the BS students:

> There is some friction between the BS and the BA students because the BA students don't take as many CS courses. And I think also, among some engineering students, there's a bit of an attitude of superiority because they take this more rigorous set of STEM background courses, not to say that the BA students do not, but certainly the engineering track has more requirements in the way of physics and chemistry and all that. And I think another factor is, since the engineering school put differential tuition in place, the students are very conscious that they're in the same courses, paying different tuitions, which, I think, is a bit of an oversimplification, but it is definitely an issue.

Bob and Frank recalled an anti-BA slogan on a mortar board at graduation one year. Bob recalls the slogan reading, "BSCS is the real CS," whereas Frank remembered the slogan saying, "BACS is BS" (implying that the BACS is bullshit). Regardless of what the exact wording was, that incident has remained in the faculty members' minds as one of the more glaring ways the BS-BA prestige narrative has manifested.

Charles said that anecdotally, the students' self-perception differs between the two programs, where the BS students think they are "good enough" but the BA students rarely do. He also sees differences in sense of belonging, when students take their first CS course through the College, they are "surprised to feel welcome" in computing – as if their expectation was that they did not belong, or that they would not be welcomed into CS. Several faculty noted the difference in behavior in the introductory courses between students in the College and those in Engineering;

those students who had previous CS experience, most often the Engineering students, and most often male, would behave as "show-offs" or perform "grandstanding" behavior, where the BA students appeared more "nervous" (Charles). Frank described "show-offy behaviors consist[ing] of asking mock questions that allowed students to show off their considerable programming experience" that was "intimidating to people with less experience."

Charles believes these narratives could be due to the BA students' later entry into the CS major (many declaring their major in their second year, rather than in their first year, as the BS students do). He said that there are "different levels of invitation to participate" in co-curricular activities such as undergraduate research. Bob believes this originates from a "shared experience" that BS students have in taking many of their CS and Engineering classes together, an experience that BA students generally do not have at State U. He described:

> If you've been forced to sit through Physics II for engineers and you survived, you might come out of that and say, "I have survived and achieved something. And you just went off and took this course in something you actually enjoyed." So, I think a lot of it is the engineering identity, and our engineers are confident here. I mean, the State U. engineering student is much less geeky or nerdy than the engineers at many other universities. I know this for a fact. They're not so different than the college students, to be honest. But I think it's sort of, sometimes, almost tribalism.

Bob went on to talk about how the curriculum itself reinforces this sense of shared identity among engineering students:

> I think the curriculum lends itself to this in a couple of ways: Operating systems is a very difficult course and it's one of the hardest fourth year courses and only BS students are required to take it. And so, one thing I do hear is like, "I don't have to do that because I'm

> a BA student or, or you don't have to do that cause you're a BA student." And so, I think that's been the main course where one of the degree programs has a really hard course and the BA doesn't.

When I probed more deeply about why certain classes must be hard and time consuming rather than enjoyable, Bob responded:

> Here at State U. And at many other schools, the service courses for core engineering, like math and physics and chemistry, often aren't enjoyable for a variety of reasons. Often they're very large. Often they're taught in traditional ways that are maybe not particularly student-friendly. Sometimes they're taught by poor instructors. Sometimes you'll get a *chemistry for engineers* class that's taught by the "bad" chemistry instructor, because the "good" chemistry instructors teach chemistry majors. So, I've seen those issues at other schools and at schools I've taught at for many years, including here.

As did the students, faculty described the BA program as having more flexibility than the BS program (due to the ability to take more electives, and fewer Engineering/STEM course requirements) and students in the BA as having more diverse backgrounds (demographically) as well as possessing more "diverse academic perspectives" and "different skillsets" (Frank). However, despite stating that the BA and BS degrees are equally valuable, there were still subtle biases inherent in the way some faculty talked about the differences. Take, for example, Frank's "surprise" that a (man) high school student he was mentoring chose to apply to the BACS program. When I asked why this was surprising, Frank responded that the student "was almost fitting the stereotype of the engineering CS major", which he described as a "male nerd." Frank went on to say, "I don't agree with [that stereotype], because I think most of our students don't

fit that, but the stereotype is surely out there in the zeitgeist." The ideas around who chooses which program, and which program is more legitimate are certainly in the "zeitgeist" at State U.

Gender Diversity in Computing at State U.

When asked about the differences in percentage of women between the BA/BS program, the faculty commonly responded to the effect that there are "more women in the College." Faculty seemed to indicate that the gender dynamic in CS was unchangeable (at least, by those at the institutional level). Charles argued that "[the gender disparity] happens before we show up" and believes that "gendered forces", "social norms", and "preconceptions" about the field of computing are responsible for the low percentage of women studying CS at the university. Adam echoed the "more women in the College" rationale and went on to discuss his observations that not only are the BA and BS programs gendered, but also that certain CS electives were more gender segregated than others. For example, in his security classes there were more typically more men, and in his privacy classes, there were more women. He also noted that computational biology was about an even split between men and women students.

Frank, a former department chair, seemed perplexed by the low numbers of women in the BS program and couched his answer as "idle speculation", positing that CS has a reputation of "being unfriendly to females." He underestimated the percentage of women in the College, believing it was "slightly majority female" when the actual percentage is close to 60%. When I asked him to elaborate on his comment about CS being unfriendly to females, he described gendered dynamics among students:

> The problem is that there are some issues among the students, and so we hear these anecdotal reports of students who, for example, don't want to be partners with somebody else. And I don't know that they ever are as flagrant to saying, "Well, I don't want to be

> partners with you because you're a girl," or, "I don't want to be partners with you because you're such and such ethnicity," but they find ways not to be partners. And the students who are on the receiving end of that, they realize that they're not viewed as ... If people don't want to be your partner, it's like when you're kids, and you're the last person who's picked for the kickball team or whatever, you feel it.
>
> And I don't think we have good ideas on how to combat that. I don't know how prevalent it is. I don't think there's very much sort of proactive negative commenting by people like, "Oh, you can't get this because you're a girl," or whatever. "You shouldn't be in this program because CS is for men," or whatever. I don't think we have much of any of that. I think it's all more subtle microaggression[s].

Later in the interview, when I shared with Frank that these subtle microaggressions at times prompted women to question themselves, he wondered if those students are "just being sensitive":

> I have wondered sometimes if some of what is perceived as a criticism or an aggression that's based on gender or minority status is actually not but interpreted through something like stereotype threat or just being sensitive. I mean, there are plenty of people who are critical of others, regardless of their demographic status, but I don't know of any way to tease that out. And I don't mean in any way to minimize what is surely happening because we hear it, and sometimes with quotes that are pretty explicitly sexist or racist. But more commonly, it is subtler. And so, if you have some self-confidence issues…it's hard not to perceive a criticism as something that's personal, rather than really more about the obnoxious personality of the speaker.

The faculty I interviewed seemed to have no idea on how to increase the percentages of women in CS. When asked whether the CS department has any influence on admissions, they all acknowledged that there was no communication or connection between the Admissions office and the CS department (other than at the inception of the BA program, where CS faculty were able to have some input into admissions criteria). Frank referred to a "brick wall" between CS and Admissions. Charles described:

> Recruiting is hard because we don't get to control who shows up in the university. We have talked multiple times about trying to figure out how admissions works and talked to those people about what we want, but we have, to my knowledge, never successfully actually found somebody that is useful to talk to in that.

Bob also feels there's no connection between the CS department and Admissions: "I get the sense that Admissions does their thing, and we just deal with the product…I really know very little about what it takes to actually get in here." He says this is different than some universities, in which the CS department works more closely with Admissions.

DEI Initiatives

I asked faculty to share their perception of the university's and the CS department's attempts for improving women's representation in CS. Several of the faculty cited concrete efforts that, while perhaps not explicitly intended to recruit more women, have resulted in increased numbers of women studying CS. Those efforts include re-vamped introductory courses, improved TA training, and the hiring of diverse faculty. Each of the faculty I interviewed felt the school could be doing more to support diversity efforts. Charles believes that striving for environmental and cultural change would help broaden participation from underrepresented groups, including women. He cited success stories at Harvey Mudd, CMU, and

Illinois for examples of what works. Adam also believes that a focus on improving the climate and the student experience would have a positive impact on women's participation in CS:

> I think there are things that definitely individual professors can do in their classes that have an impact. There's definitely things that the diversity of the faculty itself can help, but that gets into all sorts of other questions of how do you change that? And I think we've made some progress there. And then there's the culture among the students…I think being aware of it is important, that we can complain a lot about the pipeline and that the students that come into our classes or come into our majors, and those are sort of external things that we can have some influence on. But we're much better off looking internally at what happens once the students arrive and whether they have a good experience... and faculty have some role in that. We definitely should take some responsibility for that.

Bob said that one of the ways the BA program includes women is in welcoming students who "don't see themselves as engineers." That translates as more students in the College opting into the BACS as more likely to be women than entering the BS program. In addition to broadening participation for women, Bob feels they could be looking into how students with other marginalized or intersectional identities experience the CS program, especially Asian women, Black women, and LGBTQ students. He cites one example:

> I had [a transgender student] as an advisee…and because I knew this, I knew it was causing issues. And so, we had a nice advising relationship about that. We've talked about how that might affect them on team projects…so that's a group we're aware of…But I imagine that there's a whole LBGTQ community that's kind of under the

> surface that we don't see that we may not be serving, or we may be mis-serving, and I think that in terms of intersectionality, that is something we could look into.

When asked about DEI training for faculty, the former chair (Frank) sighed heavily. He said there were no organized efforts, to his knowledge, except for what he called a "pathetic online training" that any faculty who were involved in hiring were required to take. He shared that not everyone was receptive of proactive diversity efforts, citing an individual faculty member who believed in meritocracy, and being blind to race or gender. That person is apparently no longer with the university. Frank shared:

> I think, among the faculty, we have excellent ... I'm struggling for the right word here, but I think our faculty are all very dedicated to creating an inclusive environment. And I think even this one member who I said was skeptical of proactive diversity efforts had a strong belief in fairness and not ... So, he, this person wasn't supportive of proactive efforts, but that's because he had this belief that, well, we just need to be blind to all these factors and make sure that we treat everybody the same, and I think he really did.

Adam believes the current climate in higher education makes it unsafe to question the department's diversity efforts:

> The current climate makes this very hard. Despite being a tenured professor and generally willing to be contrary and outspoken on things, I think it is too risky to say anything that questions the current dogma on these things - so we don't have any critical discussions about whether efforts are harmful or beneficial.

Adam indicated there was little to no support in helping faculty form inclusive cohorts in group work.

Student Career Pathways

I asked faculty to reflect on the types of careers the BA CS program prepares students for, and in what ways the CS department supports student career development. Most of the faculty indicated that State U.'s CS curriculum prepares students for software engineering careers, and they believe that is what students are here for. As Charles put it:

> I think a lot of our students are here because they hear that software developer is a good job. And not because they have any intrinsic interest in…I mean, many of them do, but many of them are here because it's a career path and that's the career path they know.

There seemed to be a lack of involvement by faculty in students' career decision-making process. Charles said that faculty were "hesitant to engage in career conversations" with students, feeling a lack of expertise regarding career development and career guidance. He also believes there is "no consensus" among faculty about the purpose of the CS degree:

> If we decided our job as a department was to help students end up with jobs they're happy with, we would be doing differently…I think most departments are not thinking about that. We're thinking about, we want to teach you things that'll be useful in your later life. And I think we do a decent job at that, but I'm not sure we pick the right ones.

Bob shared that faculty are "isolated" and "there are parts of [students'] lives I try not to know about." He admitted, "I don't know what happens in the job search." Bob does peer accreditation reviews and says that he's "been to other schools where the department is much more engaged in this." Frank, the former dept chair, echoed that the responsibility of faculty is to teach good courses, provide opportunities for challenging projects, and feels that "the curriculum prepares students" for jobs. Generally speaking, the CS department relies on the career services units to prepare students for their careers, rather than taking that on as their responsibility.

I asked faculty if they were aware of the significant salary differences in first jobs between BA and BS students. All were aware of the differences, yet few had genuine explanations for that disparity. The faculty, for the most part, believe that employers view the BA/BS degree equally in hiring. Rather than a demand-side problem, faculty saw this as a supply-side problem. In other words, faculty hypothesize that BA and BS students self-select into or out of certain jobs. For example, the former chair reasoned that the BA students may have different career preferences than the BS students:

> BA students, on average, have lower salaries, but that's because they tend to migrate toward different jobs, and we don't know why that is. We have no reason to believe it's due to different capabilities, so we suspect it's different preferences in what kind of jobs they go into that are connected in some way with why they choose one school over the other.

Bob mentioned a "student self-selection bias" and Charles described a "multi-level process of selection" and posited that "students self-filter" into or out of certain jobs. He says:

> The plural anecdote…is that many more of the BA students want to have a product leadership role and want to live near family. And a lot more of the BS students want to have a software engineering role and want to live wherever the cool jobs are. And those things are also correlated to salary, but we don't know which one's the cause of which, and we don't actually have data. We just have significant plural anecdotes.

Charles worries that the student job selection process is rooted in self-confidence: "because of the internal student dialogue that BSs are smarter than BAs. The BSs feel like, 'I can go to Google and succeed' and the BAs think, 'I can't'…it's more complicated than maybe they come in with different interests."

Bob explained:

> I think in general your engineering student has a sort of stronger, more focused career path in mind. They came to State U. thinking they wanted to be an engineer and the whole engineering degree program is very tracked. You do many of the same courses in the first year. You are with the same students; you choose a major. And then that major doesn't have a lot of flexibility… So, BA students often come to State U. not knowing what they want to study, they experiment around, they find things.
>
> And so, we do get students who just discover computer science because they took our first course and loved it and decided to do it. We do have BA students who come knowing they want to do computer science. And those are the ones who have maybe a little bit more, like the engineering students, and how they approach the degree. But I think what I'm trying to get to is that often BA students are a little bit more wanderers, they've arrived someplace by a sort of circuitous path. And I think this sometimes makes them feel a little less secure…I think part of the reason they feel a little less secure is because they see these other students who seem to be more focused and more tracked and who are maybe a couple of semesters ahead of them in their progress in the computer science degree.

Bob also believes that differences in participation in internships between BA and BS students might also be a contributing factor to starting salary:

> I think that some of these students with more internships end up working for the higher paying companies and shooting for the hiring paying jobs. And the thing that I don't know is whether the BA students choose not to apply to those higher paying companies for other reasons, maybe they want to stay at a certain location more than the engineering

> students. Maybe they are less confident about going for those jobs or maybe they apply for them and don't get them. So, I think there's an open question there about how many of the BA students who attempt to get the higher paying jobs and how does their success rate compare to the BS students who attempt to get the higher paying jobs and I don’t know how we can measure that.

There are many open questions that these faculty cannot answer, underscoring the rationale for this study and for continued inquiry into the career pathways of computing students at State U.

Chapter 5: Discussion

This study attempted to answer the question, "How do the career interests, ambitions, and goals for women in a BACS program evolve from major selection to graduation?" Findings indicate three themes by which participants' career goals evolved, with orientations toward practical, relational, and circumstantial aspects. Before I address in more detail this over-arching research question, however, I turn my attention to my sub-questions: "What aspects of women's college experience are important contributors to their career aspirations?" and, "In what ways does the campus environment and culture of CS shape women's career aspirations?" By unpacking the aspects of women and gender nonconforming students' experiences in light of the campus environment and culture, I hope to gain a deeper understanding into students' career decision-making processes and the cultural and organizational mechanisms that shape career goals for women in computing.[7]

What Aspects of Women's College Experience Were Important Contributors to Their Career Aspirations?

Several meaningful factors contributed to the development of participants' career goals. First and foremost, the pathways through which students entered the BACS program were significant in positioning them with access to career opportunities, resources, and a network of mentors and peers that impacted their career decision-making. Many participants did not enter State U. intending to major in CS and discovered it either in the process of pursuing another major, or in hope of finding something practical they could use as a launch pad for a future career. For others who may have started in Engineering and switched to the College, or who had

[7] Throughout this discussion I refer to "women" as an inclusive term for the women and the gender nonbinary student in my study who said they feel solidarity with women in CS.

intended to major in CS from the start, choosing CS in the College reflected either a rejection of Engineering identity and values, and/or a desire to expand their academic and career prospects beyond computing. In other words, how participants came to the College of Arts and Sciences – and the mere fact that they were in the College, and not the Engineering school – impacted their career trajectories. Indeed, as faculty interviewed for this study shared, there is a strained relationship between the Engineering school and the College, one that is characterized by tension over "politics and money". And as one faculty member shared, the positioning of CS in the Engineering school and the way that engineering policies and discourses are emphasized might reflect the tensions between the schools and have the effect of marginalizing students in the BA program.

This study also brought to light the myriad identities that participants held and how those identities – and often the intersection of multiple marginalized identities – influenced their career decisions. Participants came to college with what could be called "STEM-adjacent" identities: an interest in math and science or "quantitative things" and had heard that CS would make a good career, or at least a good skill to have on one's resume. Most participants did not identify with the "typical CS person" or with Engineering students, showing how they formed career goals in resistance to established CS norms. These pathways reflect a simultaneous embracing of what is "fun" and "useful" about CS and a rejection of aspects of the most pervasive CS norms: the masculine culture, the atmosphere of competition, and a singular focus on technology. These participants were looking to do CS on their own terms, and "in their own way". Sadly, because they did not feel they fit into the dominant culture of CS, many participants questioned their abilities and believed they were "not as smart" as their male or BS counterparts. Several worried that their BA would hamper their job prospects, and others wondered if their intersectional

identities (e.g., a Muslim woman or a gender nonbinary person) put them at a disadvantage in the job search. Many felt perpetually "behind" and formed self-protective mechanisms to shield themselves from microaggressions or from the possibility of failure. The feeling of being different was so pervasive that one participant (Sherrilyn) wondered whether she fit with the study's purpose, since she wasn't planning to pursue a career in computing after graduation.

Family influences were also a significant factor for many of the participants in the study. In particular, the first-generation college students felt a strong sense of responsibility to accomplish something through their college education and to find secure financial footing. For the Vietnamese American students whose parents came to the U.S. as refugees there was a sense of an entire community counting on them to break free from the circumstances of the previous generation. These students did not take their education for granted and saw education and CS as pathways to a better future not only for them, but for their families.

The family pressure that several participants felt to pursue a financially secure career is a theme that has been reflected in prior research with Asian American students (Poon, 2014) and with first-generation college students (Tate et al., 2015). Poon's 2014 study with Asian American students whose parents were immigrants shed light on the dynamics of race and social class with regard to students' decision-making: their findings "suggested that [students'] parents' experiences of immigration, poverty, and inequalities create an important context for understanding" (p. 511), an insight that provides context for the current study. For the four students in the current study whose parents immigrated to the U.S. from Asia, their family's status as immigrants/refugees was crucial to their identity and strongly influenced their values around college as the key to financial and personal freedom. Recall Ty, whose "parents came [to the U.S. from Vietnam] from the ground up with nothing," and Allyson who felt the "pressure"

to meet the expectations of her immigrant family, as the first in her extended family network to attend college. In contrast, for the one white/non-immigrant first-generation college student in this study (Helen), her first-generation college student status did impact her career plans, but was less a salient aspect of her identity than for her Asian American peers.

In addition to families, peers were also influential in the development of participants' career goals. In reaction to the competitive and sometimes hostile culture of computing, participants forged their communities with peers who supported their identities, often outside the CS major. For some, that was a religious or cultural organization, like Hillel (Miriam), the Muslim Student Association (Leila) or the Chinese Student Association (Fan). For others, it was through women on their residence hall, a professional association, or through their research labs. It was largely through peer networks, often comprised of other women, that students learned about internships, how to interview, and what kinds of career opportunities existed for them. It was through these networks that students found community, strength, inspiration, and formed bonds that helped them survive and thrive in the often-difficult journey of college more generally and computing specifically.

Supportive faculty, advisors, and mentors – of any gender – were also instrumental in students' development of confidence and sense of belonging in college and in computing. For some, like Fan, having women faculty served as inspiration for participants to realize that they, too, could be successful within this white and male dominated field. For others, it was simply that someone took an interest to them, saw their strengths and skills, and helped them to believe in themselves. For the nonbinary participant, Ty, finding a queer person of Color mentor at their internship instilled hope that they could flourish at the organization and made all the difference to them going to work there after graduation. Unfortunately, the reverse was also true: where

participants felt a lack of support or worse, hostility, they pivoted away from those people and environments, perhaps foreclosing on opportunities that otherwise would have been a good fit for them. For example, several women in this study had either heard or experienced negativity with State U.'s Human-Computer Interaction professor and either lost interest in the field or sought learning experiences outside State U. to develop their interests in that area.

Opportunities to get hands-on experience and engage their interests and skills beyond the classroom were also paramount to students' career trajectories. Whether it was through coursework, research, student projects, hackathons, or internships, participants engaged in "anticipatory socialization" experiences (Seron et al., 2016) that shaped their views on what they wanted to do in the future. These experiences were highly individual and cannot be generalized, but for each participant, the opportunity to engage in pre-professional experiences served to enhance their understanding of the field and to amass, as Miriam put it, "confidence and skills, and confidence *in* [her] skills."

The findings that have been discussed thus far echo the literature and prior research with women in computing. For example, it is well-documented that a lack of early exposure to computing can affect women's choices to pursue computing majors and careers (Main & Schimpf, 2017). Findings about pathways into computing degree tracks (BA vs BS track) align with a previous study (Smith & Lapan, 2021) which found that women who entered a BACS program often discovered CS through an introductory computing course. Furthermore, the growing body of research on computing identity, and in particular, intersectional computing identity, draws the connection between students' intersecting identities and a sense of belonging and self-efficacy in computing (Rodriguez & Lehman, 2017; Rodriguez et al., 2020). Research with underrepresented groups has also underscored the importance of supportive peers, mentors,

and role models to the persistence of women in computing (see, for example, Dasgupta & Stout, 2014; Lapan & Smith, 2023; Smith & Gayles, 2017).

In summary, the aspects that shaped career goals, both positively and negatively, for participants in this study included structural factors, personal identities, and interactions and experiences with meaningful others both within and outside of computing. For the next question, I shift attention to the environmental and cultural factors that were present in participants' day to day experiences and the narratives and discourses that shaped their thoughts about themselves and their future careers.

In What Ways Did the Campus Environment and Culture of CS Shape Women's Career Aspirations?

According to my cultural-organizational-feminist framework, the construction of the computing field as one that is both gendered and laden with prestige was central to my research methods and interpretations. Across all participants, their narratives revealed discourses around gender and prestige, with participants barely questioning norms that position their BA degree as less valuable than the BS earned by their peers in engineering. Furthermore, while all participants were aware of the over-representation of men in their classes and internships, they held differing levels of awareness of their situation as subordinate to their men counterparts. Themes around competition, a lack of community, and an excessive focus on software engineering careers also emerged, stemming from the gendered and prestige-laden nature of the institution and of the field of computing in general. All of these cultural factors played a role in shaping participants' career goals.

White/Male Dominance

One of the most salient cultural themes that emerged from this study was a sense of (white) male dominance as a critical aspect of women's experiences in and of computing. I put the word "white" in parentheses because race was not a phenomenon that was reported by all participants. In that regard, the white women in the study seemed least likely to view male dominance as problematic; this is not surprising given white women's tendency to uphold white supremacy at the expense of feminist aims.[8] As Eisenstein (2019) noted regarding the 2016 election in which the majority of white women voted for Trump: "It would not be the first time that white women supported patriarchy in order to protect white privilege" (p. 69). In this study, white hegemony was especially powerful in the experiences of non-white and gender nonbinary students at State U. The notion of "white" was frequently used with the word "male," such as Ty's reflection that the faculty were almost all white men, or in Stephanie's observations of how "white guys" often felt the need to lead and be heard. Participants' accounts of white male dominance were intertwined with their perception of a lack of openness to or tolerance of diversity in engineering and computing spaces. Whether that was a sense of women being "outsiders," a religious minority worrying whether she would be at a disadvantage with "white Christian male" interviewers, a nonbinary student feeling like they could not share their gender-neutral pronouns, or a student with a disability being denied an accommodation, across the board the computing department at State U. felt hostile and unwelcoming to students who did not fit the dominant race and gender demographic. The anecdote of the "pink raincoat" that Rose wore into State U.'s engineering building is a powerful reminder of how gender and difference are perceived in that space. These findings align with Burack and Franks' (2004) observation that

[8] This concept is expanded in the book, "White Women: Everything You Already Know about Your Own Racism and How to Do Better" by Regina Jackson and Saira Rao (2022, Penguin Books).

"resistance to diversity" is prevalent in engineering group culture, which in this case, is synonymous with the culture of the BSCS program due to its position in the Engineering school.

Participants in this study experienced the dominance of men across all spaces relating to computing. (White) men were dominant not only in terms of their representation in physical spaces (classrooms, group projects, internships, faculty office hours), but they were also dominant *actors* in these spaces. Faculty, of course, could be seen as dominant actors purely through their positions of authority. Men students were seen by those in this study as dominant actors in the ways they asserted themselves in the classroom, "talked over" others and ignored the contributions of women students, and in the disparaging comments they made about the BA program. It was also the men students who commented on women students' success, devaluing their accomplishments by saying things to the effect that their success was just because they were women and companies had to fill diversity quotas. At State U., these behaviors by some (certainly not all) of the male actors seemed to come from the men studying CS through the Engineering school, rather than through the College of Arts and Sciences. Their belittlement of non-engineers and questioning the belonging of those who don't fit the dominant demographic suggest that men in computing, particularly those who are more closely connected to engineering, feel a sense of superiority and, therefore, a sense of entitlement.

Superiority Discourses

Allan et al. (2010) urge feminist researchers to deconstruct gendered discourses and interrogate the ways those discourses reflect and shape the conditions that marginalize women. Through this study, I uncovered discourses around the superiority of engineers as a mechanism by which women in a BACS program are marginalized. Burack and Franks (2004) describe the "superiority myth" as a narrative that is ingrained in discourses in engineering and is transmitted

to students from faculty and other powerful actors in the field. They suggest how these beliefs play out in the language of engineering education: "one way in which this dynamic occurs in engineering education, often without the deliberate collusion of leaders, is through the emphasis on engineering students and engineers as intellectually superior to those in other fields of endeavor" (p. 87). Burack and Franks note specific phrases that are often used by engineering leaders that position engineering students as "the cream of the crop" (p. 88). These engineering superiority discourses align closely with the "brilliance discourses" that Patitsas (2019) described in reference to computing culture and perpetuate the belief that one must be innately brilliant to be successful in computing. All of these discourses reify myths around meritocracy and reinforce the privileged positions of those at the top of the engineering-CS hierarchy.

Another discourse that serves to separate engineers from non-engineers, and those who do technical computing (e.g., software engineering) from those who work on the less technical (i.e., design) side is the binary of "hard" vs "soft" skills. Burack and Franks (2004) observe how language is used to position technical skills at the top of the hierarchy:

> On the surface, hard refers to that which has mathematical content or involves the use of hands-on skill with technological equipment. Soft refers to what is devoid of mathematical content and does not involve technological equipment. A closer inspection of such usage, however, reveals that there is a hierarchy, with hard skills ranked more highly, despite the recent trend to describe soft skills as just as important and more difficult to learn than hard skills. (p. 84)

Burack and Franks go on to describe how the "hard/soft" binary both reflects and reinforces gender norms; what is seen as "soft" is antithetical to masculinity and more associated with women (and thus less desirable for men). Burack and Franks explain:

> These uses of the modifiers hard and soft have no obvious connection to the skills they denote in engineering…However, connections between masculinity, virility, male sexuality, and hardness are culturally engrained, have unconscious emotional resonance, and are widely and immediately understood. Likewise, the connection of softness with femininity is a cultural signifier with both conscious and unconscious meaning. Neither are hard and soft understood as equivalent terms. Perhaps because of their status as marked with already-gendered meanings, hardness and softness are hierarchically ordered, with what is hard commanding greater respect and recognition than the soft. (2004, p. 84)

These narratives align with the ways that students at State U. refer to the different courses of study in computing, with the BS being more "rigorous" (hard) and the BA being "easy" (soft). (Recall the former department chair who also used the phrase "more rigorous" in reference to the STEM background courses required for the BS degree.) As all the student participants perceived themselves to be not "as smart" or "as CS" as the students in the BS program, it is clear that they have internalized the discourse that "technical equals smart." Daphne illustrated this internalized discourse when she described men's "implicit dominance" as "a stigma in my head" and described the nature of computing in masculine terms ("pragmatic and rigid") in contrast to the nature of women ("emotional and soft").

Superiority discourses as a means to resist diversity in engineering and computing spaces can also be heard in the disparaging remarks some men make about how women came to be in certain positions (e.g., internships, jobs, leadership roles, etc.). As several of the participants in this study remarked hearing comments to the effect of, "you only got that because you're a woman," it is clear that beliefs about the superiority of men in engineering and computing impact

who is perceived as having a right to be there. Burack and Franks (2004) say that "these group members are unable to see how all of the institutional structures and spaces they occupy are already their own – this is as invisible and unremarkable to them as the air they breathe" (p. 90). In other words, people who make such remarks are reflecting a sense of entitlement to exist in that space and are oblivious to the experiences of people who do not hold their dominant identity. As a result, they rationalize that anyone who doesn't align with the stereotype of those having innate talent in engineering (typically a white man) must have arrived there through some other means, other than talent.

Self-Protective Behaviors

In response to encountering male dominance, several participants talked about employing "self-protection" mechanisms and adapting their behaviors to navigate gendered spaces. Stephanie, for example, relegated herself to helping or support roles, while others, like Ty, avoided speaking up in engineering spaces, or spaces that were predominantly white and male. Others, like Leila, asserted themselves so their voices might be heard. One participant organized a club specifically to create a space to counteract male dominance in computing. Participants found community with other women (and men) who were supportive, primarily through social networks outside of computing. The ways that participants navigated male-dominant spaces and behaviors differed from person to person, but what they all had in common was that they navigated *around* the men and adapted to their behaviors. In other words, the women and nonbinary student in this study, to a large extent, occupied the interstitial spaces between the men who, as one participant put it, "have been doing it longer" and "were here first."

None of the student participants liked the fact that men were dominant in every facet of their experience in computing, but none of them expressed anger about the situation, either. They

all took for granted the assumption that there were more men in computing and that men often behaved in dominant ways (although some, like Leila, believe that these dynamics are changing). The State U. faculty, while acknowledging that the underrepresentation of women in their computing program was a problem, expressed a sense of impotence – or perhaps an unwillingness – to make a change. The statement "we don't control who shows up" at best pushes the responsibility for diversifying the student population onto others at the university, and at worst abdicates accountability for the problem altogether. This tendency for organizational actors to protect the status quo – even though it is less than ideal – reflects the powerful cultural narratives that are present in the discourses and everyday behavior of the people who are part of the culture. Furthermore, the former department chair's comment about students "just being sensitive" to criticism shows adherence to a dominant viewpoint in which students who are marginalized are further oppressed by the lack of recognition of their perspectives.

Prestige and Hierarchy

In addition to gendered narratives, discourses around prestige distinctions between the BA and the BS programs emerged in all the student interviews and were corroborated by the faculty. These distinctions manifested in the BA program being labeled "easier" and the BS more "rigorous." Quantitatively speaking, one might argue that because the BS program has more course requirements than the BA (126 vs 120 credits) that it is inherently more rigorous (or "academically challenging," as one participant put it) than the BA program. However, the "easy vs rigorous" narrative had as much to do with perceptions about the type of courses students took (e.g., humanities and social science vs engineering/technology) as the number of courses that were required. For example, Stephanie drew comparisons between courses like *Calculus* and *Physics* vs *Human Sexualities* and *Dracula* as "courses in niche areas that sound fake" to justify

their being labeled as easy. (Interestingly, one of the faculty (Bob) also cited the Dracula and women's studies courses as diametric to courses like physics, the former being "courses [students] actually enjoyed," whereas physics was something to be "survived.") While the faculty largely explained BA/BS prestige distinctions as engineering students' sense of superiority or "tribalism" that grew out of a shared experience, the student participants appeared to accept without question the idea that the BA inherently has less value than the BS.

Devaluing the Feminine[9]

One of the most overt examples of the way the BA/BS prestige positioning manifested in this case study was through the "College of Arts and Crafts" discourse. The phrase masquerades as a joke but, in fact, carries an insidious message of engineering superiority. While it may seem like an unnecessary detour from the discussion of computer science careers, I feel it is important to spend some time analyzing discourse around the "Arts and Crafts" meme to gain a deeper understanding of why the word "craft" is used to insult, offend, and devalue. Not only does the phrase devalue the humanities (and all sciences that are not "real" science, including the BACS), but it is also highly gendered. The word "craft," which has contested meanings, carries connotations of women's work (Glassman, 2021) and is therefore associated with having lower artistic value. For example, the Australian Centre for Contemporary Art (ACCA) describes a gendered history of art and the "cultural hierarchy" that exists between decorative arts (i.e., crafts) and fine arts: "As decorative art was in a low position on the cultural hierarchy, and women were confined to the production of decorative art, women's creativity was largely confined to a lower position within culture than that of men" (ACCA, 2018, Key Idea section, para. 3).

[9] The phrase, "Devaluing the Feminine" was inspired by England and Li's devaluation perspective, which they termed, "Devaluation of the Feminine" in their article on gender segregation in college majors (2006, p. 658).

A simple internet search did not reveal that the "Arts and Crafts" narrative is widespread (my search turned up no relevant results), perhaps indicating that the narrative is localized to State U. While it would be difficult to identify the origin of the narrative due to the fact that informal, spoken discourse carries an oral history that would not likely be recorded in any official documents, the cases of two art-related institutions that dropped the word "craft" from their names in the early 21st century might provide some clues as to how American society has come to perceive the word "craft" as something that has low value.

In the first example, the American Craft Museum, which had been established in 1956 in New York, changed its name to the Museum of Arts & Design in 2002. The museum's website has a fairly neutral explanation for the name change, saying it was "to reflect the institution's increasingly interdisciplinary collections and programming" (Museum of Arts & Design, n.d., History section, para. 3). However, in a New York Times article about the name change, a different discourse was presented, portraying how the word "craft" was associated with things of low value. The museum's then-director, Holly Hotchner, was quoted in the article as saying, "to most people, the word craft means hobby or fair" (Vogel, 2002, para. 3). The Times article also quoted Terence Riley, chief curator of architecture and design at the Museum of Modern Art: "It's all about a dissatisfaction with the word craft, which many people feel implies a lack of artistry" (Vogel, 2002, para. 9). Museum board member Alan Siegel put it more succinctly: "craft is associated with…cheap trinkets" (Vogel, 2002, para. 10). It is clear through this discourse that the museum sought to disassociate from the word "craft" in order to revitalize itself and maintain its legitimacy as a prestigious institution in the arts world.

The second example involves the name change of the California College of Arts and Crafts to the California College of the Arts in 2003. The institution, originally located in

Berkeley (now in San Francisco), dropped the word “crafts” from its name through a unanimous vote by its board of trustees. The institution’s website says the name change was implemented to “recognize the breadth of the college’s programs” (California College of the Arts, 2023, History section). In 2007 the New York Times ran an article about the college, reporting that “the 2003 name change, in which ‘crafts’ was dropped, antagonized some alumni, especially those in craft disciplines” (Hall, 2007, para. 17).

Inferring from these two examples, which occurred during the same time period at the turn of the 21st century, it seems that the word “craft” has been publicly contested in recent history and has been rejected by institutions that feared losing legitimacy. As photographer Douglas Kirkland said, “'Craft' is a tricky word, often misused….My feeling is that when the word 'craft' is used to describe a work of art, it is –wrongly – frequently considered lowbrow” (Lovelace, 2018, Craft Is Complicated section, quote 7). A brief analysis of the Arts and Crafts movement, which occurred toward the end of the 19th century, reveals its connection with industrialized labor practices. Krugh (2014) claims that “the most lasting contributions of the movement are the transformation of craft into a leisure activity and the linking of craft with unalienated labour, in opposition to mass production” (p. 282). Krugh cites the founder of the movement William Morris’ vision of craft as “joy in labour” (p. 282) and goes on to say: “[Craft’s] use as a political critique of industrial conditions and manufacturing processes provides a glimpse into a utopian future, where people enjoy their work and their lives to the fullest” (p. 296).

How interesting, then, to compare the positioning of the word “craft” as synonymous with “joy in work” with State U. students’ narratives that the humanities classes are “fun”, and therefore “easy”, compelling those at the top of the prestige hierarchy to disparage them with the

term “Arts and Crafts.” Indeed, Costa (2019) observed that “the humanities have been subject to a progressive devaluation within the academic world” which has been “mostly the result of the systematic promotion of other fields” (p. 1). Costa goes on to say that “the [humanities] field appears to be held hostage to a way of appreciation that is overly focused on the economy, established by those who govern and apparently accepted by most of those governed” (p. 3). This sentiment echoes that of Slaughter and Leslie (1997) who argued that the concept of academic capitalism upholds the prestige and legitimacy of fields that are closer to the market, such as engineering. Costa’s observation that this “way of appreciation” is accepted by most people is also apparent in the way the participants in the current study spoke about their BA degrees as less valuable than the BS degrees of their peers. Ironically, despite acknowledging that the cultural assumption around arts and crafts is that they are “dispensable extras” (p. 1), LaMore et al. (2013) analyzed survey data for Michigan State Honors College students and found that “arts and crafts training correlates significantly with success as a scientist or an engineer” (p. 228).

Competition

Another powerful feature of computing culture at State U. that aligns with prestige discourses is the culture of intense competition. This finding is not surprising, given the degree to which literature cites a culture of competition in computing (see, for instance, Garvin-Doxas and Barker’s (2004) work on defensive classroom climates). The students in this study all reflected a competitive culture at State U., with engineering and CS microclimates as even more competitive. The culture of competition is, at its core, one that focuses on individual success above the success of the group or team. Competitive behaviors showed up in the classroom, in group projects, and in the job/internship search process. Participants in the study largely saw themselves as not cut out to compete, or only able to compete in certain spheres. For a couple of

participants, the competitive culture felt “toxic” and “harmful”. One felt that mental (un)wellness was “normalized.”

At State U., what students seemed to be competing for were software engineering roles at one of five top “big tech” companies.[10] Aligning closely with the competition for a job in big tech was a cultural archetype of the “typical” CS student as someone who spends an inordinate amount of time, including leisure time, on CS-related activities. This archetype reflects the “Geek” stereotype that has been described by several researchers (Margolis & Fisher, 1997, 2002, 2003; Varma, 2007, 2009; Wynn & Correll, 2018). None of the participants in this study identified with this archetype. While most participants were pursuing non-software engineering careers in computing after graduation, three of them will be working as software engineers. Only one participant, Sherrilyn, has chosen to pursue a non-computing related career (finance). Many participants were disappointed because they perceived a lack of support and resources for non-software engineering careers at State U. and felt that they had to network outside the school to find career connections and support.

Community

The flip side of competition culture is collaboration and community. Participants in this study certainly felt a lack of community within CS. Since these students were enrolled at State U. during the height of the COVID-19 pandemic, it is possible that their perceptions of the lack of community were exacerbated by social distancing mandates and online coursework. However, participants found community through other networks at the university during this time, which may have felt more welcoming because they were removed from the culture of competition and prestige hierarchies in computing. These communities (largely religious and cultural

[10] For emerging work on this topic, see Kirdani-Ryan et al. (2023): https://doi.org/10.1080/08993408.2023.2171689

organizations, and some professional associations) welcomed students with similar, often marginalized identities and served not only as social supports, but also as communities of learning how to navigate the complexities of internship and job searching.

The forging of community in many cases did not occur just by happenstance; rather, participants used their agency to seek out and connect with like-minded individuals who were welcoming and supportive to their identities and to their career aspirations. Like Stephanie, who sought career advice from State U. alumni and professionals within her field of interest, or Fan, who reached out to a woman professor to inquire about working in her lab, the participants in this study either consciously or unconsciously realized they were not getting what they needed from the dominant spaces and found their community elsewhere. For a few of them who were not interested in following the dominant group's path into software engineering, they actively looked for pathways outside that domain.

In summary, the distinct culture of computing at State U. is characterized by a normative understanding of two distinctive and hierarchically mediated academic tracks: an engineering track and a humanities track. The culture is steeped in white/male norms and an atmosphere of competition that shaped the experiences and perceptions of the participants in this study. These experiences and perceptions, in turn, shaped participants' career goals and had implications for their post-college career destinations. In the next section, I will return to the over-arching research question about how participants' career goals evolved in light of State U.'s computing culture.

How Did the Career Interests, Ambitions, and Goals for Women in a BACS Program Evolve From Major Selection to Graduation?

Through mapping the various milestones and interactions that were meaningful influences in participants' career journeys, three general themes emerged: Students were oriented toward what can be described as practical, relational, or circumstantial aspects in the process of forming and acting on their career goals. These themes are not mutually exclusive, as some participants had elements of more than one theme in their developmental journey. In all cases, participants' career goals were shaped by not only pre-college factors (identity and experiences) but also by the organizational structure and culture of State U. In addition, the participants in this study exercised agency in spite of cultural and organizational pressures, illuminating ways that students forged their own paths and in so doing, created countercultures to the traditional culture of computing.

Most notably, the organizational structure at State U. positions students in one of two tracks: an Engineering track, or an Arts and Sciences track. For students in computing, a higher premium is placed on the BSCS program, which can be considered what Cheryan and Markus (2020) call a "masculine default". As the masculine default, the BS program at State U. appears to be neutral, but in fact disadvantages women and other minorities by excluding students without prior experience in engineering and computing and those who do not identify strongly with STEM stereotypes. The fact that there is a separate Engineering school with a separate admissions process from the College of Arts and Sciences – a process that is largely opaque to organizational actors (i.e., the faculty) - disadvantages women and other minorities by channeling students into gendered pathways at the very outset of their college experience. While the BACS program does provide an alternate pathway to the BSCS and helps broaden participation in computing, it does so in a way that positions women and other minorities in a less prestigious track. Furthermore, there is a risk that as more women choose the BA route, the

BACS program might become perceived as overly feminized and seen as a less desirable path for men (England and Li, 2006). A few participants hypothesized that men students would choose engineering because of its prestige and because it was basically what men do, even if they aren't certain about their major. When Frank, the former department chair, revealed that he was "surprised" that a high school boy whom he was mentoring chose to enter the BA program, it showed the deeply ingrained assumption of the BS program's superiority. Those assumptions reflect the ways the BS program can be considered the masculine default at State U.

Once students arrive at State U., they are subjected to gendered prestige discourses that shape their perceptions of the computing field and of themselves. Discourses around the typical CS major (Geek culture) prompt students to either identify or de-identify with that archetype. Deidentification, in turn, shapes students' self-perceptions; being a woman and at the same time studying in a less prestigious track makes them likely to internalize the discourse that they are "not as smart" or capable as their male or BS counterparts (this, despite faculty insisting that they see "no difference intellectually" between BA/BS students). Furthermore, participants felt like they were perpetually "late" or "behind", underscoring the competitive nature of State U.'s computing culture and the emphasis on finding a job with a prestigious tech company. Participants in this study had to work hard to overcome these discourses, often citing the well-roundedness of the BA and the importance to one's career of developing both technical and non-technical skills. However, while students could articulate the benefits of the BA, many of them still doubted their own self-worth in the job market, which had an impact on their decisions to pursue (or to not pursue) certain career opportunities.

Theories of Occupational Closure and Career Funneling

The findings from this study can be viewed in light of Witz's (1990) occupational closure theory, that Patitsas (2019) argues include gatekeeping policies and discourses that close the computing field to women and other minorities. Furthermore, discourses around the Arts and Crafts meme that devalue the humanities also devalue what is feminine, aligning with what England and Li (2006) call "devaluation of the feminine": "The central idea is that our culture devalues women, and this leads to devaluation or stigmatization of all things associated with women—styles of clothing, names, leisure activities, fields of study, or jobs" (p. 658). Taken together, the current study shows how social closure is reproduced through structural barriers and through language that devalues femininity and ties computing in every way to masculinity.

According to CERP surveys, the top reasons that State U. students chose CS were that the job market for the field is promising, and they like learning about this field. These reasons were echoed by the students in this study, and in particular, by those who were practically oriented in developing their career aspirations. Whether students had been exposed to CS before college or not, there was a collective assumption that the CS job market is promising. Upon deciding to major in CS, State U. students quickly come to realize from their peers the importance of internships. Moreover, they learn that the most prized jobs exist at a handful of big tech companies, and the most prestigious positions are software engineering roles. In fact, according to participants in this study, students at State U. are not often exposed to careers in computing outside software engineering. This dynamic aligns with what Binder et al. (2016) refer to as "career funneling", a mechanism by which college students are funneled into a narrow range of prestigious careers through the university as a "central socializing agent" (Binder, 2018b, p. 220).

Career funneling into software jobs in big tech did not seem to occur for most of the participants in this study. However, career funneling processes do appear to have a strong hold at State U., with the majority of BS and BA students going to work for one of eight employers (including Amazon and Microsoft). Career funneling seems more pronounced in the BS program, with 54% of State U. BSCS graduates working in web/software roles after graduation, as opposed to 42% of BACS graduates. While it does appear that, like BS graduates, most BA graduates pursue computing careers after graduation, it is likely that the BA graduates work across a broader spectrum of computing jobs than do their BS counterparts, effectively pushing the boundaries of the narrow focus of software engineering.

It is interesting to compare the faculty members' explanations of BA students' career pathways with the narratives of the students, themselves. For example, the former department chair believes that students choose the BA or BS program upon entering college based on preferences for different types of jobs. My data show this to be only partly true, as only a few students were thinking about their careers when they applied to State U.; moreover, many students entered the BA by default, due to not identifying strongly with engineering. Also problematic is faculty's "plural anecdotes" about students' career goals. As Bob shared, the general narrative among faculty is that "BA students want a product leadership role and want to live near family" and "BS students want to have a software engineering role and want to live wherever the cool jobs are." The motivations for a product leadership role or to live near family were not expressed by the BACS students I interviewed for this study. However, CERP surveys indicate that BA students at State U. have stronger interests in non-computing careers than BS students, possibly indicating that career funneling forces are more powerful within the Engineering school and within more elite spaces. Rather than assume that a dichotomy exists in

the career preferences between BA and BS students, I believe a more accurate assessment would be to say that "some BA students want careers outside of computing; also, many want to explore the wide range of careers that exist *within* computing." If the faculty have "software engineering tunnel vision," as one student described it, then they might be apt to generalize the career preferences for the different groups of students in a way that makes software engineering seem to be the exclusive domain of BS students.

Charles' framing of students' career pathways as a "multi-level process of selection" might be a closer representation to the processes I observed with the students in this study. In particular, Charles' notion that less confident students self-select out of applying for positions with top companies was reflected in at least some of the students' narratives. It could also be plausible that students who are less confident because their identities do not align with the "typical" CS student might foreclose on software engineering as a career path, because they are not confident in their coding skills. As one participant mentioned, taking "baby steps" into software engineering gave her a sense of confidence and increased her interest in the field.

The competitive and male-dominated environment of computing prompted students to form their own communities and, for many, to find their own career connections, since they perceived that State U. would not be able to help them. These students formed career goals relationally and relied on their own networks for career advice and support, rather than on the university networks. Participants who formed career goals relationally were dependent on their communal networks, consisting of family members, State U. alumni, employers, and other professionals, as well as State U. faculty and staff with whom they had formed personal bonds. These networks were instrumental for participants in exploring career options, learning skills related to job searching (such as writing a resume and interviewing), and evaluating career

opportunities. Participants perceived that the BS students had more of this "career capital" built into their program, as they were supported by the Engineering career center and had a more tight-knit community.

Self-Efficacy

For several participants, lack of confidence in their ability to succeed influenced them to talk about their career goals in a way that reflected low *self efficacy*. In other words, the way they made meaning of their career situation was attributed to "luck" and circumstances, rather than their own achievements. According to Social Cognitive Career Theory (SCCT), self-efficacy is related to career goal development and taking action toward positive career outcomes (Brown & Lent, 2019). Having low self-efficacy is associated with women's decreased persistence in STEM fields (Marra et al., 2009). One of the faculty in the current study referred to BA students as "wanderers," which may be a misguided narrative. Rather than viewing students who appear to make career goals circumstantially as "wanderers" – which connotes lost or directionless – one might also view those students as having low self-efficacy. As self-efficacy is malleable based on social support and environmental conditions (Brown & Lent, 2019), interventions could be designed to increase students' self-efficacy and sense of belonging in computing. Even the students in this study who developed career goals circumstantially had an idea of what they wanted – although they weren't confident that they could get what they wanted. Faculty members who view students from a privileged (white male) perspective might be inclined to downplay the gendered social forces that make women feel isolated and less confident. Thus, helping faculty to see how creating more inclusive cultures can increase students' self-efficacy could go a long way to helping faculty make positive cultural change in their departments.

Implications/Recommendations for Policy and Practice

The findings from this study have illuminated the ways that gender and prestige discourses impact students' career goals and offer some possible solutions (and hope) for broadening participation to gender minorities and other groups that have been traditionally underrepresented in computing. Consistent with cultural-organizational-feminist framing, gendered norms and prestige discourses that serve to exclude women and other minorities from the field of computing must be dismantled in order for the field to be fully inclusive. Below, I propose several recommendations for educational leaders in computing higher education to shift the culture of computing toward one that is more inclusive and welcoming of a diverse range of students.

Counteract White/Male Dominance

First, institutional leaders need to pay attention to how computing departments are structured and look for masculine defaults that may inadvertently exclude women and other minorities. For example, in the case of State U., student recruitment and admissions policies and practices should be examined to determine how those policies and practices exclude women and minorities. Computing faculty and department chairs should have a clear understanding of admissions practices and be involved in regular reviews to ensure that admissions policies are yielding inclusive outcomes. Institutions should support affirmative action for marginalized groups as a corrective to historical injustices. Computing leadership should also regularly assess students' feedback in introductory and required courses, with the understanding that experiences in those courses can shape persistence in the field. The goal should be to deliver those courses in a way that all admitted students can begin to effectively build career aspirations.

Second, as several participants in this study shared, representation matters. While it may seem like an obvious solution, hiring more diverse faculty can have a positive impact on

students' experiences and sense of belonging. Women faculty, faculty of Color, LGBTQ faculty, and faculty from other diverse backgrounds can signal a welcoming and inclusive culture for underrepresented groups within a department, program, or institution. As some of the participants in this study shared, they wanted to connect with faculty who shared their identities so they could talk about their sense of marginalization in computing spaces. If institutions are successful in hiring more diverse faculty and increasing the diversity of their student bodies, perhaps this will lead to fewer students feeling marginalized and mitigate the need for such conversations.

Third, computing departments should take proactive steps to make their spaces feel welcoming and inclusive to all students. Institutions could provide training to faculty on managing classroom and group dynamics. Since many of the gendered interactions the participants in this study reported took place in these settings, faculty may be well-positioned to interrupt these power dynamics. For example, knowing that men students might be more likely to speak up in class and dominate conversation, faculty could proactively invite and encourage participation from underrepresented (and quieter) students. Faculty can educate students on the gendered dynamics that often crop up in groups where women are in the minority and remind students that cognitively diverse teams are more successful at solving problems (Reynolds & Lewis, 2017). Faculty can also have regular check-ins with teams and encourage students to seek their support if they are struggling with group dynamics. And although faculty may not identify with an underrepresented group, themselves, they can still create a welcoming and inclusive atmosphere by encouraging discussion of diversity and difference in the classroom. Even sharing their pronouns, and inviting students to share theirs, can signal their openness to gender inclusivity and model respect for gender differences.

One of the more concerning findings in this study were the disparaging comments women heard, particularly being told they only got an opportunity because they are a woman and companies need to fill diversity quotas. To counteract this narrative, career development practitioners could coach women on a response to this. For example, they could say something like, “I earned this opportunity because I am qualified.” As career advisors often coach students on interview techniques, perhaps they could build into their programming for underrepresented students some tailored language and counternarratives to what seems to be a common discourse in the white/male dominated field of computing.

Foster a Culture of Collaboration

The participants in this study experienced computing culture as competitive and, for some, as harmful and toxic. Furthermore, almost all participants lamented a lack of community in the CS program. With these findings in mind, CS departments should work to build community and emphasize a spirit of collaboration rather than competition. One way they can do this is by examining course collaboration policies. For example, instead of requiring students to work on course assignments alone, faculty can encourage students to collaborate and structure learning experiences so that students are incentivized to help each other learn and grow. By reminding students that jobs in CS are plentiful, faculty can diffuse competitiveness and contribute to an abundance perspective, rather than perpetuating a scarcity perspective around jobs and careers.

Computing department leadership should also work to build community within their departments and between programs, through which students have the opportunity to get to know each other inside and outside of class. Departments could host non-competitive social events that foster relationships between students and faculty/staff (as opposed to hackathons, which are

centered around competition). Faculty should be empowered to have formal and informal conversations about students' career interests and ask questions about how students are relating the knowledge they are learning in the classroom to other spaces. Engaging students and faculty on these kinds of topics can open dialogue for faculty to support students in their career development and also communicates to the students a sense that faculty care about their lives beyond the classroom. To that end, acknowledging that computing culture can have negative impacts on students' mental wellbeing, CS departments can cultivate programming around mental health and wellbeing, perhaps leveraging campus partnerships or even hiring staff to focus on diversity, inclusion, and student wellbeing.

Another important consideration is the creation of spaces for underrepresented students to build community with one another. As almost all participants in this study found their community through student organizations with which they felt a sense of connection to their identity, it is imperative that CS departments support groups like Girls Who Code and other organizations that allow students from underrepresented groups to connect in a space that is safe from oppressive cultural dynamics. CS departments could provide funding for these groups, physical space for them to meet, and other support in terms of programming and connections that help build a sense of community and inclusion.

Disrupt Superiority and Prestige Discourses

All those who work within the field of computing, including career development practitioners, must recognize how discourse can either promote or hinder diversity and inclusion aims. Those in power, in particular, should avoid perpetuating stereotypes about the "typical" engineer or computer scientist, including making jokes about them. There is an old but resilient joke that asks: "How can you tell if an engineer is an extrovert? An extroverted engineer will

look at your shoes, rather than his own while talking with you."[11] Note the gendered reference and the reference to Geek culture. This type of narrative should be avoided at all costs. Moreover, engineering leaders should avoid perpetuating superiority myths. Burack and Franks suggest saying instead "engineers work hard and solve problems" (p. 89). Furthermore, educators and practitioners should reject the "hard/soft" skills binary; instead, they should use descriptive terms like "technical skills" or "communication skills." Even with those terms, suggested by Buracks and Franks (p. 86), leaders must avoid positioning skills as mutually exclusive and hierarchical.

Another way that discourses can be used to promote diversity and inclusion in computing is to promote the benefits of the humanities. One former dean of Engineering once publicly remarked, "we don't need any more humanities PhDs." Another proclaimed that "Engineering is the new liberal arts." A counternarrative to these discourses might uphold humanities in their own right, without positioning them as secondary to engineering. Moreover, narratives (and practices) that promote and encourage collaboration between engineering and humanities could have the effect of enabling institutions to communicate value in both disciplines. At State U., for example, the CS department promotes research opportunities for undergraduates not only in Engineering school CS labs, but in labs across the College of Arts and Sciences, thereby expanding interdisciplinary collaborations.

As the faculty in this study shared, they see no intellectual difference between BA and BS students. Recognizing that the BA/BS hierarchy is ingrained in student culture, faculty could clearly communicate that all students in their courses are intellectual equals and that each student has the same chance for success, regardless of whether they are in the BA or the BS program.

[11] Also see this commentary from the Dartmouth Folklore Archive: https://journeys.dartmouth.edu/folklorearchive/2017/11/14/the-extroverted-engineer/

Reinforcing that narrative can have the double effect of reducing stereotyping of BA students (as seen through BS students' perspectives) and increase the confidence and self-efficacy of students in the BA program. Encouraging faculty to talk about CS applications to a broader range of careers (beyond software engineering) might also help students to see value in a more diverse and expansive skillset, beyond coding. Faculty should make students aware that employers seek a broad range of skills that go beyond the technical; that practice can help dismantle technocratic superiority myths and increase the value of human-centered skills to students' future careers.

Support Student Career Development with Diversity in Mind

In supporting students' career development, institutions must consider diversity in multiple ways: not only should they acknowledge the experiences and sense of marginalization of underrepresented students, but they should also promote and celebrate a variety career pathways. This might involve bringing more diverse employers to campus, building relationships with diverse alumni, and connecting students with jobs and internships in areas like Human Computer Interaction and other areas of computing that are underrepresented (i.e., non-software engineering careers). Computing departments should facilitate students' access to mentors both within and outside of the institution to help students navigate their careers. Recognizing the power of peer influences, universities might consider developing a career-peer support program to help students navigate career exploration and the internship/job search, in the same way that CS departments often rely on undergraduate teaching assistants to support the learning of course material. Computing departments should promote early career building experiences to help students build confidence and skills (and confidence in their skills!) not only with regard to careers in industry, but also in research. Recall the example of Fan, whose undergraduate research experiences "opened the research world" to her and inspired her to pursue a Ph.D.

Recognizing the diverse ways that students make career decisions, CS departments could help students see the practical applications of CS to a variety of careers and provide opportunities for students to gain experience through internships and other hands-on learning. As students in this study demonstrated, the relational aspects of career decision-making are powerful. As already mentioned, departments should encourage students to build relationships with faculty – and encourage faculty to be more welcoming to students. Career development practitioners and computing educators can acknowledge how families play an important role for some students, especially those who are first-generation college students or come from immigrant backgrounds. For students who make career decisions more circumstantially, CS departments should provide myriad opportunities to explore a variety of career pathways, try new things, and get experience. For some students who might feel a lack of confidence, building these experiences into the academic curriculum might be a way to foster career development in all students, not just the select few who find their way to the career center.

For State U., specifically, career workshops and programs targeted to BACS students might be helpful for those students to get to know the career center and its advisors. Ty described centering their gender and difference as an asset by engaging with organizations and conferences for women in computing, a positive approach rather than one based in overcoming a "deficit," (Harper, 2010). In a similar way, State U. career practitioners could help BACS students see their BA degree as an asset to their careers and help them articulate the value the humanities courses provide in addition to their technical acumen. Just as the women in this study developed counternarratives to the prestige discourses positioning the BS as superior to the BA, career practitioners can help students to see how their unique sets of interests, values, skills, and experiences can translate to a meaningful career post-graduation.

In their final chapter of *Unlocking the Clubhouse*, Margolis and Fisher (2002) said that institutions must "pay ferocious attention to the quality of the student experience" (p. 140). In the same way that the current study details student experiences in the BA program at State U., so must institutions pay attention to, recognize, and address issues faced by underrepresented students in computing. They can do this by having frequent and direct communication with students, both through one-on-one interactions and through group listening sessions. Almost twenty years later, Frieze and Quesenberry (2019) reflected on how Carnegie Mellon University (CMU), the site of Margolis and Fisher's original case study, was doing in terms of gender equity. In 2010, the CS department at CMU was comprised of 26% women; by 2018, that figure had reached almost 50%. Frieze and Quesenberry said this had been accomplished "by paying close attention to culture and environment, and taking a cultural approach rather than a gender difference approach" (p. 23). If institutions want to support the career development of women, and of all students, they need to pay consistent attention to students' experiences, particularly in relation to their career decision-making.

Implications for Future Research

This study used cultural-organizational theory to focus on the meso, or organizational, level of culture within one specific institutional context. With that in mind, it is possible that the "Arts and Crafts" narrative is more pronounced at State U. than at other institutions because there is such a strong organizational delineation between the College of Arts and Sciences and the School of Engineering. Future research could examine discourses among students in computing at other institutions to ascertain whether the BA/BS distinction exists elsewhere, and in what contexts prestige narratives play out.

In addition, the current case study could be expanded to better understand the experiences and perceptions of students across State U.'s computing programs, and to illuminate marginalized populations that might be "under the surface," as one of the faculty members in this study suggested. Specific populations that are ripe for inquiry include LGBTQ students, first-generation college students, Black, Latinx, and Asian students. Furthermore, as a couple of students alluded to the "toxic" culture in engineering and CS, a research study that explores the ways that engineering and computing culture promotes or hinders students' mental health and wellbeing would be useful. Comparing students' experiences with the culture in the BS program to students' experiences in the BA might also yield some additional insights into how the two tracks are gendered and infused with prestige discourses, among other nuances. Another component to this case might involve quantitatively analyzing the career engagement and outcomes for students in computing.

The findings from this study revealed different processes by which students developed and acted upon their career goals. These processes could be further explored using vocational theory, such as Social Cognitive Career Theory (SCCT) in conjunction with feminist theory. For example, Lapan and Smith (2023) used SCCT and Feminist Standpoint Theory to qualitatively investigate women students' experiences in computing internships. Brown and Lent's (2019) Career Self-Management model within SCCT might be particularly apropos to investigating career goal process themes because the theory focuses on career processes, rather than outcomes. Framing research with students in computing using SCCT can help integrate cultural and environmental factors with pre-college and identity factors.

Another research direction might involve the use of occupational closure theory to further investigate the ways the computing field closes itself to women and other underrepresented

minorities. A future study could interview men students, faculty, and other members of the computing power structure (such as employers) to identify gender and prestige narratives, and ways those narratives are being resisted in certain spaces. In many ways, studies that focus on "women in computing" -including the current study- can be problematic in that they reinforce gender binaries and obscure the voices of gender nonconforming and nonbinary persons. Smith (2021) offered a possible solution in proposing Cheng's (2020) framework of "ingressive" and "congressive" behaviors as alternatives to the gender binary in future computing education research (Smith, 2021, p. 444). In any case, future research must include women of Color as well as trans and nonbinary students to ensure that the voices of the most marginalized and oppressed are represented in scholarly research.

Conclusion

Through the use of a cultural-organizational-feminist framework, this study took a novel approach to examining gender inequity in computing. The findings shed light on the ways that women/nonbinary students experienced white/male hegemony and how discourses in computing that position CS as a masculine domain also uphold CS careers, especially software engineering, as the pinnacle to which computing students should aspire. These discourses interact and are leveraged by those already at the top of the hierarchy (men in engineering and computing) to exclude and marginalize people who do not conform to their narrow definition of who fits in computing. Unless those with power – CS department leadership, faculty, employers, and men students – actively deconstruct and resist these discourses, the inequalities will only continue. Cultural change has the power to not only invite more diverse participation, but also to transform the environment of computing into one that is more welcoming and sustainable for all who wish to participate. It is my hope that scholars, educators, and practitioners who read this study will be

inspired to change the culture of computing by interrogating and dismantling the discourses around gender and prestige within computing education.

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Table 1

Top Computer Science Programs in U.S. Higher Education

Institution	Location within Institution	Primary CS Program	Alternative/ Joint CS Programs	Rank*
Carnegie Mellon	School of Computer Science	BS in Computer Science	Bachelor of Computer Science & Arts (intercollege degree program w/ College of Fine Arts)	1
MIT	College of Computing	BS in Computer Science and Engineering	CS + X blended majors, offered jointly with other departments	1
Stanford	School of Engineering	BS in Computer Science	*CS + X pilot discontinued in Spring 2019*	1
UC Berkeley	College of Engineering	BS in Electrical Engineering and Computer Sciences	BA in Computer Science	1
Cornell	College of Computing and Information Science	BS in Computer Science	BA in Computer Science	5
Georgia Tech	College of Computing	BS in Computer Science	BS in Computational Media	5
U. Illinois, Urbana-Champaign	College of Engineering	BS in Computer Science	BS in Math & CS, BS in Statistics & CS, many blended CS + X programs	5

*Rankings reported based in the 2022 U.S. News & World Report "Best Undergraduate Computer Science Program Rankings." Other information was obtained from institutional websites. In 2018, State U.'s CS program ranked among the top 40 undergraduate CS programs.

Table 2

Starting Salaries for Computer and Information Sciences and Support Services Majors (U.S. Bachelor's Degrees)

Academic Major	# of Salaries	Mean	25th Percentile	Median	75th Percentile
Computer and Information Science	1573	$78,603	$59,538	$72,456	$103,528
Computer Programming	147	$86,098	$90,507	$90,507	$90,507
Data Processing	9	$44,124	$44,124	$44,124	$44,124
Information Science	113	$66,228	$62,083	$68,763	$72,533
Computer Systems Analysis	29	$52,951	$47,900	$60,656	$60,656
Computer Science	2419	$85,766	$70,639	$85,000	$98,571
Computer Software and Media Applications	83	$59,915	$49,000	$53,248	$69,099
Computer Systems Networking and Telecommunications	22	$57,591	$56,333	$56,333	$61,000
Computer/Information Technology Administration and Management	268	$59,032	$52,635	$58,000	$67,000

Adapted from "Bachelor's Degrees / Starting Salary by Academic Major," by National Association of Colleges and Employers, Summer 2021, *NACE Salary Survey: Final Starting Salaries for Class of 2020 New College Graduates*, p. 12.

Table 3

Student Participants

Participant	Gender Identity	Race/Ethnicity	Other Identities	Other Major/*Minor*	Career Plans
Ty	Nonbinary	Asian/Pacific Islander (Vietnamese American)	Refugee family, first-generation college student, "creative, artistic, nerd," woman in STEM, also, not a woman	*Asian Pacific American Studies*	Software Engineer for large banking company (return offer from internship)
Stephanie	Woman	Asian/Pacific Islander (Vietnamese American)	First-generation college student; refugee family	Psychology	UX Designer at a software company (return offer from internship)
Allyson	Woman	Asian/Pacific Islander (Vietnamese American)	First-generation college student; parents immigrated from Vietnam	Art History	Seeking employment at time of interview
Sherrilyn	Woman	Asian/Pacific Islander			Master's degree in commerce/finance, then finance job
Daphne	Woman	Asian/Pacific Islander		Economics	Consulting (hybrid between consulting and programming)

Participant	Gender Identity	Race/Ethnicity	Other Identities	Other Major/*Minor*	Career Plans
Kerry	Woman	Asian/Pacific Islander	Able-bodied, learning disorder, 2nd gen immigrant		Data science analyst at mortgage company
Fan	Woman	Asian/Pacific Islander (Chinese)	International student	Psychology	Ph.D. in CS at State U.
Leila	Woman	Middle Eastern	Muslim, hijabi, creative	*French*	Software engineer at global retail company
Miriam	Woman	White	Jewish	*Environmental Science*	Seeking job in tech + environment
Rose	Woman	White	Honors scholar	*Global Studies in Education*	Software development engineer (return offer from internship)
Helen	Woman	White	First-generation college student		Summer internship in software engineering, then Master's in CS
Gina	Woman	White	"extroverted introvert"	Mathematics	Cyber risk analyst for big consulting firm

Table 4

Provisional Codes

Code	Description	Source
Geek Culture	A subculture of CS characterized by a singular focus on computers.	Literature (Margolis & Fisher, 1997, 2002, 2003; Varma, 2007)
Brilliance Discourse	A discourse that says to be successful in computing, one must possess inordinate intelligence.	Literature (Metcalf et al, 2018; Patitsas, 2019)
Competition/Collaboration	A culture that reinforces competition and discourages collaboration.	Literature (Garvin-Doxas & Barker, 2004; Powell, 2008)
"Girl CS"	The gendered notion that certain sub-disciplines of CS are more appropriate for women or girls, and others for men and boys.	In vivo code (Lapan & Smith, 2023)
Gendered microclimates	The interpersonal and group dynamics present within the day-to-day experiences of participants, rather than the larger organizational culture.	In vivo code (Lapan & Smith, 2023)
Imposter syndrome	The sense that one is an "impostor" or a fake; fear that others might discover a perceived flaw or incompetence.	In vivo code (Lapan & Smith, 2023)
Proving competence	The need to go above and beyond what is expected in order to compensate for one's perceived incompetence.	Lapan & Smith, 2023
Support networks	Supportive relationships of any gender that provide encouragement a sense of belonging	Lapan & Smith, 2023

Figure 1

Theoretical Framework

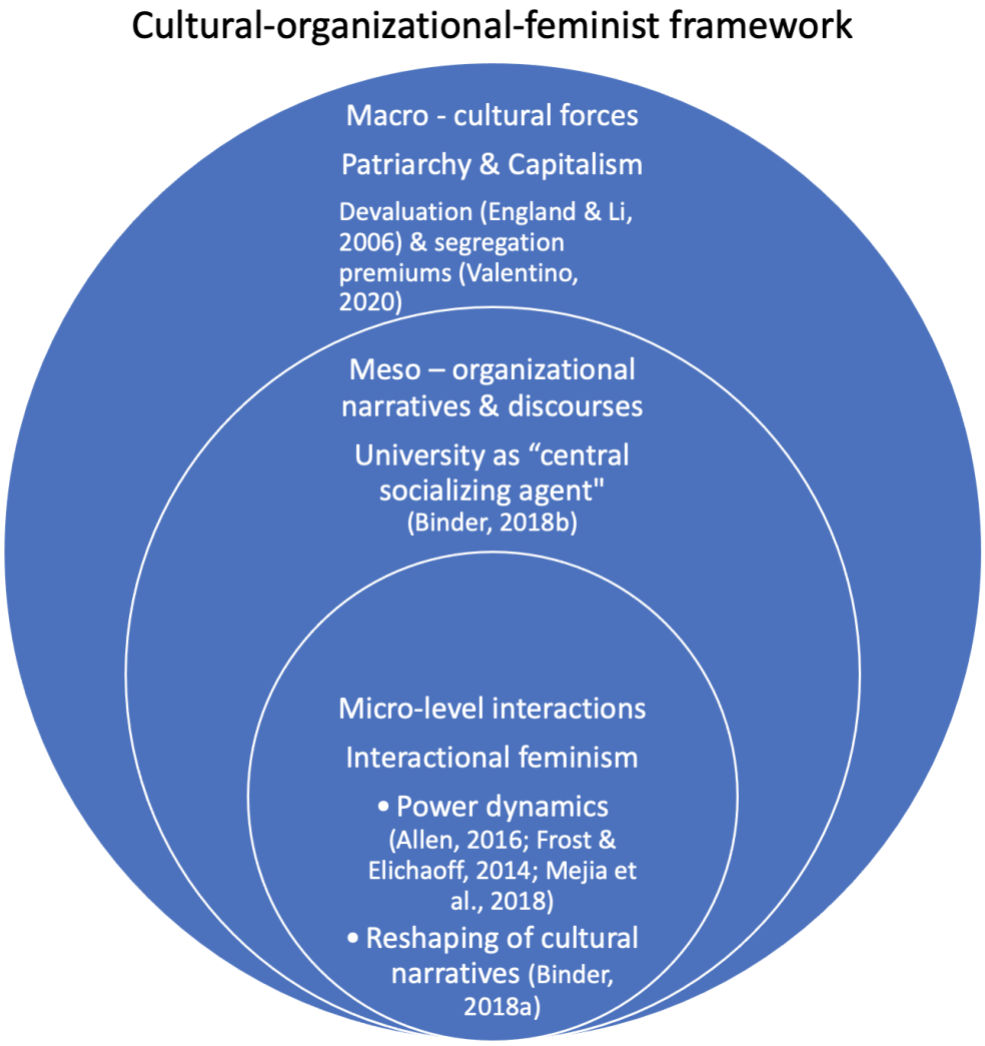
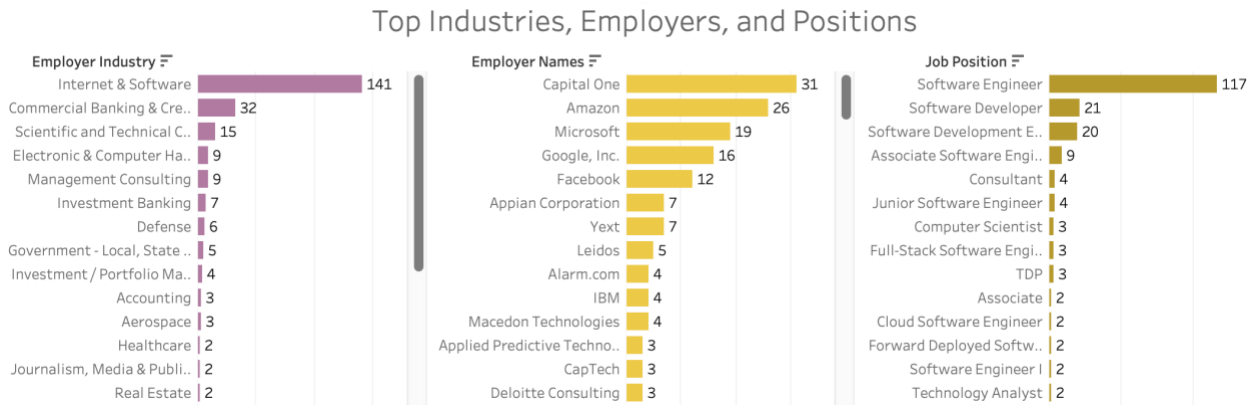


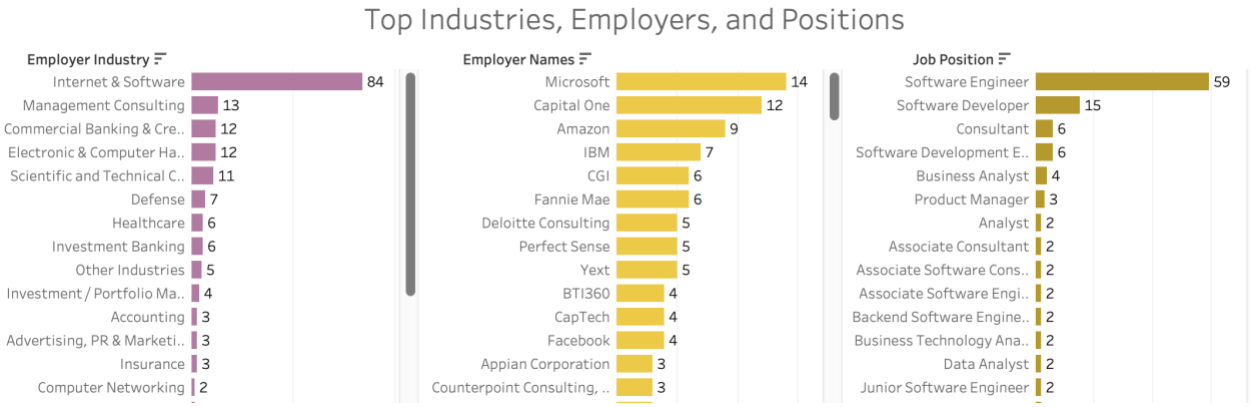
Figure 2

Career Outcomes for State U. Computer Science Graduates, 2018-2020

BSCS: Median salary: $99,000, 6% continuing education, 2% still seeking work or education



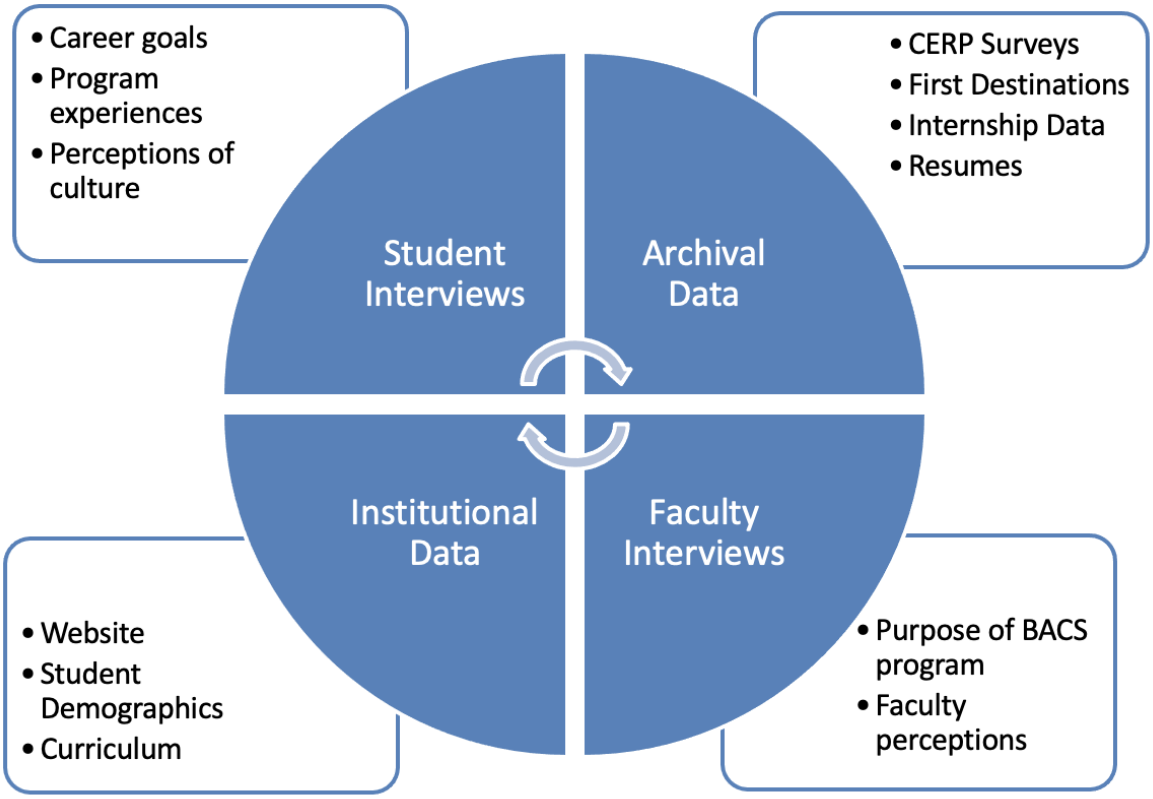
BACS: Median salary: $80,000, 5% continuing education, 6% still seeking work or education



Adapted from: State U. School of Engineering First Destination Survey (unpublished)

Figure 3

Data Sources



Appendix A

Initial Student Recruitment Email

Dear [First Name],

I am conducting a research study as part of the capstone requirement for my EdD in Higher Education at the University of Virginia (State U. IRB-SBS ####). My objective is to learn about women's experiences in State U.'s BACS program and how students' career goals evolve throughout the program.

I am seeking women students graduating from State U.'s BACS program who are willing to talk about their college and career-related experiences. Participants who are selected for the study will be invited to participate in an individual interview lasting approximately one hour, either in person or via Zoom (participant's choice). Participants will be asked a series of questions about their experiences in the BACS program and their past and future career plans. Interviews will be audio and/or video-recorded and will be treated as confidential. Pseudonyms will be used so that participant identities and other personal information will not be identifiable in final reports. After the interview, participants will be asked to review a written copy of their interview transcript for accuracy and will be compensated with a $20 Amazon gift card at the conclusion of the study. All students who identify as women, including cisgender and trans women, regardless of sexual orientation, are welcome to participate. I am especially interested in the experiences of a diverse group of women, so women of all racial/ethnic identities are encouraged to participate.

If you are interested in participating, please complete this brief survey: (see Appendix B) Please note that participation in this study is completely voluntary and participants may opt out at any time. Your decision to participate has no effect on your grades or access to State U.'s services, including career services. If you have any questions, or if you would like to discuss this study by phone or in person, please feel free to email me at Julia.Lapan@virginia.edu or call me at (434) 924-3050.

Thank you for your consideration,

Julia Lapan
Ed.D. Candidate, School of Education and Human Development
Director of Career Development, School of Engineering and Applied Science
University of Virginia

Appendix B

Student Recruitment Qualtrics Survey

Women's Career Development in CS

Start of Block: Intro

Thank you for your interest in the Women's Career Development in CS study. Please complete the following survey and the principal investigator will be in touch with you. This research study has been approved by State University's Institutional Review Board for the Social and Behavioral Sciences, Protocol ####. If you have any questions, please contact Julia Lapan at jcg9j@virginia.edu.

End of Block: Intro

Start of Block: Default Question Block

Please select your major(s) from the drop-down list (note: you must be majoring in BACS to qualify for this study):

- ☐ BA in Computer Science (1)
- ☐ Other major(s) (please specify) (2) _____

What is your anticipated date of graduation (month/year)?

- ○ Month (1) _____
- ○ Year (2) _____

Page Break

What is your gender?

- ☐ Woman (1)
- ☐ Other (optional to specify): (2) _____

What is your race/ethnicity? (check all that apply)

- ☐ African American/Black (1)
- ☐ Asian or Pacific Islander (2)
- ☐ American Indian or Alaskan Native (3)
- ☐ Hispanic/Latina (4)
- ☐ Caucasian/White (5)
- ☐ Other (please indicate): (6) _____

Page Break

Please provide information on how you can be reached to schedule an interview:

- ○ Name (1) _____
- ○ Email (2) _____

By Clicking this Box, I confirm that I am at least 18 years of age:

- ○ I confirm I am 18 or older (1)

End of Block: Default Question Block

Appendix C

Follow Up Student Recruitment Email

(Revisions to initial recruitment email in bold.)

Dear [First Name],

I am conducting a research study as part of the capstone requirement for my EdD in Higher Education at the University of Virginia (State U. IRB-SBS ###). My objective is to learn about women's experiences in State U.'s BACS program and how students' career goals evolve throughout the program.

I am seeking women students graduating from State U.'s BACS program who are willing to talk about their college and career-related experiences. Participants who are selected for the study will be invited to participate in an individual interview lasting approximately one hour, either in person or via Zoom (participant's choice). Participants will be asked a series of questions about their experiences in the BACS program and their past and future career plans. Interviews will be audio and/or video-recorded and will be treated as confidential. **Participants may also be asked to provide a copy of their resume to the principal investigator.** Pseudonyms will be used so that participant identities and other personal information, such as organizations worked at, will not be identifiable in final reports. After the interview, participants will be asked to review a written copy of their interview transcript for accuracy and will be compensated with a $20 Amazon gift card at the conclusion of the study.

All students who identify as women, including cisgender and trans women, regardless of sexual orientation, are welcome to participate. I am especially interested in the experiences of a diverse group of women, so women of all racial/ethnic identities are encouraged to participate. **Since it is late in the semester, I am very flexible with scheduling interviews, giving participants the option to schedule once courses/final exams are over, if preferable.**

If you are interested in participating, please complete this brief survey: (see Appendix B)

Please note that participation in this study is completely voluntary and participants may opt out at any time. Your decision to participate has no effect on your grades or access to State U.'s services, including career services. If you have any questions, or if you would like to discuss this study by phone or in person, please feel free to email me at Julia.Lapan@virginia.edu or call me at (434) 924-3050.

Thank you for your consideration,

Julia Lapan (she/her)
Ed.D. Candidate, School of Education and Human Development
Director of Career Development, School of Engineering and Applied Science
University of Virginia

Appendix D

Faculty Recruitment Email

Dear [First Name],

I am conducting a research study as part of the capstone requirement for my EdD in Higher Education at the University of Virginia (State U. IRB-SBS ####). My objective is to learn about women's experiences in State U.'s BACS program and how students' career goals evolve throughout the program.

I would like to speak with you to learn more about your BACS program and the ways that you view women's career development through the program. You are invited to participate in an individual interview lasting approximately 30-45 minutes, either in person or via Zoom (participant's choice). Participants will be asked a series of questions about the BACS program and women students' career development. Interviews may be audio and/or video-recorded and will be treated as confidential. Pseudonyms will be used so that participant identities and other personal information will not be identifiable in final reports. After the interview, participants will be asked to review a written copy of their interview transcript for accuracy.

If you are willing to participate, please let me know. Please note that participation in this study is completely voluntary and participants may opt out at any time. If you have any questions, or if you would like to discuss this study by phone or in person, please feel free to email me at Julia.Lapan@virginia.edu or call me at (434) 924-3050.

Thank you for your consideration,

Julia Lapan
Ed.D. Candidate, School of Education and Human Development
Director of Career Development, School of Engineering and Applied Science
University of Virginia

Appendix E

Student Interview Protocol

The following questions serve to guide a semi-structured interview. Additional probing questions may be asked following any of these prompts to elicit more details, especially when participant responses are especially rich, unique, or unclear. Specific areas to probe include responses around power dynamics, culture, status/prestige, and gendered experiences and discourses. *(Several of these questions were adapted from the interview protocol of Lapan and Smith, 2023, except where otherwise noted.)*

Introductory Questions:

1. How would you describe yourself? (or Would you please describe yourself?)
    a. What is/are your most salient identity(ies)?

2. What led you to pursue the BACS at State U.?

    a. What were your career goals upon entering the program?

3. Did you ever consider the BSCS program? Why or why not?
    a. How do you think the BA and BS programs in CS at State U. differ?
    b. What have you heard others say about the differences between the two tracks?

4. Have your experiences in the BACS program been consistent with what you were expecting?
    a. If yes, how so?
    b. If no, what surprised you?

Now I'd like to delve into some specific aspects of your college experience:

5. Would you please briefly describe your experience in CS courses?

6. What have your interactions been like with other students in CS?

7. Would you please describe your interactions with faculty?

    a. How about your interactions with staff/administration?

    b. What interactions, if any, have you had with career services (State U.'s Career Center and/or Engineering Career Center)?

8. Did you join any student groups? Why or why not? If so, what were your experiences with those groups?

9. Tell me about any internships or research experiences you may have had. (If none, probe why not.)

10. What have been your experiences with the recruitment process and the job market? (adapted from Larsen & Stubbs, 2005, p. 169)

11. Were there any interactions that you found particularly meaningful to your career plans during your college experience? If so, can you tell me about those interactions?

12. Can you describe a disappointment you experienced in your program?

    a. Can you recall a time when you were not part of the conversation?
    b. Or when you weren't chosen for something?

Next, I'd be interested in hearing your thoughts on CS culture:

13. Over the past few decades there has been much research on the underrepresentation of women in CS. What has this dynamic looked like, from your experience?

14. Were you aware that there are more women, proportionally, in the BA program than the BS program? Why do you think that is?

15. Did you ever witness (or experience yourself) any instances of being treated differently because of your gender, or any other identities? (If yes, probe for examples and feelings/perceptions).

To finish up the interview, I'd like to circle back to your career plans:

16. What are your career goals now?

17. How have your career goals evolved through participation in the BACS program?

    a. What, specifically, do you think influenced your career goals?

18. In what ways have you felt supported in your career development?

    a. Can you share any experiences of feeling not supported in your career development?

19. In what ways does the following statement resonate with you? “All CS students have equal opportunity when it comes to internships and full-time jobs”

20. In what ways could State U. better support its women in CS? Better support students in the BACS program?

Final question: Is there anything I didn’t ask that you wished I had asked? -OR- Is there anything else about this topic that you feel would be important for me to know?

Thank you again for participating in this study. I’m going to turn off the recorder at this point and I would be happy to answer any questions you might have off the record.

Appendix F

Faculty Interview Protocol

The following questions serve to guide a semi-structured interview. Additional probing questions may be asked following any of these prompts to elicit more details, especially when participant responses are especially rich, unique, or unclear. Specific areas to probe include responses around power dynamics, culture, status/prestige, and gendered experiences and discourses.

1. What is your title at State U.?_____
   a. Please describe your responsibilities:

   b. How long have you been in this role?

2. *(for someone with history with the program):* What is the history of the BACS program?

   a. When did it start?

   b. Why was it started?

   c. What was its original purpose?

   d. Is that still the purpose today?

3. My study is looking specifically at the career development for women in the BA program.
   a. Can you comment on what kinds of careers the BA program prepares students for?
   b. In what ways does the CS department support student career development?

4. Are there differences in what kind of student enters the BA track vs the BS track?

   a. If so, what are those differences?

   b. Why do you think those differences exist?

   c. *(if not addressed):* Why do you think there are more women in the BA program?

5. How do you think employers view students in the BA and BS programs in the hiring process?

6. Were you aware there is a salary difference between students graduating from the BA program vs the BS program? Why do you think that is?

7. What are your perceptions of your university's and your department's attempts for improving women's representation in CS?

8. Is there anything else you'd like to tell me?