STEM in Higher Education: Analysis of Gendered Themes Across Pacific Northwest Institutional Policies

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Although women earned about 50% of U.S. undergraduate STEM degrees in recent years (National Science Foundation, 2018a), women remain underrepresented in many STEM fields in the U.S. Gender disparities become more apparent at higher levels, with women comprising 45% of master's degrees, 41% of doctoral degrees, and 37% of post-doctoral positions (National Science Foundation, 2018b). Additionally, women with doctoral degrees in STEM fields hold only 38.5% of academic doctoral positions (National Science Foundation, 2019). These disparities extend beyond academia, with women occupying only 26% of non-academic STEM occupations (National Science Foundation, 2019).

Within academia, women faculty's underrepresentation in STEM is likely, at least in part, a result of structural conditions within institutions of higher education that disadvantage women. Women faculty are marginalized and discouraged by masculine work cultures (e.g., Richman et al., 2011; Gupta, 2007; Burger, 2009; Uriarte et al., 2007), which ultimately counteract their career trajectories. Masculinized stereotypes that accompany these work cultures inherently exclude women faculty (Cheryan et al., 2013; Cheryan et al., 2017; Kmec, 2013) and make women more likely to have negative perceptions of academic work climates than men (Riffle et al., 2013). Other ways in which women faculty are marginalized within STEM fields include highly specific and sexist dress codes (Heflin, 2015), inaccurate representations of women at work (Osei-Kofi & Torres, 2015), and depictions of women in STEM that emphasize their personal relationships or relationships with men instead of their contributions (Moreau & Mendick, 2012; Osei-Kofi & Torres, 2015; Heflin, 2015). These structural forces have a doubly negative impact on women faculty in STEM by making them uncomfortable in their workplaces

and misrepresenting them and their work. Additionally, women faculty are further marginalized in the workplace because these same instances of misrepresentation and depiction of personal relationships are not applied to men in a similar fashion.

The strides institutions have taken to acknowledge systemic gender inequality and attempt to remediate it are noteworthy. Previous scholarship suggests that policies targeting gender equality and inclusion may help support women faculty, promote greater numbers of female applicants (Gardner, 2012), and aid their promotion prospects (Britton, 2010). However, this body of literature lacks a more robust analysis of institutional policies and their connection to persistent gender inequality in the academy. In this study, we apply Acker's Theory of Gendered Organizations (1990) to the higher education setting by analyzing policy texts from each institution's website to assess the extent to which they are dominated by conventionally masculine or feminine language. A holistic summary and institution-specific findings are presented in the results section below. We conclude with implications for recruitment/retention policies, representation, and directions for future research. In the next section, we discuss Acker's Theory of Gendered Organizations and the current literature on gender and STEM in higher education.

Theory of Gendered Organizations

A gendered organization (G.O.) is an organization that is constructed in ways that favor one gender, almost always the masculine gender (Acker, 1990; Acker, 1992). The process of gendering, or the process by which an organization comes to favor one gender, occurs at the cultural level through the reflection and reproduction of gender through policies and practices, inter-worker interactions that reproduce inequality, and the construction of worker identities in gendered ways through their work (Britton & Logan, 2008). The interdependence of gender and

organizations creates and reinforces gender inequality because gender becomes embedded in organizational logic, or the fundamental "assumptions and practices that construct most organizations" (Acker, 1990, p. 147).

Gendered assumptions inform components of organizations (e.g., hiring materials and processes, search committees, promotion processes), which perpetuates gendered processes, maintains inequality, and ultimately undermines attempts at gender neutrality (Acker, 2012). These assumptions are often referred to as gender subtexts (Smith, 1988), or the underlying, latent functions of an organization's policies and procedures that "systematically reproduce distinctions based on gender" (Bendl, 2021, p. 34). On the surface, the policies and procedures organizations abide by—whether explicitly written or implied—seem gender neutral. However, *intentions* of maintaining gender-neutral operations often result in disparate impacts on women in the workplace when *implemented* (Acker, 2012). In other words, written and unwritten rules that outline and shape an organization's functions often have *de jure* gender-neutral language, but lack of explicit consideration for ways in which women may be marginalized result in a *de facto* gendered implementation of policies.

Higher Education as a Gendered Organization

Despite research that supports implicitly gendered policies, higher education was only recently recognized as a gendered organization (Lester et al., 2017). Much of the G.O. literature examines how women faculty experience gender inequality at work via policy impacts (Britton, 2010), women's experiences in and perceptions of their work climates (Britton, 2017), and pathways to advancement (Hart, 2016). For instance, departmental promotion requirements outline expectations that professors must meet to advance their careers, which often consist of some combination of teaching, research, and service. Typically, these parameters for promotion

are not given equal weight (e.g., research accomplishments are often prioritized in evaluation over service—see Denker, 2009; Bird, et al., 2004), and women generally participate in and are *asked* to participate in service at higher rates than men (University of Oregon Social Sciences Feminist Network Research Interest Group, 2017; Moore, et al., 2010). Service to the institution often creates additional work and requires a large time commitment that is infrequently acknowledged or rewarded in tangible ways, such as through compensation or promotion. Other common examples of gendering in STEM include so-called "chilly" climates that marginalize women (Hirshfield, 2010; Riffle et al., 2013; Smith-Doerr et al., 2016), masculine work cultures (Richman et al., 2011; Gupta, 2007; Uriarte et al., 2007; Burger, 2009; Smith-Doerr et al., 2016), and negative stereotypes about women in STEM (Cheryan et al., 2013; Cheryan et al., 2017; Kmec, 2013).

Additionally, gendered substructures, or hidden organizational processes that reproduce gendered assumptions and perpetuate gender inequities, manifest clearly within academic evaluation criteria. Workplaces, including postsecondary institutions, expect their employees to be available to work without responsibilities outside of work (i.e., the ideal worker norm) (Acker, 2006; Williams et al., 2013). Though not explicitly a gendered concept, the ideal worker norm has a disproportionately negative effect on women, who are often expected to bear primary caregiving responsibilities for children. Gender equity requires solutions that are not based on the masculine model of faculty member/scientist, but ubiquitous gender subtexts tend to get in the way of equitable implementations.

Barriers to Gender Equity in STEM. The effects of gender bias have unique negative impacts to women. Men are often perceived as more hirable and competent, and tend to receive higher salaries and more mentoring opportunities (Moss-Racusin et al., 2012). These

preconceptions invoke identity threat to women scientists who may worry that any of their own shortcomings will be attributed to women scientists as a group and, in turn, devalue women scientists as a group. These concerns impact women's sense of belonging in their fields and hinder their performance (Cheryan et al., 2009; Schmader & Beilock, 2012; Walton et al., 2015).

Gendered concerns that women face in their work also impact the type of work with which they choose to engage, as well as their perception of the compatibility of their work with other parts of their lives. Women scientists tend to engage in research that benefits or contributes to society, while their male counterparts often strive to produce research that is theoretically based, with less of an explicit benefit to society (Parson, 2016; Smith-Doerr et al., 2016; Kongar et al., 2008; Espinosa, 2011). Regarding work-life balance, women often bear additional responsibilities outside of work (e.g., childcare or caregiver responsibilities) that can conflict with their work responsibilities, compounded with lack of paternity leave and stigma around flexible work accommodations (Ceci & Williams, 2011; Cech & Blair-Loy, 2014). The gendered nature of activities outside of work can be incongruous with and inhospitable to women in STEM because their colleagues are more likely to be male than other fields, such that they may not bear similar responsibilities outside of work.

Efforts to Support Women in STEM. Despite the masculinized nature of postsecondary education systems and STEM fields in particular, some institutions have implemented programs and policies that attempt to remedy women's disadvantage. Mentoring programs, for example, are commonly implemented to support diverse faculty and attempt to mitigate structural conditions that emphasize masculine values. Scholars have also suggested that institutions of higher education move away from individual-oriented practices in favor of more structural solutions for retaining women in STEM (Fox et al., 2011). Some institutions have responded to

the call for more structural solutions by implementing policies and practices that attempt to reduce structural barriers, or the underlying causes of women's underrepresentation in STEM. One recent example comes from Seattle University, where tenure and promotion guidelines were reconfigured to value all academic responsibilities, including service activities that often become "invisible labor" and disproportionally fall to women faculty (O'Brien, et al., 2023).

Policies and practices that aim to help women in academia (e.g., paid parental leave; Diversity, Equity, and Inclusion (DEI) training; and implementing institutional support programs) have resulted in increased engagement and sense of belonging (O'Brien & Moss-Racusin, 2020), job satisfaction (Smith et al., 2018), and more positive attitudes towards women in STEM (Moss-Racusin et al., 2021). Additionally, initiatives that directly target inclusion and climate in academia (e.g., NSF-funded ADVANCE) can improve women's retention in STEM (Bilimoria et al., 2008; Stepan-Norris & Kerrissey, 2016).

In the following sections, we present our assessment of institution and department policies prior to the implementation of one such initiative: the ADVANCE VAuLTS program. We examined how written policies manifest as gender subtexts (Acker, 1990; Acker, 2012), and assessed the extent to which institutions adopt policies that negatively affect women's retention (Gardner, 2012) or marginalize women in STEM. Similarly, a *lack* of policies also impacts the gendered substructure, given that a lack of explicit, formal practices and guidelines for tenure and promotion make promotion to full professor difficult for women faculty (Britton, 2010). We based our criteria on past studies of organizational culture through text, which found that language intended to be gender-neutral is often gendered (Bejerano & Bartosh, 2015; De Pillis & De Pillis, 2008; Moreau et al., 2010; Moreau & Mendick, 2012; Parson, 2016). Examples of gendered language include authoritarian and individualistic tones (rather than collaborative

and/or relational themes—see De Pillis & De Pillis, 2008; Parson, 2016; Bejerano & Bartosh, 2015); language promoting competitive and "chilly" climates (Parson, 2016); and an emphasis on "masculine" thinking, or a scientific paradigm that is limited in scope (such as pursuing primarily theoretical research) and does not consider addressing social issues (Berjerano & Bartosh, 2015; Parson, 2016; Uriarte et al., 2007).

We analyzed policies related to tenure/promotion, recruitment, retention, and professional development opportunities; including guidance on promotion processes; professional development programs, materials, and opportunities; job advertisements and descriptions; institution-wide faculty handbooks; departmental handbooks for faculty and graduate students, as graduate students are "in the pipeline" to become future faculty. Data were also collected from DEI initiatives and department-specific webpages. We selected these policies as tenure/promotion, professional development opportunities, and handbooks are resources that faculty can use to advance in their career. Given the barriers women faculty in STEM fields have been noted to face in terms of their career advancement (Richman et al., 2011; Gupta, 2007; Burger, 2009; Uriarte et al., 2007), it is important to ascertain if these obstacles are in part a function of the gender subtexts embedded in the materials intended to serve as resources and provide guidance in promotion decisions. This study investigated differences in gender subtexts across multiple institutions with varying contexts, including doctoral granting universities and primarily undergraduate-serving schools, like community colleges. As such, this is a novel, exploratory investigation to understand institution policies' connection to persistent gender inequality in the academy.

Methods

We created an archive of institutional policies related to promotion, tenure, recruitment, retention, and professional and leadership development, targeting initiatives related to advancement from 13 schools in the Pacific Northwest. All schools participated in the Values-based Academic Leadership Trajectories for Women in STEM (VAuLTS) project, funded by the National Science Foundation ADVANCE partnership award (HRD 1936019). Participating institutions were selected to represent different higher education settings in the Pacific Northwest (PNW): doctoral-granting and primarily undergraduate-serving institutions as well as community colleges. The focus on PNW was a function of the fact that the partnership activities benefited significantly from geographic proximity, which facilitated frequent in-person visits and project events, and because of commonalities in regional institutional culture (e.g., same state-wide regulations impacting higher education). Leadership from partner institutions represents a core group committed to the proposal writing, and subsequently implementation of VAuLTS. Most are administrators or otherwise involved in Diversity, Equity, Inclusion (DEI) or faculty career-development work (e.g., member of the ADVANCE team) at their respective institution. Policies included those at the department and institution levels, and were considered along with job ads and evaluation-related materials. We were particularly interested in policies and materials affecting faculty, and also considered graduate students as they frequently enter the academy upon graduation. In this way, graduate students' experiences impact future faculty, as they in fact represent the faculty "pipeline."

Data Collection

Data were collected from each institution's website using selected keywords (see Table 1, below). A list of institutions and their demographics are available in Table 2. Keywords were

developed after compiling a list of policies we aimed to collect. These lists were then distributed to our research team members at each school to determine if any relevant materials or keywords were missing from our lists.

Table 1

Website Search Keywords

General Search	Department Level Search
• Faculty handbook • Faculty manual • Promotion • Tenure • Career-Track • Professional development • Faculty resources • Retention • Recruitment • Bargaining agreement • Faculty senate • Human resources • Employment • Employment opportunities	• Department • Department + policies • Department + procedures • Department + faculty + policies • Department + faculty + procedures • Department + faculty + resources

Table 2

Institution Demographics

Institution	Institution Type	Public or Private	% Women Faculty
Bellevue College	Primarily Undergraduate Institution	Public	57.36
Columbia Basin College	Primarily Undergraduate Institution	Public	52.30
Everett Community College	Primarily Undergraduate Institution	Public	54.80
Heritage University	Primarily Undergraduate Institution	Private	56.60
Missoula College	Primarily Undergraduate Institution	Public	51.72
Montana State University	Doctorate Granting Institution	Public	47.80
Oregon State University	Doctorate Granting Institution	Public	42.03
University of Montana	Doctorate Granting Institution	Public	42.55
Washington State University	Doctorate Granting Institution	Public	43.36

Wenatchee Valley College	Primarily Undergraduate Institution	Public	54.8
Western Washington University	Doctorate Granting Institution	Public	47.23
Whatcom Community College	Primarily Undergraduate Institution	Public	60.7
Yakima Valley College	Primarily Undergraduate Institution	Public	52.24

We conducted policy searches through the search function on each institution's webpages. Upon completing the general key term searches, we then conducted a search at the department level with the department key terms below following the same procedure. We only included STEM departments in our analysis. We compiled lists of STEM departments for each institution (see Table 3, below) and asked our institutional leads familiar with these settings to review and revise the list as needed.

Most of the institutions in our sample had promotion/tenure criteria in their collective bargaining agreements or faculty handbooks. If we were unable to access or locate these materials, members of our research team from those institutions provided these documents. Table 4 shows a breakdown of the number of policies collected from each institution. From these policies, we calculated several metrics as part of a baseline prior to the VAuLTS Program implementation. Metrics included polarity scores for relevant concepts, an overall feminine-masculine polarity score, and word and phrase frequencies for each concept (n-gram).

Table 3

STEM Departments by Institution

Institution	STEM Departments
Bellevue College	Anthropology; Astronomy; Biology; Botany; Chemistry; Communication Studies; Computer Science; Cultural and Ethnic Studies; Economics; Engineering; Environmental Science; Geography; Geology; Life Sciences (Includes nutrition); Mathematics; Meteorology; Molecular Biosciences; Network Services and Computing Systems; Oceanography; Physics; Political science/international studies; Psychology; and Sociology
Columbia Basin College	Agricultural Food Systems; Agriculture; Anthropology; Astronomy; Biology; Chemistry; Communication Studies; Computer Science; Computer Science and Information Technology; Cyber Security; Economics; Electronics; Engineering Technology; Environmental Science; Fire Science; General Engineering; Geography; Geology; Horticulture; Mathematics; Nuclear Technology; Nutrition and Food Science; Physics; Political Science; Psychology; and Sociology
Everett Community College	Anthropology; Astronomy; Atmospheric Science; Biology; Botany; Chemistry; Computer Information Systems; Computer Science; Communication Studies; Economics; Engineering; Engineering Technology; Environmental Science; Fire Science; Geography; Geoscience; Information Technology; Mathematics; Mechatronics; Natural Science; Nutrition; Oceanography; Physics; Political science; Psychology; Sociology; and Veterinary Medicine
Heritage University	Biology; Computer Science; Environmental Studies; Mathematics; Pre-engineering; Psychology; and Sciences
Missoula College	Applied arts and sciences; and Applied computing and engineering technology
Montana State University	Agricultural Economics and Economics; Animal and Range Sciences; Cell Biology and Neurosciences; Chemical and Biological Engineering; Chemistry and Biochemistry; Civil Engineering; Computer Science; Earth Science; Ecology; Electrical and Computer Engineering; Land Resources and Environmental Sciences; Mathematical Sciences; Mechanical and Industrial Engineering; Microbiology and Immunology; Physics; Plant Sciences and Plant Pathology; Political Science; Psychology; and Sociology and Anthropology

Institution	STEM Departments
Oregon State University	Agricultural Education and General Agriculture; Animal and Rangeland sciences; Biochemistry and biophysics; Biological and ecological engineering; Botany and Plant Pathology; Chemistry; College of Earth, Ocean, and Atmospheric Sciences; Crop and soil science; Environmental and Molecular Toxicology; Fisheries and wildlife sciences; Food science and technology; Forest ecosystems and society; Horticulture; Integrative biology; Mathematics; Microbiology; Physics; School of Chemical, Biological, and Environmental Engineering; School of Civil and Construction Engineering; School of Electrical Engineering and Computer Science; School of Language, Culture, and Society; School of Mechanical, Industrial, and Manufacturing Engineering; School of Nuclear Science and Engineering; School of Psychological Sciences; School of Public Policy; and Wood Science and Engineering
University of Montana	Anthropology; Biological Sciences; Biology; Chemistry and Biochemistry; Communication Studies; Computer Science; Economics; Ecosystem and Conservation Science; Environmental Studies; Forest Management; Geography, Geosciences; Mathematical Science; Physics and Astronomy; Political Science; Psychology; Society and Conservation; Sociology; and Wildlife Biology
Washington State University	Animal Sciences; Anthropology; Biological Systems Engineering; Chemistry; Civil and Environmental Engineering; Crop and Soil Sciences; Economic Sciences; Engineering and Computer Science; Entomology; Food Science; Global Animal Health; Horticulture; Institute of Biological Chemistry; Integrative Physiology and Neuroscience; Mathematics; Physics and Astronomy; Plant Pathology; Psychology; School of Biological Sciences; School of Chemical Engineering and Bioengineering; School of Electrical Engineering and Computer Science; School of Mechanical and Materials Engineering; School of the Environment; Sociology; and Veterinary Microbiology & Pathology
Wenatchee Valley College	Natural and Physical Sciences, Social Sciences; Natural Resources; Computer Technology; Math; Engineering; Electronics; Aerospace electronics; and Fire science
Western Washington University	Anthropology; Behavioral neuroscience; Biology; Chemistry; Communication studies; Computer science; Economics; Engineering and design; Environmental Science; Environmental Studies; Geology; Mathematics; Physics/Astronomy; Political Science; Psychology; Sociology; and Women, Gender, and Sexuality Studies
Whatcom Community College	Mathematics; Sciences; Social Sciences; and Technology

Institution	STEM Departments
Yakima Valley College	Aerospace Machining Technology; Agriculture; Anthropology Biology; Chemistry; Communications/Speech; Computer Science; Economics; Engineering; Geography; Geology; Information Technology; Mathematics; Nutrition; Physics; Political Science; Psychology; Sociology; Tree Fruit; Veterinary Technology; Vineyard Technology; and Winery Technology

Table 4

Policy Breakdown by Institution

Institution	Department Materials	Diversity Reports	Faculty Agreements & Handbooks	Faculty Senate	Job ads & Hiring Materials	Performance Evaluation Materials	Professional Development Materials & Opportunities	Promotion & Tenure Materials	University-wide Policies
Bellevue College	48	0	0	0	3	3	4	0	16
Columbia Basin College	26	0	2	0	10	0	2	7	0
Everett Community College	37	0	3	0	15	0	10	0	0
Heritage University	7	0	1	0	5	0	1	0	1
Missoula College	3	0	1	0	1	1	1	1	0
Montana State University	92	1	27	1	14	1	7	0	32
Oregon State University	238	2	11	7	0	0	12	0	50
University of Montana	89	2	2	11	4	8	7	3	39
Washington State University	180	0	3	3	21	0	10	1	21
Wenatchee Valley College	26	0	2	0	2	0	1	1	0
Western Washington University	70	0	9	6	18	2	0	0	29
Whatcom Community College	6	0	2	0	6	0	4	0	2
Yakima Valley College	21	0	3	0	8	0	0	1	0

Metrics (Polarity Scores)

Polarity scores are common in sentiment analysis of text (Taboada et al., 2011). Typically, they are applied to more simplistic tasks, such as calculating the positive and negative sentiment of restaurant reviews (e.g., Ding et al., 2008; Taboada et al., 2011). We used polarity scores to calculate the presence (or absence) of concepts related to gender and STEM, as well as the overall feminine-masculine polarity of each group of texts.

Each concept was measured by finding word matches on a list of words representing each concept, or a *lexicon* (see Table 5 for the specific words in each lexicon). To calculate a concept's polarity score, the R algorithm we've developed looks for matches in each concept's lexicon with words in each group of texts. It then calculates the score as follows:

$$concept\ polarity\ score = \frac{total\ concept\ word\ matches}{total\ words}$$

The second polarity score we calculated is the overall feminine-masculine polarity score. Positive scores indicate more feminine polarity, while negative scores indicate more masculine polarity. Scores of 0 are complete neutrality, either due to feminine and masculine matches canceling each other out, or a complete absence of either feminine or masculine concepts (it will be important to explore which type of neutrality, if any, exist). The algorithm looks for matches from both the feminine and masculine concepts, and these polarity scores were calculated as follows:

$$feminine\text{-}masculine\ score = \frac{feminine\ matches - masculine\ matches}{total\ words}$$

It is important to note that we removed extraneous words, or stop words, before calculating these polarity scores, so the scores and results better reflect the actual concepts. Examples of stop words range from unnecessary words or symbols (such as "www") to more

subtle stop words that use the concepts in unrelated ways to our analysis (such as “biological diversity” and “human resource services”). In other words, there was some automation of the finding of matches using R statistical software.

Concepts and Lexicons

Using Morton’s (2019) concepts and lexicons, we initially looked at four concepts (two feminine and two masculine): feminine collaboration, feminine socially-connected science, masculine expectations of brilliance, and masculine scientific thought. In creating these concepts, we completed a review of interdisciplinary studies about gender and STEM. From these findings, we created lexicons, or word lists, to indicate the presence of these concepts. To be clear, these lexicons reflect socialized characteristics or traits that are disproportionately associated to or benefiting one gender, as shown through empirical research. This is not to say that *only* men value scientific thought or *only* women value socially-connected science. Below, we include our justification for these concepts and Table 5, which provides the empirical support for our concepts and lexicons.

Collaboration Across Disciplines (Feminine). Although women in STEM often report a more negative workplace climate than men (Riffle et al., 2013), promoting a supportive, inclusive, and collaborative culture is a viable solution to improving women’s perceptions of the workplace climate (Fox, 2000; Rhoten & Pfirman, 2007; Kongar et al., 2008; Kasarda et al., 2010). This is not a surprise, as women tend to value collaborative cultures, interdisciplinary research, and working in teams while conducting their research (Kongar et al., 2008; Fox, 2000; Rhoten & Pfirman, 2007; Smith-Doerr, 2005). Besides collaboration, there is support for women having proclivities towards interdisciplinary research (Rhoten & Pfirman, 2007; Van Rijnsoever & Hessels, 2011), although bureaucratic structures provide a disadvantage for women in this

area. Because collaboration across disciplines may be particularly important to women faculty in STEM, we included this concept as being a part of feminine organizational culture.

Socially-Connected Science (Feminine). We labeled socially-connected science, or science done with the purpose of contributing to society, as a part of feminine organizational culture. Women in STEM are found to value traits such as social consciousness, public welfare, and social responsibility more so than men, who typically have more masculine values such as technological leadership (Cech, 2015; Cech, 2014; Canney & Bielefeldt, 2015). In several studies, women expressed interest in doing research that impacts society (Smith-Doerr et al., 2016; Kongar et al., 2008; Espinosa, 2011). The notion of engaging in socially-conscious scientific pursuits reinforces the idea that women are inclined to do research that crosses disciplines and serves missions and stakeholders outside of academia (Rhoten & Pfirman, 2007).

Expectations of Brilliance (Masculine). The first masculine cultural concept we considered was expectations of brilliance. The social science literature has shown that academic fields with the highest expectations of brilliance, or the expectation that one must be brilliant or a genius to succeed in their field, have the lowest proportions of women (Leslie et al., 2015; Storage et al., 2016). Relatedly, women also typically perceive competitive environments in STEM more negatively than men (Gupta, 2007), and one study found that one of the biggest factors discouraging female students in engineering is competition in the classroom (Burger, 2009). Ultimately, competition may be a factor that discourages women to enter STEM fields (Uriarte et al., 2007; Smith-Doerr et al., 2016; Burger, 2009).

Masculine Scientific Thought (Masculine). The last masculine cultural concept is masculine thought, which is defined as a scientific paradigm that is limited in scope (such as to only theoretical pursuits) and does not consider addressing social issues (Uriarte et al., 2007). As

a result of women's proclivity towards scientific research that helps society, women leave academic STEM fields in part because of the inability to make STEM education accessible or aligned with their goals of contributing to society (Espinosa, 2011); as such, socially-disconnected science is often problematic for women in STEM (Uriarte et al., 2007; Rhoten & Pfirman, 2007).

Table 5

Concepts and Indicators to Measure Organizational STEM Culture in Texts

Masculine STEM Culture		
Concepts/Indicators	**Lexicon**	**Sources**
Expectations of Brilliance • Emphasizing a program as rigorous or highly-ranked • Competitiveness • Expectations of Brilliance	innovative, research innovation, unparalleled, world class, world leading, worlds leading, competitive, in competition, much competition, award competition, perfect competition, global competition, global competitiveness, factors competition, of competition, top college, top student, top professors, top faculty, top department, top hiring, top promotion, rated top, top ranked, top program, top notch, top tier, top area, top university, brilliant, ambitious, rigor, rigorous, prodigy, leading institution	Parson, 2016; Mervis, 2011; Gupta, 2007; Uriarte et al., 2007; Smith-Doerr et al., 2016; Leslie et al., 2015; Storage et al., 2016
Masculine Thought • Linear, rational thinking • Knowledge as static and unchanging • Socially-disconnected science • Emphasis on theoretical rather than	central science, independent laboratory, independent solution, independent research, work independently, independent thought, think independently, independently research, independent work, specialized, rigid, vigor, vigorous, competing theories, theoretical knowledge,	Parson, 2016; Smith-Doerr et al., 2016; Kongar et al., 2008; Espinosa, 2011

practical application of science	theoretical approaches, theoretical approach, theoretical perspective, theoretical advance, theoretical focus, theoretical directions, theoretical grounding, theoretical idea, theoretical discussion, theoretical work, theoretical background, theoretical development, emphasizing theoretical, theoretical foundation, theoretical basis, powerful method, challenging theoretical, theoretical orientation, exceptional theoretical, strong theoretical, theoretical underpinning, important theoretical, originality	
Feminine STEM Culture		
Concepts/Indicators	**Lexicon**	**Sources**
Collaboration Across Disciplines • Teamwork collaboration • Emphasis on interdisciplinary research • Learning as a collaborative process • Personalized Education	partnership, versatile, comprehensive study, comprehensive program, teamwork, collaboration, collaborative, interdisciplinary, multiple disciplines, multidisciplinary, multi-disciplinary, integrative approach, integrative discipline, integrative learning, multifaceted	Kongar et al., 2008; Smith-Doerr, 2005; Fox, 2000; Rhoten and Pfirman, 2007; Sharpe and Sonnert, 1999; Sonnert et al., 2007; Bettinger and Long, 2005; Schneeweis and Zweimüller, 2012; Stearns et al., 2016; Robst et al., 1998; Price, 2010; Griffith, 2010; Marra et al., 2012; Chanderbhan-Forde et al, 2012; Dalrymple and Evangelou, 2006; Daily et al., 2007
Socially-Connected Science • Involvement in social justice issues • Diversity and inclusion • Research that has practical applications • Field is considered dynamic	supportive, welcoming, environmentally conscious, practicality, practical application, social justice, useful science, soft skills, community service, learning community, service to community, service to society, service learning, service-	Smith-Doerr et al., 2016; Espinosa, 2011; Kongar et al., 2008; Rhoten and Pfirman, 2007; Bejerano and Bartosh, 2015; Parson, 2016; Heflin, 2015

• Emphasis on problem-solving	learning, improve society, socially connected science, socially-connected science, build connection, build social connection, impact of science, impactful science, impact on society, meaningful, empathy, empathetic, diverse, diversity, inclusive, inclusion, friendly environment, friendly atmosphere, sustainability, environmentally friendly, sustainable, caring community, caring individualized, caring faculty, caring professors	

Findings

Institutional Comparisons

Figure 1 below shows the polarity scores for the four concepts (feminine collaboration, feminine social connection, masculine brilliance, and masculine thought) in each institution's combined policies. Longer bars to the right indicate more feminine polarity, while longer bars to the left indicate more masculine polarity. Overall, there was a high presence of feminine social connection across institutions, especially Heritage University, Oregon State University, and Western Washington University. Feminine collaboration had the largest presence in Montana State University, Washington State University, Yakima Valley College, and Oregon State University.

While the two masculine concepts were less present in the overall institutional policies, masculine brilliance was highest for Washington State University and Oregon State University. While the masculine thought scores were low for all institutions, they were highest for Heritage University and Columbia Basin College.

With respect to the balance of feminine and masculine concepts, institutions such as Yakima Valley College and Everett Community College had a much higher presence of feminine concepts than masculine, but Washington State University and Columbia Basin College had about an equal presence of masculine and feminine concepts in their policies.

Figure 1

Feminine and Masculine Concept Overall Policy Polarity Scores by Institution

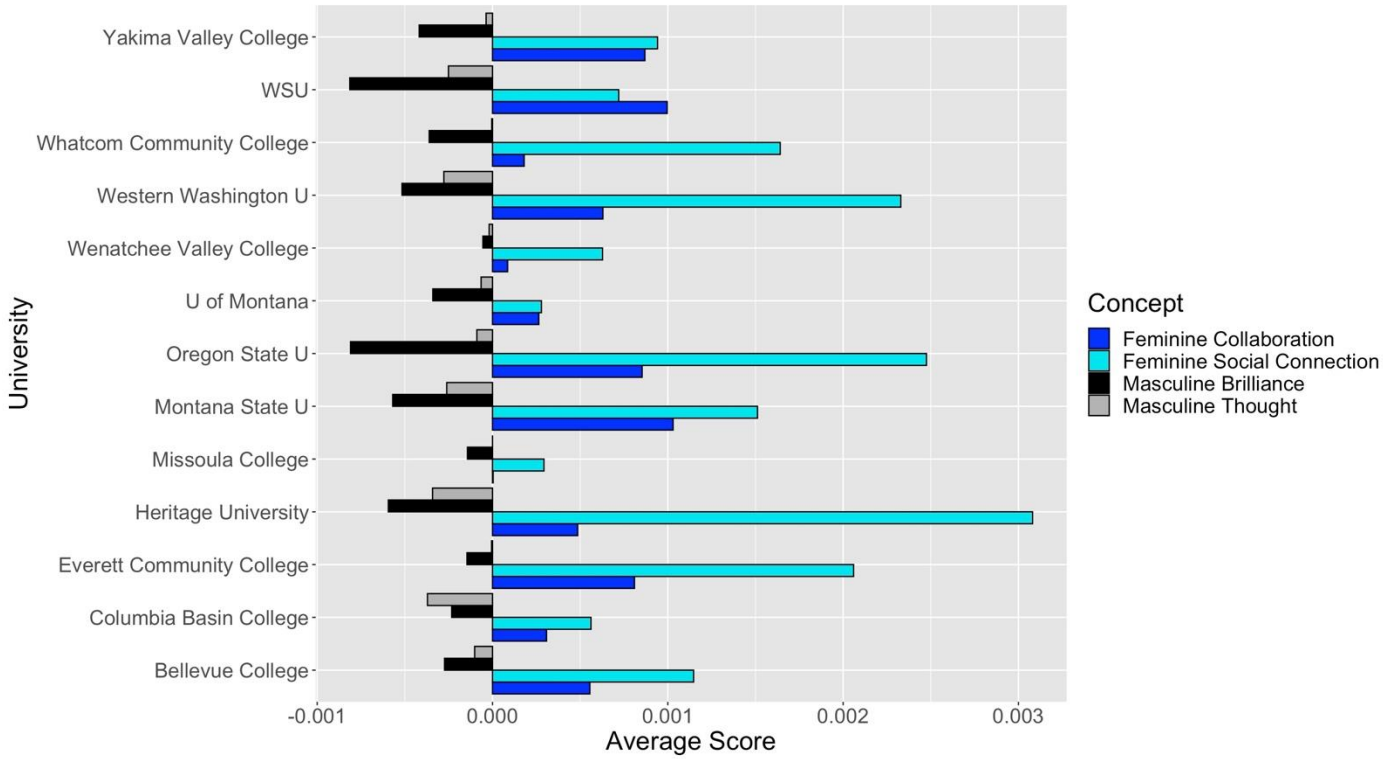
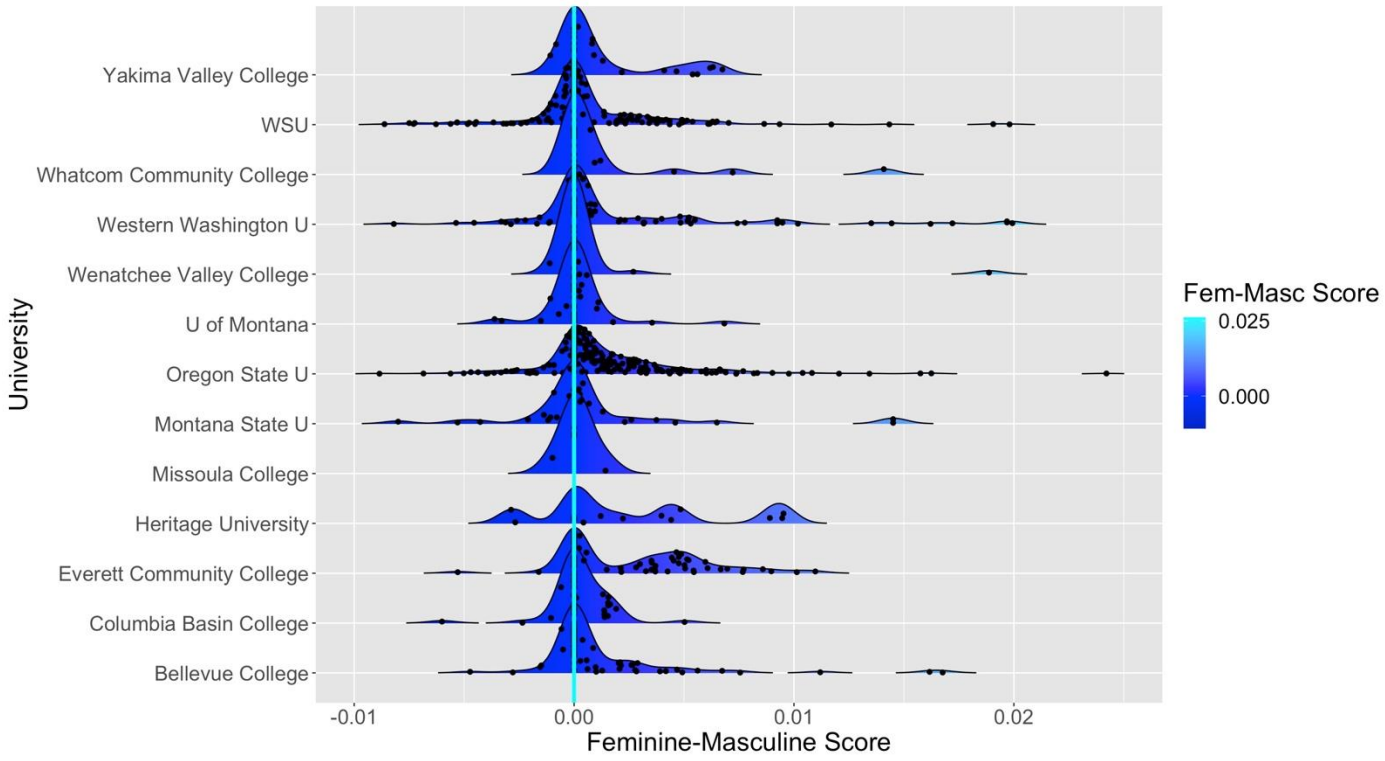


Figure 2 shows the overall distribution of feminine-masculine scores for each institution's policies. Each black dot in the plot represents an institution's policy, and the light blue vertical line is the marker for gender neutrality (score of zero). Since most of the institutions have the bulk of their policy distributions centered around zero, this shows that most of the institutional policy has gender-neutral polarity. However, some institutions lean more feminine since there is a large feminine presence on the right side of the curve, such as Yakima Valley College, Everett Community College, and Bellevue College. Washington State University and

Oregon State University, while leaning gender-neutral overall, still had a high presence of masculine-typed policies relative to other institutions in the study.

Figure 2

Feminine-Masculine Scores for Overall Policy by Institution



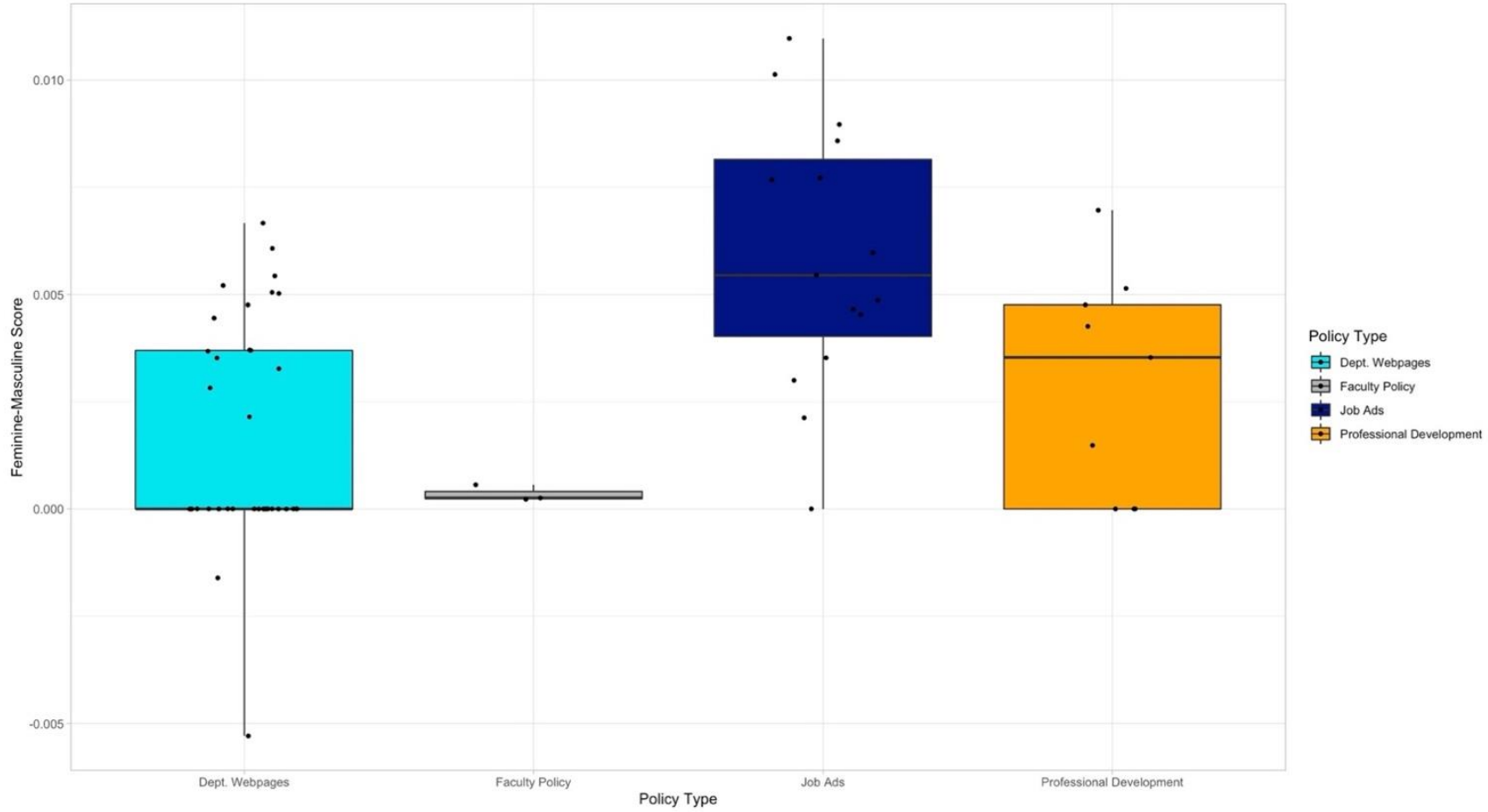
Findings by Select Institutions

As an illustration of a more in-depth examination of these themes in individual institutions we focused on the Everett Community College and Washington State University. These institutions were selected because they represent prototypical exemplars the two types of institutions within our sample: primarily undergraduate serving and doctorate granting institutions. As both institutions are located in the state of Washington, no differences as a result of state regulations, policies, and procedures were anticipated. Moreover, Everett Community College and Washington State University also provided the most data points, resulting in more robust analyses.

Everett Community College. Figure 3 is a boxplot of Everett Community College's feminine-masculine polarity scores by policy type in which each dot represents a policy. The majority of the policies were associated with feminine scores, especially the job advertisements and professional development policies. The department webpages did not have as much variation in scores as other institutions and demonstrated a higher presence of gender-neutral and feminine compared to masculine texts. The faculty policy can be described as gender-neutral.

Figure 3

Boxplot of Feminine-Masculine Polarity Scores by Policy Type (Everett Community College)



Figures 4 through 6 are Everett Community College's top 5 n-grams, or word and phrase frequencies, for the feminine (socially-connected science and collaboration) and masculine (expectations of brilliance and masculine thought) concepts. Everett Community College had a much higher presence of feminine n-grams than masculine n-grams. The feminine n-grams were about diversity and inclusion, whereas the masculine n-grams were about competition.

Figure 4

Top 5 Feminine and Masculine Bigrams (Everett Community College)

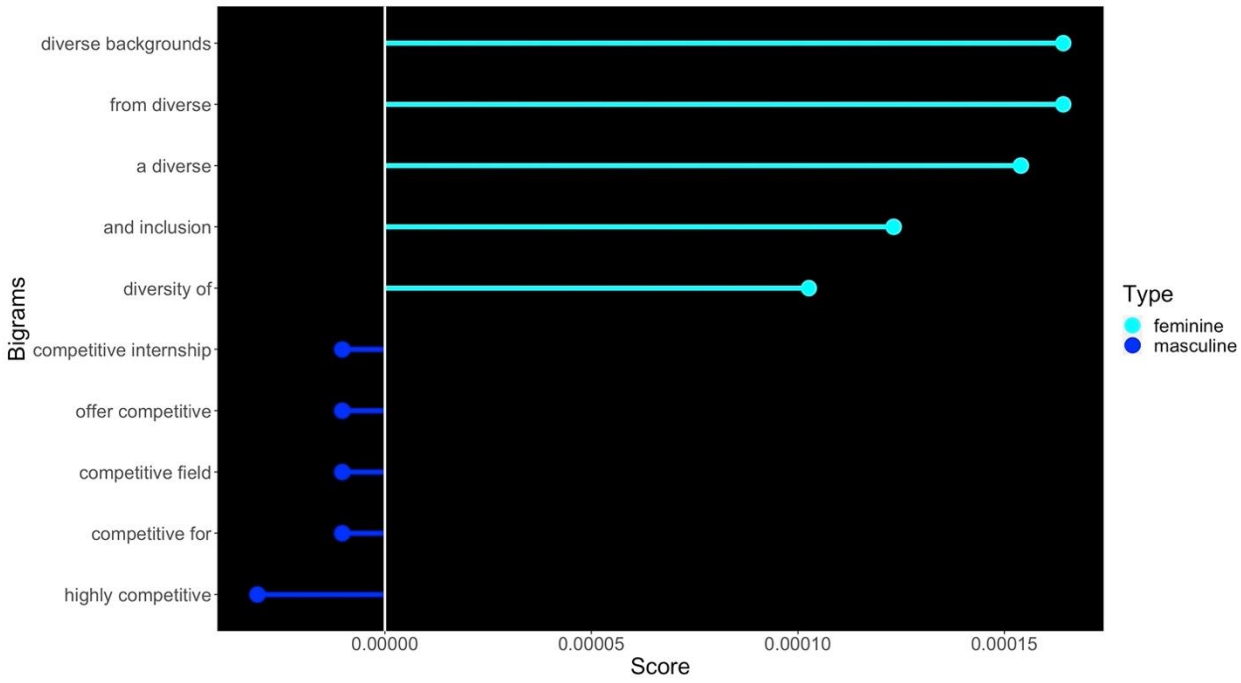


Figure 5

Top 5 Feminine and Masculine Trigrams (Everett Community College)

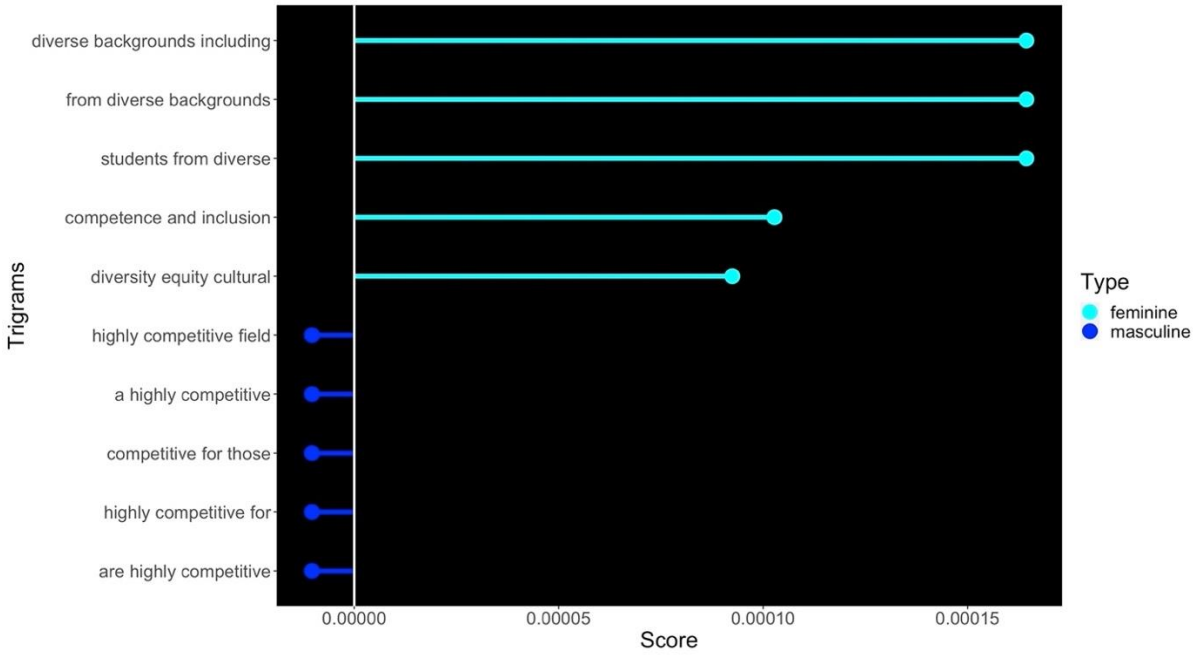


Figure 6

Top 5 Feminine and Masculine Four-grams (Everett Community College)

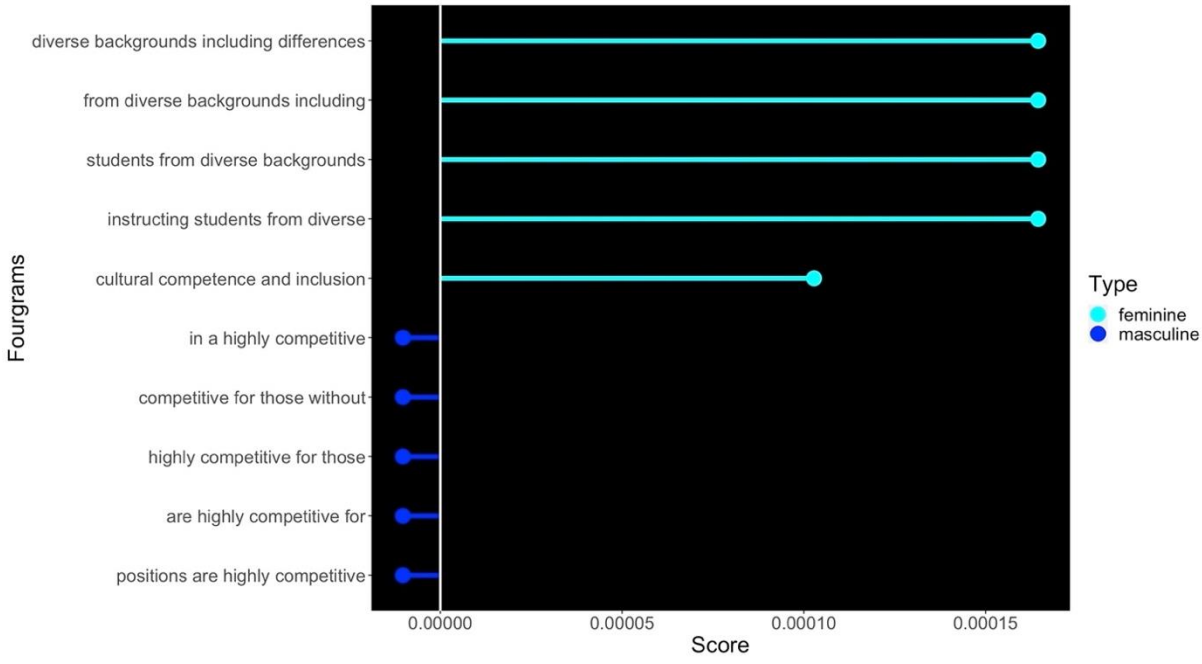
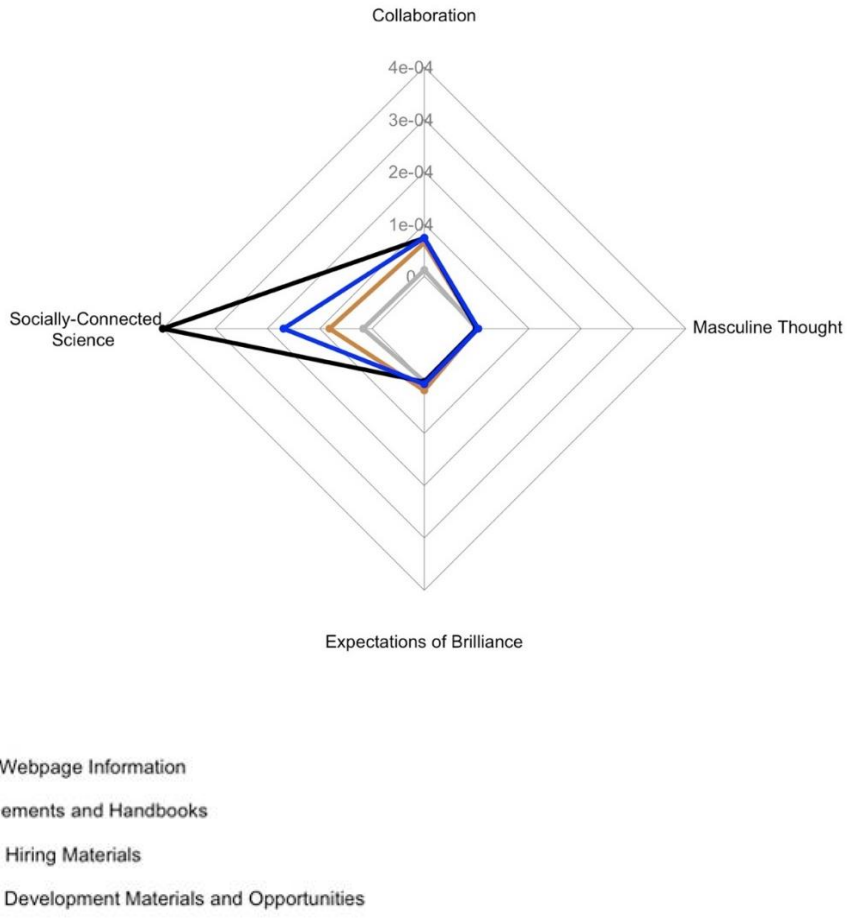


Figure 7 is a radar chart of Everett Community College's feminine and masculine concept scores by policy type. All the policy types have very little presence of the masculine concepts relative to the feminine concepts. The job advertisements and professional development materials exhibited a large presence of socially-connected science, whereas the department webpages only had a low-level representation of this concept. These policies had a slight presence of collaboration and minimal presence of expectations of brilliance. The faculty handbooks were gender-neutral with little to no presence of feminine or masculine concepts.

Figure 7

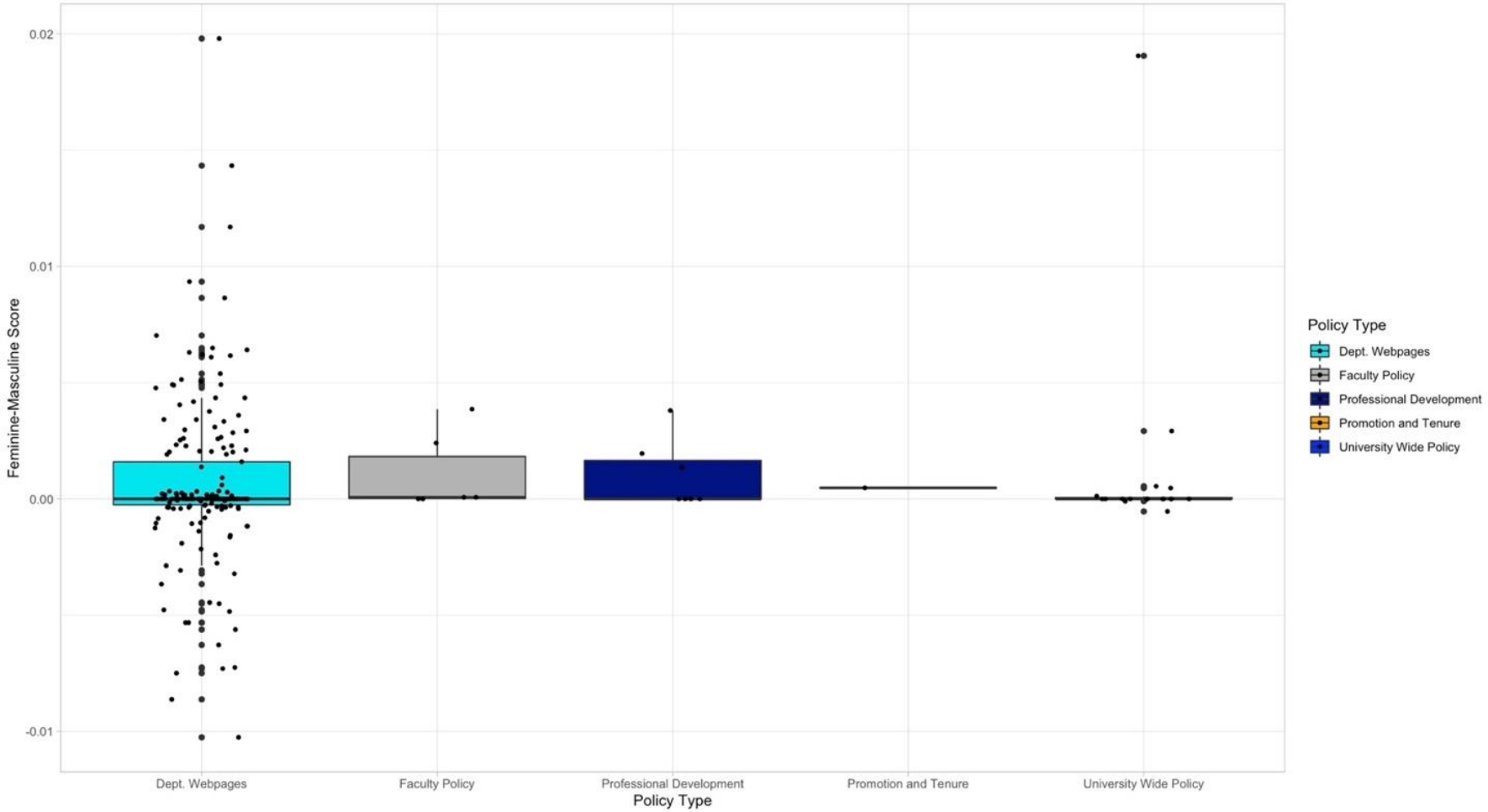
Radar Chart of Concept Scores by Policy Type (Everett Community College)



Washington State University. Figure 8 is a boxplot of Washington State University's feminine-masculine polarity scores by policy type. While a majority of the policies leaned towards gender neutrality (i.e., around a feminine-masculine score of 0), there was much variation in these scores in the department webpages, with a substantial amount of webpages leaning more feminine or more masculine. This pattern of results suggests that a large factor in institutional policy feminine-masculine polarity is at the department level rather than the institutional level. There were also a few institution-wide policies that lean more feminine, but most policies above the department level are gender-neutral.

Figure 8

Boxplot of Feminine-Masculine Polarity Scores by Policy Type (Washington State University)



Figures 9 through 11 reflect Washington State University's top 5 n-grams for the feminine (socially-connected science and collaboration) and masculine (expectations of brilliance and scientific thought) concepts. As shown, Washington State University's top feminine n-grams revolve around collaboration (e.g., "collaboration with" and "interdisciplinary research"). The top masculine n-grams have to do with innovation and competition (e.g., "innovative research," and "world class"). Masculine and feminine n-grams have a roughly equal presence.

Figure 9

Top 5 Feminine and Masculine Bigrams (Washington State University)

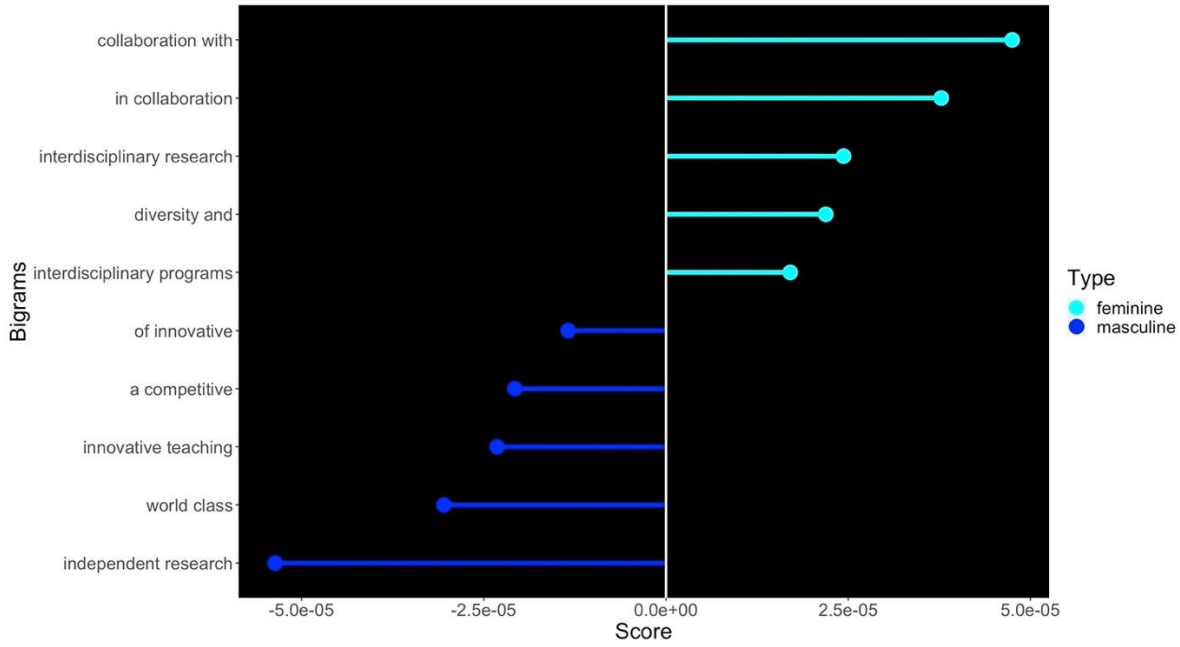


Figure 10

Top 5 Feminine and Masculine Trigrams (Washington State University)

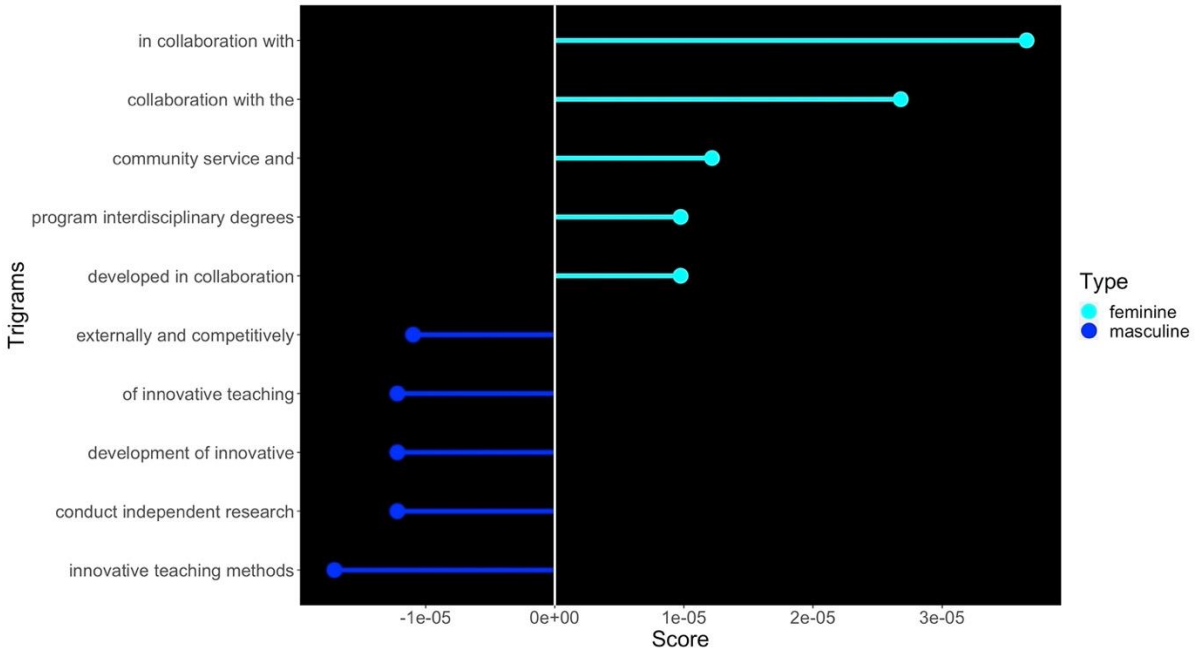


Figure 11

Top 5 Feminine and Masculine Four-grams (Washington State University)

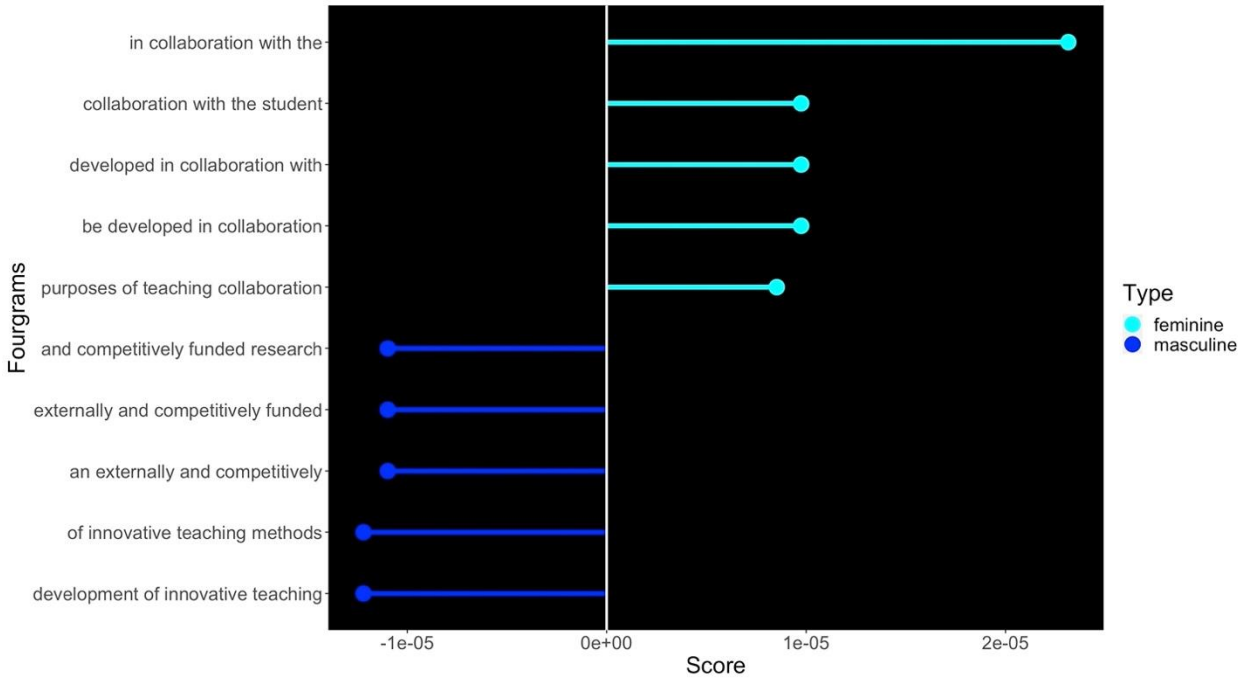
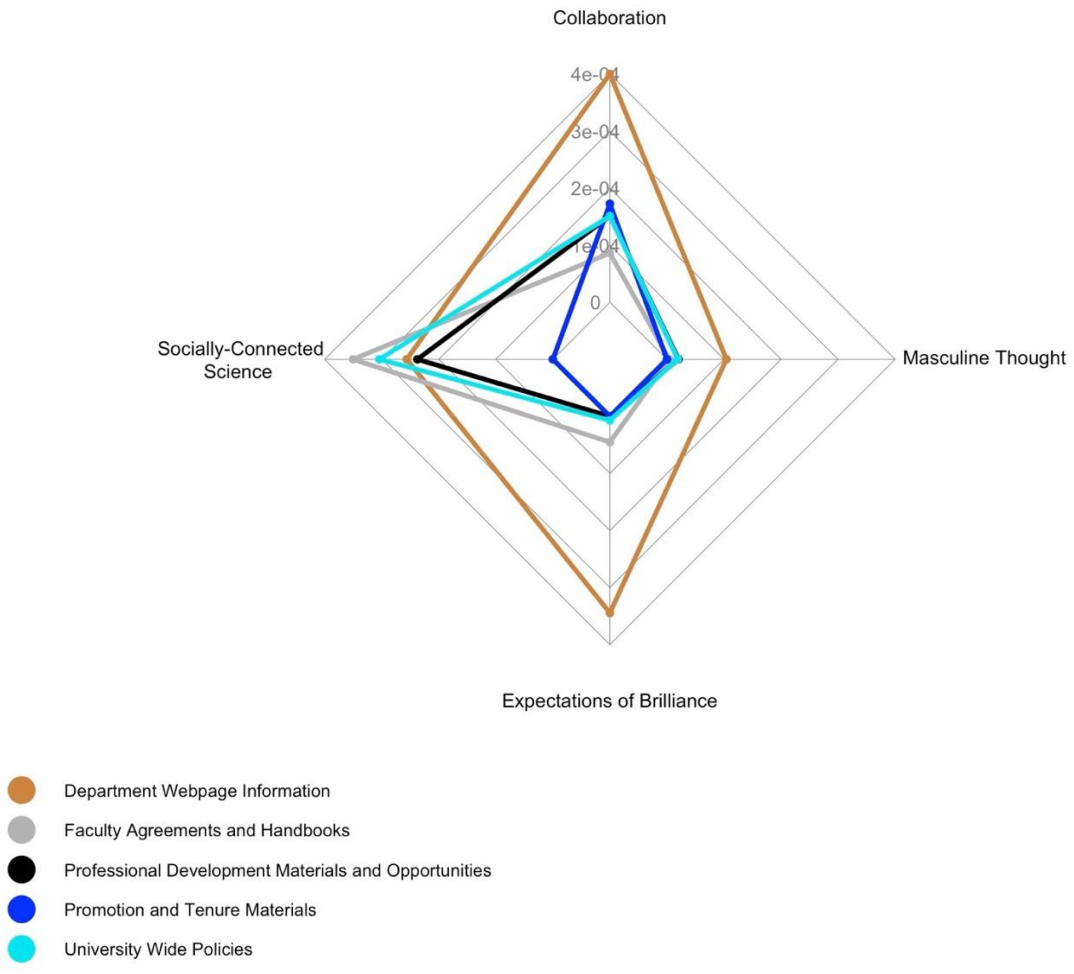


Figure 12 is a radar chart of Washington State University'-s overall policy scores for each concept (feminine socially-connected science, feminine collaboration, masculine expectations of brilliance, and masculine scientific thought) by policy type. Department webpages had a high presence of socially-connected science, collaboration, and expectations of brilliance, and a slight presence of masculine thought. The faculty agreements and handbooks, professional development materials, and institution-wide policies had a high presence of socially-connected science and collaboration, and low or no presence of the masculine concepts. Promotion and tenure materials had a presence of collaboration, but none of the other concepts.

Figure 12

Radar Chart of Concept Scores by Policy Type (Washington State University)



Discussion

Our exploratory analyses indicated that most of the schools included in our sample had gender-neutral policies by our criteria. However, when gendered concepts were present, institutional policies generally had a higher presence of feminine concepts across all institutions in our sample. Despite gender-neutral polarity scores across institutions in our sample, masculine-type policies were disproportionately found at doctorate granting institutions; however, these institutions' overall feminine-masculine polarity scores were still rather gender-neutral.

The lack of *overt or explicit* gendering in the policy documentation examined does not elininate the possibility that institutions of higher education are gendered organizations. According to Acker (1990), a gendered organization is constructed in ways that favor one gender, typically the masculine gender; however, organization language considered for institutions of higher education herein appears to be gender-neutral and at times feminine-leaning. In fact, policies that result in gender inequities can be written in gender-neutral ways. That is, the implementation of policy is the mechanism that may ultimately allow gender inequity to persist within organizations such as higher education insitutions (Acker, 1990; Britton & Logan, 2008), possibly leading to women faculty being disproporionately negatively impacted in recruitment, retention, and advancement. It may be that, as anticipated by Acker (2012), *intentions* of maintaining gender-neutral processes result in disparate impacts on women in practice, or the "unwritten rules" of the organization (which are not gender neutral) adversely impact women's career trajectories in academic STEM. While we cannot conclusively say that the policies in our sample aren't gendered in their implementation, we can say that the policy texts are not explicitly gendered in a way that disadvantages women, given the gender neutral

scores obtained herein. At minimum, existing institutional policies and practices are not articulated in a manner that disadvantages women faculty explicitly, and do not appear to prioritize values women faculty rarely endorse, all of which could be viewed as progress toward gender equity.

The notably higher presence of feminine concepts and feminine-leaning polarity scores, though still largely gender-neutral, may be indicative of the institutions in our sample beginning to implement policies and practices to address gender inequality. Often, policies that address gender-related barriers (e.g., childcare, perceptions of competence) but avoid explicit use of gendered language nontheless become gendered policies in their implementation. Publication criteria have always arguably favored men (Lynch et al., 2020), and the COVID 19 pandemic further exacerbated this gender inequity. Publishing guidelines for promotion during the COVID-19 pandemic demonstrate this well. Though a seemingly gender-neutral expectation, parents, especially mothers, were differentially affected than both fathers and dependent-less peers. Academic mothers experienced the "care-ceiling"—the point at which those with care-giving responsibilities are unable to advance in their careers due to care-free ideal worker expectations (Ivancheva et al., 2019), possibly because of being perceived as having more flexibility in their careers. Additional caregiving responsibilities during the pandemic depleted women faculty's ability to complete research-related tasks, due to emotional, physical, and mental exhaustion. As a result, mothers in higher education published less than fathers (Górska et al., 2021). Publication related promotion criteria were not developed with the pandemic in mind, and it can be argued these criteria have always placed women faculty at a disadvantage (Lynch et al., 2020). This inequity was magnified by COVID impacts, which may or may not figure into promotion related decisions, depending on the institution and whether or not a related policy is adapted, as well as

policy implementation. That is, gendered implementation can occur despite promotional policies, such as publication guidelines, and others being generally written to be gender-neutral.

Nonetheless, policy language is important in its own right, and can be a critical step toward gender equity in higher eduction, and academic STEM in particular. Intentionally gender-neutral recruitment texts represent one relevant example. Publicly available job advertisements across all schools in the sample emphasized the importance of socially-connected science. While some advertisements still emphasized masculine concepts, overall, feminine concepts were much more prominent. For instance, Everett Community College had a minimal presence of expectations of brillance in their advertisements, and Figure 7 shows advertisements had a significantly higher presence of socially-connected science and a slightly higher presence of collaboration. Because women scientists tend to value socially-connected science greater than their male counterparts (Cech, 2015; Cech, 2014; Canney & Bielefeldt, 2015), women may be more likely to apply for these positions, resulting in a more gender-balanced applicant pool and ultimately greater gender balance in academic STEM. This practice could lead towards a more inclusive academic work environment, facilitating recruitment of women faculty.

Findings by Select Institutions

For both Everett Community College and WSU, department webpages had the most variation in terms of feminine-masculine polarity scores. Most of Everett's policies were feminine-leaning with only one masculine-oriented text—a department webpage—in their institution's sample. Washington State University had much more variation in feminine-masculine polarity scores, with many masculine leaning texts in their institution's sample. Most of these texts, again, were department webpages. Figure 12 shows that WSU's department webpages emphasize collaboration and expectations of brilliance the most, with a slightly lower

presence of socially-connected science. Thus, masculine constructs were still well represented in these texts. The difference in concept polarity scores may be attributable to WSU's status as an R1 research institution, or institution with highest intensity research activity according to the Carnegie Classification (American Council on Education, n.d.). R1 status is based on the number of research/scholarship doctorates conferred as well as total research expenditures; thus, institutions may need to demonstrate that their research programs adhere to masculine leaning thought and brillance expectations. Of note, other R1 schools in our sample (Montana State University and Oregon State University) also had a more pronounced presence of masculine concepts in their information.

Alternatively, these differences may stem from other insitutional differences. WSU may have more masculine type policies because they are a doctorate granting instution (DGI). All DGIs in our sample had higher presence of masculine concepts than the primarily undergraduate institutions (PUIs) in our sample. Since DGIs generally have a greater emphasis on research than PUIs, this may explain differences in concept polarity scores. It is important to note again that though these scores are slightly higher than other schools in our samples, their overall feminine-masculine scores are still considered gender-neutral.

Implications and Future Directions

Our findings suggested that department-level changes may be important for institutional transformation, as the most variation and masculine leaning texts were found on department webpages. Changes at this level may be vital to retaining women in STEM, as faculty spend the majority of their time in their home department, which typically sets expectations for workload and provides a social mileau. Departments with masculine leaning texts may endorse more traditionally masculine ideals that discourage women from joining these units, likely

unintentionally. Job advertisements in our sample leaned feminine, making these positions attractive to women; however, masculine-leaning departments may funciton in a manner that conflicts with the messaging of this advertisement. As a result, women may expereince work climates as “chilly” and feel marginalized upon accepting a job. This mismatch between expectations set by advertisement and lived experience can be expected to result in a disproportionate attrition of women faculty compared to male counterparts. Department-level changes would require systematic reviews of departmental websites, brochures, handbooks, and policies for masculine-leaning language, which may be an artifact of outdated materials. These reviews and revisions could be performed by those who oversee retention and recruitment of faculty, potentially initiated at the college or university level.

Moreover, seemingly gender-neutral policies can still have disparate impacts on women. That is, though the policy may be written and intended to be gender-neutral, women may be disproportionately impacted by its implementation. It has been noted, for example, that departmental promotion requirements frequently disadvantage women faculty because women are disproportionately asked to participate in demanding service activities when compared to male faculty (University of Oregon Social Sciences Feminist Network Research Interest Group 2017; Moore, et al., 2010). Though service is a component of promotion requirements, it is not given the same weight as research and scholarship accomplishments. In short, women are more frequently asked to participate in necessary, time-consuming, yet underappreciated tasks that detract from research time, resulting in weakened promotion application materials. In a sense, women are stuck “doing chores” for the academy at the expense of their own career advancement (Mayo, 2023).

As noted by our PUI partners, the promotion process is different across DGI and PUI institutions. Some PUI institutions simply do not offer tenure, or promotion is granted after a set amount of time at the institution. Moreover, faculty workloads vary greatly by institution type, with PUI partners indicating that instruction and student success represent their primary area of focus, with less importance assigned to research/scholarship, and often unclear expectations about service and participation in shared governance.

The observed pattern of results raises additional questions about the implementation of gender-neutral policies and practices. Though a policy may prescribe a gender-neutral protocol, actual implementation of the policy (i.e., practice) may be gendered. Thus, several questions remain, such as: Are women faculty in STEM experiencing the benefits of these inclusion/equity efforts in terms of promotion/retention? Is gendered language across policies and messaging regarding programs, employment, etc. amenable to institutional change? Further, the role of other identities and their intersections with gender may shape the experiences of women in STEM. Next steps include conducting analyses specifically targeting intersectionality to increase understanding of identity-based nuances in different higher education settings, which we plan to report in the future.

Future research can begin to answer these questions with additional data analyses conducted across different regions, institutions, and links with retention/advancement markers for women faculty in STEM. Our focus was exclusively on institutions of higher education in the Pacific Northwest, and although justified by the need to ensure a shared culture among participating institutions, it may be that some of our findings are unique to this region. Another potentially fruitful research avenue involves further investigating potential differences between doctorate granting institutions and primarily undergraduate institutions to better support women

in STEM across all institution types. Although there is much more work to be done, our assessment of institutional policies suggests structural change towards a more equitable academy is possible.

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