The Blue Blazer Club: Masculine Hegemony in Science, Technology, Engineering, and Math Fields
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Abstract

The under-representation of women in Science, Technology, Engineering, and Math (STEM) fields is of continuing concern, as is the lack of women in senior positions and leadership roles. During a time of increasing demand for science and engineering enterprise, the lack of women and minorities in these academic disciplines needs to be addressed by concentrated institutional attention and resources. Although the overall historical gender inequity in earned doctorates is decreasing, women remain underrepresented in scientific and engineering disciplines in the workforce and in faculty positions. Given the gendered patterns evident in engineering and STEM academic disciplines, it is important to consider the factors contributing to these phenomena, including the interplay between work and family constraints in academic careers. Rather than simply male dominance or individual preferences or capacities, this under-representation in STEM is also due to "deep seated" gender barriers, such as the persistent belief in gender differences in abilities which maintains the status quo and affirms current inequalities as "natural." Our paper focuses on hegemonic masculinities in organizations to better understand the institutionalization of gender inequalities.

Math Fields

Introduction

This paper addresses the masculine hegemony of work in informal and formal institutional practices. Hegemonic masculinity refers to the maintenance of practices that institutionalize men's dominance over women (Connell and Messerschmit 2007). Such practices are visible in the following "Blue Blazer Club" story. In one professional society, each year there is a one day specialty pre-conference before the main conference. Historically, at the end of this day, the leading scholars in the area offer their thoughts on the future of the field. Perhaps not surprisingly given their numerical dominance in academia, in the 1970's and 1980's all of the eminent scholars chosen were men. On one particular day, all of the eminent men happened to be wearing khaki slacks and blue blazers, thus these scholars became known as the Blue Blazer Club. While this may seem a funny joke or harmless commentary on the dress choices of men in the mid-1980's, the fact that for years people allowed the group of eminent scholars to be called "the blue blazer club" indicates that everyone bought into the belief that the membership in this symbolic club truly was only open to and deserved by those who would wear such an outfit – i.e., men and specifically white men of at least middle class (Ely and Meyerson 2000). Like most

hegemonic practices, this example of masculine authority went unquestioned until it was recently challenged by a woman scholar who stood up (following a male speaker who made the now widely accepted reference to the BBC) and said, "if I hear one more word about the blue blazer club…." . It should be noted that the meeting following that comment was the first time in 18 years that no one mentioned the Blue Blazer Club (in 2008).

It is the unspoken and unchallenged acceptance of institutional processes and group practices such as the blue blazer club that is the focus of this paper. Though there is rhetoric of full inclusion, in many fields, including academia there is only the illusion of full participation. For example, more men hold tenured or tenure-track jobs than women do (84% of faculty jobs held by men were tenured or tenure-track, while only 72% of faculty positions held by women were tenured or tenure-track (AAUP 2005)). Though these data demonstrate improvement, we still have work ahead. For example, Bergom and Waltman (2009) note that women are disproportionately represented in what are viewed as the lowest levels of the academic hierarchy - in the non-tenure-track or contingent faculty positions.

Gender equity is an issue not only in full-time versus part-time positions, but in the representation of women on the faculty relative to their representation in the Ph.D. pool. Specifically, at our own institution, women make up 29.2% of the faculty, yet they comprise only 13% of tenured and tenure-track STEM faculty - 21% of assistants, 12% of associates, and 6 % of full—a total of 41 women in 2008. Interestingly, 28% of all our students in STEM were female and in 2006-07 women earned 27% of bachelors, 31% of masters, and 21% of doctorates in STEM departments at our institution. Our representation of women students in STEM is consistent with national trends. In 2006, an NSF report found that at U.S. institutions, science (broadly defined) and engineering doctorates awarded to women in STEM increased 8.8%, indicating a 25% increase since 2002 (Burns, Einaudi, and Green 2009). Overall, 40% of the doctorates awarded were to women although women's presence in different STEM fields varies tremendously (e.g., biology at a high of 50%, mathematics at 30%, and engineering at a low of 20% for instance; note the 40% includes field such as psychology in which 78% of the doctorates are awarded to women and in some institutions, math includes math education). As scholars have noted, the supply end of the "pipeline" then is not the major cause of the lack of women professors in STEM fields.

Women in STEM: Fixing the Leaky Pipeline

It was initially thought that once enough qualified women entered STEM fields (the "pipeline"), gender equity would be achieved (Glazer-Raymo 1999). Although women are making strides in all fields of science, especially biology, in obtaining doctoral degrees and even in assistant professor positions, they are still underrepresented at the full professor rank. For example, women make up only 30% of the tenured or tenure-track professors at doctoral granting institutions and an even lesser 19% of the full-professors (across all science and engineering fields; 2003 data cited in Burrelli, 2008). In some fields, such as engineering, women are only 5% of the full professors, followed closely by math (8.6%) and physical sciences (8.3%). Finally, Bentley and Adamson (2003) concluded that women were 14 percentage points less likely than men to be full professors at 14-15 post-degree as well as 20-21 years post-degree. Interestingly, in a study of medical school faculty, Ash and colleagues found that women's slower rate of advancement to full professor was not due to productivity (Ash, Carr, Goldstein, and Friedman 2004). Finally, Marschke, Laursen, Neilson, and Rankin (2007) ran several models predicting gender parity in faculty representation to proportion of women with PhD's (40%) and found that if institutions take no additional action/steps to achieve gender equity, there will only ever be 34% women faculty; if they only hired women, it would take 7 years to reach 40% and another 4 to reach exact gender parity; with hiring men and women in equal proportions (and retaining, promoting, and retiring), it would take 20 years to reach the 40% mark and 57 years to reach 50%.

Since the available pool of applicants for tenure-track positions has increased, women's absence from the tenured ranks often revolves around perceptions about family-work responsibilities creating a "leaky pipeline" from the assistant professor rank which usually coincides with a woman's prime childbearing years (Leboy 2008). However, although higher education lags behind business and industry in promoting programs and policies supporting work-life demands (Gibson 2006), the lack of such procedures does not fully explain women's absence from STEM fields.

Another myth often cited for the lack of women in science is that women just do not like math and science. A full review of this literature is beyond the scope of this paper, but though

there is some evidence of a gender gap in STEM pursuit by middle school (Fox 2008), Halpern et al. (2007) asserts the differences in male and female expectations and choices regarding STEM learning are much more complex than previously assumed. For example, Beatriz Chu Clewell and Angela B. Ginorio (2002) found in their review of research on the progress of diverse groups of women in science, that although both boys and girls view math as a masculine undertaking/field by middle school, these conceptualizations are held most strongly by white males. Fouad (2008) found that girls' feelings of self-confidence are a precursor to girls' interests in science and math and Wigfield and colleagues (2006) found that girls are more likely to choose courses and aspire to careers in science and math if their interest in these fields is encouraged and cultivated throughout their school years. Others have found that "positive experiences in high school serve as the most consistent and important predictors of students' future interest in science" (Tolley 2003, 3). Thus varying perceptions of STEM fields as "masculine" indicate that the gendering of STEM disciplines historically may be less important to girls' comfort, achievement, and interest in science than an array of other factors and the argument that women do not enter science simply because they do not enjoy it is not born out by the research. In addition, even as students experience affinity for particular fields rather than others, researchers must still ask how individual preferences and desires are fostered in gendered ways through socialization, differing opportunities, and the availability of influential role models.

Historical trends also undermine traditional myths. Tolley (2003) argues that "proportionately more girls than boys studied science" in the 19th century, but by the 1930s, these demographics had reversed. Lack of jobs for women in the sciences led to their decreasing participation up through the mid-1900's and the big business of science took off at post World War II universities which had high male enrollments (or)/representation because of the GI bill. (Corbett, Hill, and St. Rose 2008; Eisenmann 2007). School policy and curriculum contributed to the decline in women's participation in science as schools required girls to pursue particular gendered vocational courses such as homemaking (Tolley 2003). Today, it is clear there is a stall-out for women in all fields in academia in reaching the upper ranks, even those in which women are over represented at the Ph.D. level (e.g., psychology). It is clear that time will not solve the problem (Jacobs 2004), nor is the problem that women cannot or do not want to do STEM focused work. What forces are at play then?

Masculine Hegemony: The Hidden Dimensions to the Organization of Work

Most explanations for the lack of women in STEM fields overlook the masculine hegemony or gendered character of bureaucracies and workplaces (Connell and Messerschmidt 2007). Briefly, hegemonic masculinity is "the maintenance of invisible practices (*or more visible ones such as wearing blue blazers*) that institutionalize men's dominance over women" (Connell 1987, 185-86 as cited in Bird 1996; italicized text is the current authors' addition; see also Connell and Messerschmidt 2007). To better understand the institutionalization of gender inequalities our broader research is guided by the following questions: What are practices of masculine hegemony? How are these masculine hegemonies institutionalized? What is the role of masculine hegemony in organizational decision making?.

Connell and Messerschmit (2007) point out in their review and revision of the concept of masculine hegemony, "masculinity' represents not a fixed or certain type of man but, rather, a fluid, contested, and diverse set of discursive practices in which groups of men position themselves. Indeed, they offer the assertion based on Holter's work (1997, 2003) that, 'it is a mistake to deduce relations among masculinities' from the direct exercise of personal power by men over women" (p. 839). Rather, "'masculine domination' as a tactic to exclude women is open to challenge and requires considerable effort to maintain" (844). Connell and Messerschmidt point out that such complex labor is illustrated in Bird's (1996) work on homosociality as well as Martin's work (2001) on the enactment of masculinity in organizations. They emphasize that specific institutional practices are an important part of the way hegemonic masculinities operate. They state, "at the local level, hegemonic patterns of masculinity are embedded in specific social environments such as formal organizations" (p. 839). Just as children engage with and contest patterns of masculinity and femininity in schools through peer groups, control of space, dating patterns, speech, and harassment (Thorne 1993 as summarized by Connell and Messerschmidt 2007), so too are academic departments and institutions spaces where patterns of hegemonic and complicit masculinities are engaged and contested.

This paper contributes to the development of a more complex model of gender hierarchy by considering the agency of women in terms of creating a space for their participation within

institutional cultures (Connell and Messerschmidt 2007). For example, many faculty do not avail themselves of family-leave policies for fear of not being seen as a serious academic (Hoofman-Kim 1999). Simply having a policy in place without addressing the potentially negative culture of a department or institution in regard to such policies will have limited impact because they do not address patterns of gendered social relations.

In an essay published in 1975, sociologist Arlie Russell Hochschild discussed logistical and conceptual disconnections between women faculty's lived experience and traditional academic structures based on such hegemonic practices as the "clockwork of male careers" (p.134). Hochschild's discussion is pertinent to the status of women in STEM 30 years later. Arguing that overt discrimination and gendered socialization do not adequately explain women's absence from the top ranks of academe, Hochschild (1994) writes,

> to ask why more women are not full professors, or "full" anything else in the upper reaches of the economy, we have to ask first what it means to be a male full professor—socially, morally, and humanly—and what kind of system makes them in to what they become (126).

She argues that an array of subtle formal and informal practices contribute to differential gendered experiences in institutions. For example, the lack of professional and personal role models for female faculty means they are sometimes left out of networking opportunities and access to information their males colleagues have access (Eberspacher and Sisler, 1988). This differential treatment starts in graduate school where women are less likely to be taken seriously in seminars and afterward are less likely to be invited to social gatherings. Though there have been strides made in delaying the tenure clock, it still favors younger women during child bearing years rather than those women who have completed the social reproduction and kinship work of raising their children. It also facilitates what Hochschild calls the "smooth choicelessness" of male colleagues who do not usually have high levels of childcare duties and have more flexibility to negotiate work schedules (p.133).

Assessing the status of faculty women thirty years later when she was reflecting on a reprinting on her original 1973 essay, Hochschild notes few changes in the fundamental structure and expectations that govern academia, arguing that feminism has wrought only selective and particular changes. She reflects,

> American culture incorporated what of feminism fit with capitalism and individualism and it marginalized the rest. The culture incorporated the idea that a

woman has a right to a job and to equal pay. But it resisted a real change in the
structure of work and the social character of men" (135).

In sum, she voices a lament echoed in current efforts to advance the number of women in top tier positions: "the clockwork of men's careers has proved easier to *join* than to *change*" (139; emphasis added)[1]. Varied hegemonic practices contribute to the reproduction of inequities in the academy and in scientific workplaces. Here we provide a brief overview of the gendering of science and women's abilities historically, institutional practices such as the tenure clock favoring male roles and the privileging of individual rather than collaborative scholarship in many scientific fields, enduring overrepresentation of men in leadership positions, gender biased student and performance evaluations, personal and embodied experiences such as birth and family responsibilities perceived to interrupt the typical work day, and socialization practices that encourage students to imagine themselves in particular gendered roles.

Feminist Analysis of Organizations

Institutional practices create and legitimize experiences and not all members have equal power in deciding what constitutes legitimate knowledge (Unger 1982; Wilkinson 1998). It is this lack of power on an institutional level that allows the maintenance of hegemonic practices that can keep women and people of color from fully participating and succeeding in their institutional and social roles. Highlighting feminist debates, discussion, and efforts to revise organizational structures in less-hierarchical and more collaborative ways is imperative to heighten consciousness about the machinations of contemporary masculine hegemony and its expressions. What are the various forces that sustain it and how is organizational structure at work in the process?

Feminist scholars and activists have worked for more than a century to revise and reinvent traditional hierarchical and competitive organizational practices in ways that unlock other relational forms and that better serve the actualization of both women and men's potential. Although traditional organizational structures are often perceived as gender neutral, the structure

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[1] It should be noted that other institutionalized processes of hegemony can intersect with those of masculine hegemony and that both subordinate and dominant masculinities exist in given contexts (e.g., heterosexual, such as in the availability of family leave for spouses and parents but not for partners; racial/ethnic hegemony that associates "real science" as Western; socioeconomic hegemony in which resources and cultural capital to perform appropriately are linked to class). See Connell and Messerschmit, 2007.

and practices of organizations have profound gendered consequences, from perpetuating gendered behavioral norms, to rewarding particular gendered behaviors, to institutionalized processes of discrimination. For example, Merton (1968) argues men are cited more often than women in some fields because to increase ones own credibility one cites high status and established scholars rather than low status "unknowns." Women are often regarded as "low status," and are not cited frequently, even by other women as this can decrease their own credibility still further. Wilkinson (1998) observes this practice even in the field of psychology in which women earn 78% of the PhD's.

Feminists have offered incisive critiques of the values institutions nourish through daily practice, language, policy, and arrangements of space and material artifacts. For example, how many times have each of us walked into a conference room or other public space within the University to be greeted by a wall or two of primarily white male leaders? While arguably "showcasing" notable/worthy Deans or Presidents in a given institution's history, this practice also sends the message that men are the authentic representatives of academic knowledge and Others are destined to be outsiders to our "Club." Those who have resisted women's presence in governmental, educational, and military organizations historically have contributed to nourishing institutional hegemony through both subtle and overt forms: expectations of a particular work ethos that women behave "like men," extracurricular activities and informal rituals (such as fishing, ball games, drinks after work) that exclude women, silences about preferential treatment or discriminatory behavior, and denigration of "feminist" practices and beliefs. Or there's lip service to equality while business goes on as usual at the Blue Blazer Club.

In a critique of organizational structures still relevant in contemporary leadership research, feminist activists during the 1960s and 1970s critiqued organizational hierarchies as inherently masculine and authoritarian. They argued, in particular, that adopting patriarchal methods and organizational forms is antithetical to disrupting patriarchal practices; indeed, Black feminist and poet Audre Lorde phrased it perfectly in the title of her article, namely " The Master's Tools Will Never Dismantle the Master's House" (1984). These critiques prompted feminists to work against racist practices among women and experiment with more democratic practices and structures: collaborative and participatory practices, rotation of leadership tasks, equal access to resources, consciousness-raising, consensus, reducing hierarchy, and sharing authority (Freeman 1970). These organizational models emphasize community, growth, and

empowerment rather than power and control (Burnier 1995). Significantly, they are directly at odds with the traditional hierarchical structure of higher education.

However, Jo Freeman's (1970) critique of the limitations of "structurelessness" in organizations spurred feminists to reexamine the conflation of organizational structure or bureaucracy with domination. Freeman argued that lack of structure could also be tyrannical and mask power, was idealistic and unrealistic, and that demonizing an organizational structure as inherently masculine and anti-feminist might actually be counterproductive to a feminist mission. "Unstructured groups," she argues, are not "very good for getting things done" (5). These rich debates prompted scholars and activists to continue to pursue "feminist" ways of accomplishing work within hierarchical structures.

Working Within and Against

In her paper on using stories to empower oneself, Ockerstrom (2007) writes

> Our very marginality however can become our best asset precisely because of our outsider position for one simple reason: from the margins *we can see what insiders cannot*. (5)

Is working for changes from within an institution or system of beliefs a viable practice? Does such labor buy into and support the structure we want to change? How realistic is imagining/starting a whole new system? Feminist methodologists such as Patti Lather, Elizabeth St. Pierre, and Wanda Pillow (2000) argue in the realm of research methodology that, necessarily, we must work both within existing discourses and structures available to us while critiquing, pushing against them, and working for other visions and possibilities for our lives and research. Such a position requires consciousness of and competency with the intricacies of the system we work within—its norms, structure, messages, symbols—to maintain a position in which we can work for transformation. Meyerson writes extensively of this in her book *Tempered Radicals* (2001). Interestingly, in the acknowledgements she writes of asking her then 9 year old son to delay his birthday party by several months so she can finish her book; thus even when we are arguing for change, we may inadvertently buy into the system that we are so desperate to have value us and our ways of working and being. There is, of course, on a personal level, a very real danger that any of us who work (at least partly) within the academic system

may be co-opted by it. Self-vigilance as one makes choices and negotiates career issues may be prudent to guard against losing oneself along the journey.

No matter how changes are promoted, institutions often resist them. One strategy often used is to deny the problem. For example, arguments that women and people of color have advantages as special interest groups or beneficiaries of affirmative action have increased significantly in recent years. However, if you ask women or people of color, they themselves perceive discrimination and unequal access to resources (Agócs 1997). If those in positions of power do not recognize the problem, they do not legitimize the problem or the agent of change. People in power have the luxury of institutionalizing their belief system as reality and often actively fight against acknowledging the existence of hegemony and discrimination, as to acknowledge it would lead one to the uncomfortable conclusion that one should do something about it. And changing such complex economic, political and social legacies seem formidable.

Another form of institutional resistance is that of blaming the victims—when they get good enough, have enough degrees in the right fields, play the game the way those in power do, then the problem will be solved—until then it is their fault because they do not behave in the "right" ways, produce the "right" publications, negotiate their personal/professional lives more smoothly, or fit in to the existing structure without making waves. However, playing the game may be impossible or undesirable. For example, Sax and colleagues (2002) found no differences in productivity due to family responsibilities and thus suggested that even when women play the game they do not seem to reap the same rewards. For example, Nielson and colleagues (2006) sought to explain the pay differential between men and women at their university (which is similar to others, women earn approximately 80% of what men earn). In their statistical model that predicted salary for both men and women without accounting for gender, they found that tenure status was worth a considerable amount of money. However, when they ran separate models for women and men attempting to include different contextual variables valued in men's and women's work that went beyond simple demographic variables (such as age, years since hire), they found that if women were paid based on men's pay structure (or what is considered important for men to get paid more), tenure would gain them an average of $7,000 per year, but if men were paid based on women's pay structure, they would lose an astonishing $23,000 per year.

A final tactic is the advice to "be patient—it will change over time." however, as Arlie Hoschild's reflections over a thirty year span demonstrate, we can see that "joining" is often easier than "changing." Many individuals might feel unable to fight for institutional change while negotiating the politics and demands of an academic job. In addition, as noted earlier, change in the higher ranks is not keeping up with change in the lower (e.g., very small percentages of female full professors, the gendering of adjunctification) and the time for waiting is over (Agócs 1997).

The "What is Science" Myth: Critical and Feminist Approaches to Science

Elizabeth Cady Stanton's early words,

> He has compelled her to submit to laws, in the formation of which she had
> no voice. (Elizabeth Cady Stanton, from Schneir 1992, 79)

could easily translate in academia as 'women are compelled to submit to norms and priorities of what is science, in the formation of which she had no voice."

Nancy Tuana's (1993) analysis of dominant philosophical conceptions of women across fifteen centuries demonstrates the biologically-essentialist belief persisting since Aristotle's time that women are inherently "misbegotten men," that is, physically inferior replicas of vibrant originals. Indeed, scientists in the 18th and 19th centuries argued that women's inferior intellectual capacity and emotional constitution made them "unreliable" witnesses for verifying scientific experiments. These beliefs that intelligence was inherently male meant women were barred from the Royal Society of London until the 20th century (Haraway 1997). The idea that primates are smarter than women or that the size of women's skull explained their inferiority is clearly laughable today, but the underlying opinion that men are intellectually superior in science remains. Indeed, the same reductionist arguments that women are not biologically hardwired to "do science" reappear with depressing regularity and continue to justify the systematic exclusion of women from science.

Many feminist scholars have argued that the things valued in science—objectivity, rationalism, individualism—are the things associated with masculinity and are believed to be implicitly superior (Brickhouse 2001). "Science" inspires a degree of trust that no other realm of knowledge equals. Critical attention to the construction and production of scientific knowledge is

imperative given the almost mythical power it has accrued as a field of knowledge, the staggering financial resources that support it, and the resulting power it wields in the lives of human beings. (Fox 2001). Feminist scholars of science have offered critiques of historical understandings of science as "neutral" and "objective," highlighted the role of science in the orchestration of power, and developed alternate approaches for thinking about science. They, and others, have argued that scientific knowledge is produced in particular contextual circumstances, is inevitably value laden and gendered, and has been determined mainly by men of European ancestry reaching back to Aristotle's work in early B.C.

Barton and Brickhouse (2006) draw from these key conceptual approaches in feminist science studies to advocate conceptualizing girls' participation in science as "engagement" rather than "achievement" or "careers" because the term emphasizes the embodied nature of science (223). This conceptual emphasis on engagement acknowledges both the "knowledge, skills, or ways of thinking that girls acquire" and the "identities that girls generate or accept within science communities, how these identities are dynamic and locally situated, their reasons for particular forms of engagement, and the relationship they perceive these roles have to the practice of science" (224). Rather than viewing aspects of identity and personal experience as intrusive to the scientific enterprise, these authors foreground embodiment—that men and women, embodied and historically situated—produce scientific knowledge. The researchers suggest that such social locations and identity configurations are significant because the conceptual work of imagining oneself, and others, as scientists and participants in the culture of science are part of the nexus of knowledge students need to acquire to advance. The authors suggest that identity and embodiment matter in feminist approaches to science because girls imagine themselves differently as they participate in science, and their participation offers others' opportunities to imagine them differently as well.

This conceptualization is consistent with Donna Haraway's foundational work in feminist science studies in which she details the situated and embodied nature of knowledge claims (1988). She argues that knowledge claims forged from traditional scientific practice often reflect the "god trick," the "view from nowhere," universal or decontextualized pronouncements that emerge as if unrelated to the embodied individuals who produced them. The 'god trick' obscures the workings of power and the situated, contextualized production of scientific knowledge and, by extension, the orchestration of power in organizations.

Feminist approaches that foreground embodiment and subjectivity are sharply at odds with traditional approaches to scientific investigation in which "objectivity," "rationality," "procedure," and "rigor" are foundational guiding principles that scientists believe should transcend the irrelevant particulars of the individual researcher. In this view, the quest to understand the physical world involves universal principles, systematic procedures, and unwavering attention to method and the specific scientist need only function as a tool in the discovery and transfer of knowledge. And yet, this conceptualization of science as a relentlessly objective and masculine enterprise obscures the reality that embodiment and subjectivity have utterly shaped the conduct of science, from beliefs in women's inferiority, to studies of skull size, to women's exclusion from scientific fields. In contrast, feminist approaches to science foreground embodiment and advocate "situated knowledges" (Haraway 1988) as necessary and valuable elements of scientific practice.

One might argue that the vestiges of beliefs that embodiment pollutes science are the very roots of hegemonic practices that girls must negotiate to imagine themselves as scientists and that female faculty must negotiate to work in STEM jobs. Barton and Brickhouse (2006) suggest that in the process of cultivating girls' content knowledge when preparing them for scientific training that educators too frequently neglect an equally significant aspect of scientific preparation: the cultivation of girls' identities as scientists and cultural capital that aids women in negotiating the masculine-dominated culture of science. They provide a quote from Seymour and Hewitt (1997) that crystallizes the challenge for young women of confronting a male-dominated and masculine higher educational environment despite years of academic achievement:

> We posit that entry to freshman science, mathematics, or engineering suddenly makes explicit and then heightens, what is actually a long-standing divergence in the socialization experiences of young men and women…it occurs when a relatively small number of inexperienced young women are encouraged….to venture into an institutionalized….teaching and learning system which has evolved over a long time period as an approved way to induct young men into the adult fraternities of science, mathematics and engineering. Most young white men seem able to recognize and respond to the unwritten rules of this adult male social system. The rules are familiar because they are consistent with, and are an extension of, traditional male norms that were established by parents, and which have been reinforced by male adults and peers throughout their formal education, sports and social life (quoted in Barton and Brickhouse, 227).

This narrative suggests that girls' achievements and accumulation of knowledge from academic courses might be insufficient preparation for the daily machinations of scientific practice in specific environments (Herzig 2004 in Boaler and Sengupta-Irving, 2006).

Barton and Brickhouse also point out that formal, standardized pedagogical methods reinforce knowledge as hierarchal and absolute. Indeed, existing and commonly accepted methods to pursue science education and determine competence—tests, courses, grades—limit and constrain the kinds of scientific trajectories that educators reward girls (and boys) to pursue. Such notions undermine autonomy, creativity and non-hierarchical ways ranking of knowledge and experience. Their concern is that such "gatekeeping devices" (232) and school-based practices in science do not necessarily "provide real competence in science" (226) but rather reinforce highly rationalized, formulaic and objective methods of knowledge acquisition. In their view, a feminist approach to science education would expand attention to science-in-context that has tangible benefits in local communities. For example, students might study the effects of environmental toxins in a particular community or the ways community members might improve their soil quality or agricultural production. Boaler and Sengupta-Irving (2006) argue that a feminist approach to mathematics acknowledges that math is a "system of knowledge, a product of human thought, discovery and practice" (215)—in other words, it is an embodied enterprise with specific consequences for human beings. Interestingly men's embodiment, as in the example of the blue blazers cited earlier, is often celebrated, but women's bodies and all of their messy femininity and all of their appendages are perceived to be in the way and threaten the professionalism of the workforce or the objectivity of science.

A feminist approach would also critique rigid understandings of participation or non-participation in science, advocate varied participation on a continuum of what constitutes "science," foster access to "multiple entry points" in science (Barton and Brickhouse 2006), and consider performance and gender as relational, co-constructed and contextual rather than a static characteristic a given individual possesses (Boaler and Sengupta-Irving 2006). Thus participation in science in every level from entry in grade school to research publications is influenced by the current value placed on the culture of individualism versus a culture of community and collaboration.

Masculine Hegemony, Institutional Barriers, and Policy and Practice

Two explanations Rosser (2004) offers for women's exodus from STEM are the lack of mentoring and family responsibilities. This is an example in which practices in organizations that appear to be gender neutral have unequal and gendered consequences. The enduring challenges these conceptual and organizational components pose for faculty is evident in the interviews Rosser conducted with female scientists (Rosser and Taylor, 2009). The first explanation Rosser offers is the challenges of negotiating career and family and the second she terms a "lack of professional networks" (9). In terms of family negotiations, Rosser reports that the cumulative effect of women's reproductive and kinship responsibilities, the age and biological parameters of childbearing, the lack of U.S. federal and institutional policies that support childcare or paid leave, and the challenges of negotiating dual-careers lead to the gradual decrease in women's presence in the scientific workforce.

To emphasize the relationship between these variables she draws a compelling statistic from J. Scott Long's study of gender differences in scientists and engineers with Ph.D.s: whereas single men and women scientists participate "about equally" in the workforce, a married woman with young children is "30 percent less likely than a single man to be employed" (9). While the choice to have children can be viewed as a "personal decision" on the part of any individual, as a society and species we could not survive if everyone chose to not have children, thus we are collectively obligated to assist families to function well for the common good of society.

Many of the barriers faculty with children face and most especially women as they bear the children are much broader than an institutional level but are powerful forces that influence institutional policy and informal practices. For example, in 2000 out of 20 countries including China and Cuba, the U.S. was only one of two countries to offer 0 days of funded maternity leave (Australia was the other although they did offer one year of unpaid leave). Such policies at the national level essentially leave the responsibility for supporting social reproduction is in the hands of individual employers and families. Even in the contexts that offer work-family policies, Blair-Loy and Wharton (2002) found that employees do not necessarily utilize these policies because they anticipate negative reactions in the workplace. Indeed, an additional aspect of hegemonic practice seemed to be at work in researchers' finding that those who had alliances with powerful figures in the workplace were more likely to use work-force policies. We must continue to recognize the deeply embedded nature of hegemonic practices and the many layers and levels of barriers continue to impede the actualization of women's potential success.

It is important that institutions interrupt the institutionalization of masculine hegemony and the reproduction of gendered practices perceived as "gender neutral" and address institutional barriers to women's success in multiple ways. While addressing and developing official policies regarding parental leave and delayed tenure clock are important initial steps, it does not address gendered culture and practices of STEM disciplines, historically characterized by male domination and gendered prejudice against women (Valian 1998) that become institutionalized and taken-for-granted as normative. One way to address contexts in which such practices are normative is to highlight these sometimes invisible practices and begin, as Rosser (2009) suggests, to create a more inclusive, mentoring culture in order to facilitate the advancement of all untenured and tenured STEM faculty, women as well as men.

Solutions

The Why

The first question that must be addressed prior to proposing solutions is: What does it matter that there are fewer women in STEM than men? Mary Thom (2001) provides one answer in her argument that "Talent resides in all groups and genders. Therefore if one is really looking at a robust economy based on science and technology, and if you have a myriad of social and environmental problems that have to be addressed, you don't have anybody to waste! (p. 14). This perspective shifts the focus from women as a "special interest group" to the potential benefits their scientific knowledge and work can bring to humanity as a whole. Cecily Selby argues (1999) that "we've progressed to the point where we recognize that it's not simply a matter of figuring out how women, and others who have been excluded, can be made to "adjust" to an alien environment. We're daring to dream of making the environment of science and engineering inviting to every person who has the talent and the desire to participate in the scientific enterprise." (29)

Stout, Staiger, and Jennings (2002) conclude in their report on the status of women at the University of Texas, "Moreover, equity creates a stronger and more viable institution in terms of a national reputation for fairness as well as building loyalty among the faculty" (23). When some people routinely obtain advantages by subverting the normal channels in the long run this not only perpetuates the behaviors, but also leads to distrust and ultimately a weaker work force and undermines everyone's ability to succeed. Our first job is thus to build awareness that

"demoralizing any class affects the institutional culture as a whole and has negative effects throughout the institution and is a waste of resources" (23).

The How

One specific strategy that institutions can adopt is a systematic change in what constitutes "valued" scholarship. Specifically, in many fields, collaborative scholarship and collaborative practices are not rewarded to the same degree as single-author work and thus contribute to maintaining hegemony (Unger 1982). Similar to the women who stood up and spoke out about the right to vote, we must stand up and demand the right for the acknowledgement and support of collaborative scholarship. We must demand our seat at the table and then change the table's shape. For example, feminist researchers have sometimes utilized creative citation practices such as an equal sign between authors' names (=) to reject traditional ranking practices on manuscripts and indicate both authors contributed equally (Kochran and Mullen 2001). Until institutions recognize that women may "do" science differently than men and demand that their science is valued and recognized in an array of ways that better reflects the reality of women's lives and work, women will remain in the minority in academia, especially in male dominated fields. As Hoschild (1994) noted, we have too often focused our efforts in asking individuals to change while structures and practices at the institutional level remain unchanged (Ely and Meyerson 2000).

Rosser and Taylor (2009) offer a series of other suggestions. They emphasize solutions Universities are currently seeking in light of workforce needs for scientists and the benefit of having diverse perspectives influence the production of scientific knowledge. Some of their suggestions include that grants should support the reality that women have a limited window for childbearing and provide family-friendly stipends for family, child, and elder care; that there be better enforcement of discrimination policies in light of the "institutional bias [that] do creep in to chill the climate for women scientists" (10). We would add that equal attention must be paid to the "quiet" problems of better lab space, start-up funding, access to teaching and research assistants, course preferences and loads that favor men over women as to more egregious instances of discrimination and/or harrassment. Interestingly, Leahy (2006) conducted a study of gender differences in productivity using only research intensive universities to "control for many of the resource based influences on productivity including not only expectations, research

funding, and travel expenses, but also time available to devote to research relative to teaching which has been shown to affect productivity" (760). Not surprisingly she finds gender differences in the exact type of institutions that have the lowest percentages of female faculty, especially full professors. It was her assumption that at least at these institutions hegemony does not exist that we hope this paper has allowed you to challenge.

They also recommend expanding the NSF's ADVANCE PROGRAM…which has "achieved fantastic results at almost thirty U.S. universities." The ADVANCE program is aimed at "Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers". The best practices from these programs must be shared with other universities. We would add that since "broader participation" is one of two main criteria for awarding research funding, NSF must hold universities accountable for their progress in broader impacts when awarding any type of funding. They further suggest that we must continue to aggressively promote women to the highest positions in science (e.g., editorships, advisory boards, etc.). Finally, interestingly, they suggest that our country "as a whole must reject the portrayal of women scientists as a special interest group" and support policies that make it possible for women to contribute their skills and knowledge to improving people's lives, the social world, agricultural production, and the environment through science.

One Solution: Mentoring

Institutional approaches targeted at gender equity have resulted in an improved work climate for both men and women, as men many times report the same isolation and limited access to information as their female colleagues. Mentoring programs in academia have been shown to enhance the development of individuals in terms of job satisfaction, lower turnover intentions, and creating higher organizational commitment (Boyle and Boice 1998; Gibson 2006; Jackson and Simpson 1994). However, depending on context, people who take advantage of optional mentoring programs are sometimes perceived as needy or incompetent (Bailey and Self 2007), thus how mentoring practices are envisioned, promoted, and executed are important aspects of implementing a mentoring program. In addition, some champion mentoring programs as "cure alls" for institutional problems or as evidence of supportive employee policies when their functions are superficial in practice (Bailey and Self 2007).

Based on the dominant view of science as objective, rational, and a product of the individual, there is persistent belief that science is done in isolation. The image of the lone scientist huddled over the microscope and the distribution of awards to noteworthy scientists who have advanced scientific knowledge can overshadow the teams of people that make such advances possible. However, it has been argued that what people have failed to realize is that some men benefit from informal mentoring practices because they are members of the "Old Boys' Network" without even knowing it because they are members of a particular demographic group. Specifically, men are oftentimes privy to informal mentoring systems that are available to them simply by the fact that they are men – invited to football games, beer drinking, and golf games – similar to what occurs in business (Bagihole and Goode 2001). In such cases, men may not intend to discriminate against women, but, rather, they perceive women as uninterested in such activities. However, no matter the reason for the lack of an invite, the invite is still lacking, and the informal benefits therefore inaccessible. An institutionalized approach and appreciation for mentoring may be one potential solution to such a problem.

Final Thoughts

Hrabowski and Maton (2009) write, "transforming the culture of a university requires understanding its values, assumptions, and beliefs" (12). Rather than focusing on counting bodies or decontextualized concepts of "retention" and "promotion", cultural transformation is related to "how faculty and students perceive the campus environment and whether they see themselves as important parts of the community; both respected and supported" (13). It is important for us to recognize the value of investigating the nuances of particular institutional and cultural contexts, rather than assuming challenges in a given university context are universal. Women in the developed world, for instance, have greater access to science and to legal protection from discrimination than those in developing countries (Barton and Brickhouse 2006; Coley 2007). Thus, their challenges are different. This idea of not assuming each member of the group is alike is not new, but we must constantly fight the temptation to make it so.

Any and all changes have to be institutional and cultural--it is potentially exploitative if it is simply individual. For example, there could be a situation in which a new faculty member is hired and a colleague attempts to help this person with various tasks such as syllabi, finding a house, identifying childcare, navigating institutional culture, etc.. However, such aid is actually

an institutional and collective rather than individual responsibility to provide. Over time the new faculty member might feel resentful, bitter, angry, and discouraged because the bits and pieces of aid offered were insufficient. The new faculty member may experience this as a failure of individuals—the mentor let them down, so and so didn't give them enough time, etc—when in actuality a complex web of institutional gaps is responsible, including a tenure and promotion process that does not affirm collegial and supportive acts such as the ones new faculty (and us, and many others) need. There is no space on the tenure and promotion documents for informal and humane socializing into institutional practices and processes. So change cannot be framed as only an individual responsibility.

Finally, Chu Clewell and Ginorio (2002) remind us that the phenomenon of under-representation is the result of a constellation of factors. Not just hostile climate or the lack of role models or girls' exclusion from the hard sciences, but a cumulative and powerful process that includes masculine hegemony. Their writings reflect a move in gender and feminist research away from relentless emphasis on "women" and "gender" at the expense of other categories of identity and cultural processes that intersect with, and mediate, gender. We need to continually remind ourselves that multiple systems of hegemony inform women's experiences.

At the least, mount your own resistance – refuse to buy into the system; get allies (these allies can be members of the dominant group or they can be members of the less powerful group – people in numbers are extraordinarily powerful); continue to make the case for change both within and outside the organization; obtain positions of power and enact change; form new organizations (Agócs 1997).

In "Field of Dreams" Kevin Costner's character states "if we build it, they will come". He is referring to transforming his dying farm into a baseball field, but this sentiment can apply equally to universities. If institutional culture supports the growth and development of its constituents then tenure and promotion will come. The attention must shift from the historical focus on "retention" and "counting" (e.g., the leaky pipeline) to the processes that contribute to respect and satisfaction and thus encourage retention. Such supportive and respectful processes as we have outlined above might naturally nourish the numbers of women in STEM and if enacted will allow all people to "come to STEM".

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