Authority, Expertise, and Impression Management: Gendered Professionalization of Chemists in the Academy

by

Laura Ellen Hirshfield

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Sociology)
The University of Michigan
2011

Doctoral Committee:

Professor Karin A. Martin, Chair
Professor Emeritus Mark A. Chesler
Professor Abigail J. Stewart
Associate Professor Renee R. Anspach

To Dr. Anne Newman Hirshfield,
a truly inspirational scientist and amazing mother.

Acknowledgements

This dissertation focuses on the barriers that women face in the Academy, but it is inspired by the many women teachers and academics that I have known who have made academic success look easy. Thus, this dissertation is dedicated to the women who have mentored me (both formally and informally) and acted as role models throughout my academic career, especially Trudy Bush, Jodi Flaws, Lisa Smulyan, Farha Ghannam, Rena Bezilla, Phyllis Wise, Meena Rao, Deborah Hirshfield, Lynnette Nieman, Gerry Taylor, Patricia Hill, Linnea Hauge, Laura Kramer, Mary Wright, and numerous others who helped me during graduate school. Most importantly, it is dedicated to my mother, Anne Hirshfield, a wonderful scholar and mentor who has taught me so much about living your life while loving your work.

The process of writing a dissertation is an exhausting one and I could not have made it through without the help of an incredible number of people. I cannot adequately express here (partly due to that exhaustion) what the assistance and comfort of all of you has meant to me along the way, but it's important that I at least explain the role that many of you played in this long journey.

I owe a great debt to Lisa Frehill, who was the first person to put the idea of conducting an ethnographic study into my head. I also am extremely grateful to the administrators and administrative assistants in the chemistry department where I conducted my study. I was treated with utmost kindness and warmth by every member of

the office staff I interacted with, which made the (sometimes tedious) process of conducting back-to-back interviews much more pleasant than they otherwise might have been. One particular administrator in the department supported my project from the start, helping me to obtain a census of the graduate students, forwarding my name and request for access to faculty members, and endorsing my study to the department as a whole. Without his help and sponsorship, I would not have been granted entrance into these research groups or experienced the level of cooperation with my participants. I am also extremely appreciative of my participants themselves. Over the nine months that I observed them, they showed remarkable good humor, warmth, and openness towards me.

I could not have written this dissertation without the help of my two transcriptionists: Jaime Brunton and Susan Scherrer. I am terrible at transcription, so Jaime and Susan made my work considerably easier by transforming my interviews into manageable data. Susan, who was new to transcription, was a natural. Jaime, who did the majority of the transcription, was fabulous as usual and finished in record time. More importantly, Jaime sent little comments with each set of interviews she transcribed, and these notes (e.g., "how interesting!" and "this one was great!") really kept me motivated.

My dissertation committee was made up of some of the smartest and most caring faculty members at Michigan, who were always careful to check in on both my well-being and my progress through the program. Karin, Mark, Abby, and Renee were all a pleasure to work with and made the experience of discussing my work exciting, rather than nerve-wracking.

Throughout my time in Michigan, Karin Martin has quietly and gently led me to make some of the most important choices in my graduate career: she gave me the

confidence to teach statistics, supported me in my focus on teaching, and introduced me to several incredibly influential future mentors (and committee members!) She also supported my decision to pursue a teaching opportunity before I had completed this dissertation despite her reservations, and provided detailed, helpful feedback on my work. I respect her scholarship so much, and I feel very lucky to have gained insight into her research and writing process through the advice she has given me over the years.

From the moment I began working with Abby Stewart and the ADVANCE project, she has been consistently supportive and engaged with my progress through graduate school, despite the numerous hats she wears as faculty member, ADVANCE director, and dean. One of the best aspects of working with her is that she is so incredibly clear and straightforward about what she believes her role as a mentor is and should be – she truly embodies many of the lessons about advising and mentorship that ADVANCE provides for women. While Abby is quick to provide helpful and important feedback for your work, she also makes it clear that you, as an individual, come first.

When Abby suggested that I have a brief meeting with Mark Chesler, I never guessed that it would lead to a position in a warm and highly knowledgeable research group (FACDIV), several publications, and a great mentor. Mark has always pushed me to think deeply about my methods and my position as a researcher and teacher. He also never hesitates to engage in conversations about these topics, no matter how uncomfortable, which I truly admire.

Finally, though we never had the opportunity to work together on a project, Renee has always been extremely enthusiastic and supportive of me and of my work. Renee has come through for me several times when I needed her to, most importantly when I needed

a reference for my position at New College. Her knowledge about identity and impression management were invaluable during the early phases of dissertation writing and her engagement in my project was extremely heartening.

Several other faculty members in sociology have been supportive of me during various stages of my graduate training. These include Jason Owen-Smith, David Harding, Elizabeth Armstrong, Al Young, and Ray De Vries. I also greatly benefitted from the support of several important colleagues and friends in the sociology department here at Michigan. Sara Crider, Jen Torres, and Jess Wiederspan were all wonderful allies to discuss teaching and feminist research methods with. Dan Hirschman was always willing to offer suggestions for citations about science and expertise – I was so sad that our time at Michigan did not overlap more fully, since the work that we do is so related (as are our names!) Jennifer Ailshire has also been an immensely important friend to me from nearly the first week of graduate school. I'm so glad that we have been able to maintain this relationship across such a great distance, and I hope that we will be able to continue to be there for each other in the future. Finally, Steph Osbakken, my part-time roommate, friend, and colleague was an absolute treasure to live with for the short time that we spent together. Steph and I shared so many interests both personally and intellectually that I felt that I grew intellectually every time we curled up with wine and chocolate and chatted. I am indebted to her for so many of those off-handed comments she made that ended up sparking important concepts that made it into this dissertation.

As a member of several research groups (of varying degrees of formality) throughout my time at Michigan, I was lucky enough to receive support from a wide array of sources. The Faculty Diversity group provided me with many moments to think

deeply about my own identity, my research methods, and provided me with a wonderful co-author in Tiffany Joseph. The ADVANCE group, which I worked with most closely in 2006, was a wonderful chance for me to think deeply about the issues that women in science face. Over the years, as I've written about this topic, I've often emailed requests to Keith Rainwater or Cynthia Hudgins for help obtaining information that I needed and they have always followed through with data or citations. Finally, late in graduate school, I was blessed to find myself working with Linnea Hauge's research group in the department of Medical Education. Linnea was one of the most amazing mentors I have ever come in contact with – energetic, motivated, a clear communicator, and passionate. I am so glad to have had that chance to work with her.

Once I arrived at New College, I felt a bit adrift and was concerned that I would be all alone while I wrote this dissertation. Yet I was incredibly lucky to join a wonderful department whose members helped me adapt to a new environment, protected my time, and helped me to grow as a professor, while still completing this massive project. Emily Fairchild, in particular, acted as a generous mentor, friend, and colleague, and I never would have made it through the first few weeks in Sarasota without her. I also could not have completed this dissertation without Steve and Alice Shipman. They took me to Roller Derby, made tempura with me, and generally kept me sane. Steve, a chemist, also acted as a sort of technical consultant, filling in gaps in my chemistry knowledge when they arose.

Aaron Kimel has been a reassuring presence in my life as a graduate student ever since the day I walked home after a disastrous first section teaching as a GSI. He talked me down then, and has talked me down multiple other times, assuring me that I am a

good teacher and scholar, that I will manage to finish my work, and that I will get whatever fellowship or job I want. He has also read more of my research than any other colleague or mentor, providing feedback on ways to improve both my language and my reasoning, and over the years, I have learned a lot about clear writing from his feedback. Despite the fact that I often give him little notice to read my work and often send him things to edit that will bore him to tears, he always comes through for me. Most importantly, while he teases me mercilessly, he believes deeply in me and encourages me when it matters most.

The past eight years have been an intense time of growth and loss for me, during which I was lucky enough to have the love not only of my blood relatives, but also of a group of friends without whom I could not have made it through. First and foremost among these family-friends are the members of GSSSG: David Hutson, Emily Kazyak, Zakiya Luna, Carla Pfeffer, Kristin Scherrer, and Katherine Luke. This group has sustained me in a way that I never dreamed possible when we first formed in 2005, and we have stood together through an amazing amount of life moments: weddings, births, break-ups, publications, illnesses, new jobs, defenses, moves, and overwhelming loss. Through it all this amazing group of colleagues and friends has provided a solid space for being both a human and an academic. I'm really not sure what I would have done this year without David's help with my final copies, Emily on Skype talking me down, Carla's awesome emails and facebook feed to cheer me up, Zakiya's willingness to be on 24-hour notice for check-ins and venting, and Kristin's accountability meetings (plus construction paper chains). Also, though I'm devastated that Katherine is not here with us, I have felt her presence throughout this process in myriad ways. Not only did she

share her wonderful family and friends with me, but she also taught me an unbelievable amount about being a scholar, a colleague, and a friend. I miss her every day.

One of the most amazing gifts that Katherine gave me was my friendship with Dana Levin. Dana and I became close early in my graduate school career and she helped me get through all of the most challenging things that I experienced along the way. She became my home away from home, my family away from my family, in a deep and profound way that still surprises me. I don't really have the right language to thank Dana for everything she did for me over these years, but I can say that I feel incredibly lucky to have her in my life and to have benefitted from her presence throughout each of the many hurdles (both formal and informal) that I faced over the past 8 years.

Finally, I need to thank the rest of my family for their support throughout graduate school. My parents, Anne and Michael Hirshfield, and sister, Elizabeth Hirshfield Moss, have never once questioned my desire to go to graduate school. Instead, they have encouraged me, fed and coddled me, and never once asked me why I wasn't finished yet. They have helped me in tangible ways (by helping me move across the country and planning my trips for me) and in intangible ways (by checking in just when I needed to hear a friendly voice). Having such wonderful parents, nieces (Ella and Sarah), and sister and brother-in-law, makes me feel beyond fortunate.

Table of Contents

Abstract

Authority, Expertise, and Impression Management: Gendered Professionalization of Chemists in the Academy

by

Laura Ellen Hirshfield

Chair: Karin A. Martin

Women face more barriers to their success than their men counterparts in science, technology, engineering, and math (STEM) disciplines. While much of the research on women's experience in science has focused on their entry into or exit out of STEM fields (the "leaky pipeline"), less is known about the obstacles that women scientists face at work, due to the dearth of ethnographic work exploring gender and day-to-day experiences in the academic workplace. Using data from a qualitative study of graduate students and postdoctoral fellows in chemistry involving over 120 hours of ethnographic observation and 40 semi-structured interviews, I focus specifically on the gendered nature of authority, expertise, and impression management to investigate several of the obstacles women scientists face at work.

In the first chapter, I investigate men and women graduate students' and postdocs' expectations of expertise. I argue that overall, men are more likely than their women peers to be seen as experts in chemistry. As a result, men graduate students benefit from

more practice with skills that are applicable to their future careers: applying scientific knowledge to relevant questions and communicating this information to others.

In the second chapter, I focus on gender and graduate student socialization. I find that the link between men, science, and academia creates a context in which men do not need to work as hard to establish their claim to scientific authority. Therefore, men are able to perform masculinity in varied and complex ways, while women, who do not embody masculinity, feel more pressure to conform to strict norms of competition that are associated with traditional masculinity.

In the last chapter, I discuss the impression management strategies that men and women chemists-in-training use to navigate authority and expertise. I find that men are more likely than women to employ interactional styles that feature their expertise when in group situations, while women are more likely to minimize theirs. In contrast, while teaching, women sometimes use styles that align with masculinity rather than with femininity. Finally, men's bodies occasionally eliminate men's need for impression management in the classroom because being masculine grants them authority.

Chapter 1

Introduction

Research on gender inequality has demonstrated numerous barriers that women face in the workplace, including sexual harassment (Uggen and Blackstone 2004), tokenism (Williams 1991), wage differentials (AAUW 2011), and cultural taxation (Hirshfield and Joseph forthcoming). While some of these problems have gradually improved as women have continued to enter the workforce, gender bias and inequity are still a major concern. For example, though the wage gap between men and women has been gradually decreasing, women still make only 77% of what men do (AAUW 2011). A key reason for this gap may be women's underrepresentation in STEM (science, technology, engineering, and math) careers, because studies show that salaries in these fields tend to be more equitable than in non-STEM fields (Beede, Julian, and Langdon 2011).

Since one of the areas in which gender inequality has been particularly slow to recede is in the STEM disciplines, research about gender discrimination and gender bias in the STEM fields has been of particular interest to social scientists. Researchers have focused on the myriad underlying mechanisms through which this issue persists, particularly the "leaky pipeline" through which it has been argued that women drop out of science and math classes, programs, and careers (Blickenstaff 2005). The low

proportions of women in the sciences are slowly shifting, however. Some fields, such as the biological sciences, have already seen a dramatic transition in gender ratios, and others, such as chemistry and environmental sciences are following suit. Indeed, though the faculty in these disciplines are predominantly male, the proportion of women in undergraduate and doctoral programs is quickly gaining parity with men (Hill, Corbett, and St. Rose 2010). Thus, these are particularly interesting contexts within which to explore gender norms, stereotypes, and socialization, particularly during a simultaneously historic period of change.

Yet there is evidence that women face barriers to success once they are in STEM doctoral programs and careers, as well. In this dissertation, rather than focus on the features of the STEM pipeline that cause women to "leak" out of it, I concentrate instead on several characteristics of the scientific context that produce difficulties for women. In this project, I examined chemistry, a shifting gendered context, to explore some of the more nuanced mechanisms through which gender inequalities emerge in science disciplines. In particular, I focused on gender at the interactional level; examining ways that men and women express and utilize expertise differently, how they engage with norms of competition and collegiality, and differences in impression management strategies related to research expertise and authority in the classroom. I have focused specifically on these issues because they were the most salient gender differences that emerged within this scientific context. While there is no question that several of these women chemists-in-training also faced difficulties related to sexual harassment, career/family balance, and gender discrimination, the issues I describe in this dissertation were experienced by a far greater majority of the women I observed.

Previous scholarship has demonstrated that women and men facultys' authority and expertise are evaluated differently in both the classroom and in research contexts, and this can have significant consequences for their subsequent promotion and tenure. These studies have shown that women faculty are more likely than their men peers to face challenges to their authority in the classroom (Sprague and Massoni 2005; Sandler 1991) and that women are expected to be more than twice as productive as men to be considered equally knowledgeable or productive in their fields (Wenneras and Wold 1997). Further, women scientists feel that they are less likely to be viewed as experts and receive less respect from faculty than their men peers (Fox 2001; Johnsrud 1995). Research has also demonstrated that despite the highly collaborative nature of much scientific research, many STEM departments embrace extremely competitive, macho norms that can make women graduate students and faculty feel isolated or out of place (Ferreira 2003; Traweek 1988). Thus, this dissertation endeavors to explore more closely some of the differences in the ways that men and women express their expertise to others, how authority is conveyed and challenged in classroom settings, and how norms of competition and collaboration affect men and women scientists differently.

Defining My Terms

In the workplace, hierarchies of power are established through the effects of both authority and expertise. In social science research, these constructs are often conflated, and thus their varying definitions and effects are not well understood. Loosely defined, authority is the power to make and enforce decisions, while expertise is a series of mastered skills with increasing levels of difficulty in specific areas of functioning (Turner 2001; Ericsson 2006). Despite the presumption that people with authority are the experts,

as well as the opposing norm, that higher levels of expertise accompany authority, this relationship does not always hold constant (Clancey 2006). However, there is strong evidence that knowledge and expertise are key factors in determining influence and authority, particularly in scientific disciplines (Turner 2001). Experts are often defined as such only in contrast to non-experts (Mieg 2006), yet context is key; expert status may shift such that in some contexts individuals are experts, while in others they are not (Jacoby and Gonzales 1991).

Both competition and collaboration are important aspects of the scientific process. Collaborative research, both within research groups and between research groups, is at the very heart of the training process of the majority of the "hard" natural sciences (Sonnewald 2008). On the other hand, many research scholars investigating STEM programs have described the intensely competitive and hierarchical behaviors that are the norm in the departments that they observed (Traweek 1988; Sallee 2011; Ferreira 2003). These studies highlight common double standards between spoken norms of collaboration and cooperation and the hidden ideals of individualism and "making it big" (Traweek 1988). Finally, competition and collaboration are both gendered constructs. Stereotypical gender beliefs about masculinity lead us to connect men with competitiveness and aggressiveness (Thorne 1993; Ridgeway 1997, 2011; Donaldson 1993), while we tend to associate women with collaboration, cooperativeness, and nurturance (Connell 1987; Thorne 1993; Martin 2003; Gilligan 1982; Ridgeway 2011).

Finally, impression management involves the behaviors and practices individuals use to control others' feelings or perceptions about themselves. Goffman (1959), one of the most influential scholars in the field of impression management, argued that it is in

individuals' best interests to influence other people's perceptions of themselves in order to control others' conduct and reactions to them. To do this, individuals share information about themselves through the use of "symbols," which provide social information about their level of prestige or about their undesirable characteristics (Goffman 1963). In Goffman's articulation of impression management there are two different kinds of communication or expression that individuals use constantly: expressions you *give* and expressions you *give off*. Expressions you *give* are verbal signals used purposively, communication in the narrow and traditional sense. Expressions that you *give off* are a wide range of actions the observer can treat as symptomatic of the actor, which are nonverbal and are presumably an unintentional kind of communication. Often, observers use the second type of expression, which is usually thought to be unconscious, to verify the first type, i.e., a cook will watch how quickly a person eats his food and monitor the number of helpings he takes to determine whether or not his polite, "This food is delicious!" actually reflects his true beliefs. Goffman explained that people often manipulate the expressions they *give off* to make others believe what the expression they are *giving* more fully.

One method that individuals use to convey their position to others (or expression that individuals give) is through the use of clothing (Rafaeli et al. 1997; Pratt and Rafaeli 1997; Mast and Hall 2004; Hunt and Miller 1997). Indeed, many feel that attire acts as a "visual metaphor" for social identity (Davis 1992; Hunt and Miller 1997). Another way that people communicate their social identities is through the emotions they express. Since women are thought to be more emotional than men, by expressing themselves emotionally, they perform their femininity (Fischer 1993). In contrast, crying in men's

peer groups is heavily sanctioned and men are harshly criticized when they appear to be too sensitive *(ibid)*. Women also do far more emotional labor and emotion management than men do (Hochschild 1983). Finally, the clearest way that people reveal their identities is through the words and expressions they use. These discursive practices are often used strategically to control the way that others understand our ethnic, gendered, and class identities, among others (Goffman 1959; Davies and Harre 1982; Trudgill 2001).

Data and Methods

The Context of Chemistry

Nearly all STEM disciplines continue to be male-dominated, since the majority of practitioners, faculty members, and graduate students in most STEM fields are men (Hill et al. 2010). However, like the biological sciences, in which more than half (52.8%) of those employed in the field and nearly half (47.9%) of all doctoral students are women, the proportion of women in chemistry has been improving progressively over the past few decades (*ibid*). Indeed, of the STEM disciplines *other* than biology, chemistry is the discipline with the highest percentage of women who are currently practicing scientists and who are doctoral students (33.1% of the workforce and 34.3% of graduate students are women) (*ibid)*. Accordingly, chemistry provides a useful case to explore gender in a field that is currently shifting in both its demographics, and perhaps, as a result, its norms and values.

At the time of my study, the particular chemistry department I observed was both selective and research-oriented. The department was also quite committed to gender diversity. Though the percentage of women faculty in the department was fairly low

(approximately 25%), the proportion had improved significantly: doubling since 2004. Further, the chair of the chemistry department was a woman. The percentage of women graduate students was substantially above the national average: just under half (49.2%) of all graduate students were women. I benefitted greatly from faculty members' commitment to issues of gender diversity throughout the beginning phases of this project. Several faculty members (both men and women) showed interest in my study, provided me with free access to their research groups, invited me to events beyond the scope of my original research plan, and shared articles with me that were related to science, gender, or the academy. Additionally, a key member of the department's administration worked with me to help provide access to information about graduate students' research group membership and faculty members' rank, as well as providing important insights into the chemistry graduate program and the discipline itself. The department had recently been involved in a research study undertaken by a fellow chemist, so many faculty members were already comfortable with social scientific methods. Lastly, my informant sent e-mails that endorsed me and my study to those faculty members that we had identified as potential candidates.

Data Collection

Given my interest in interaction and impression management, I chose to use ethnographic methods for this research study; I felt that they were particularly well suited to describe my research context, explore participants' interpretations of their experiences within that context, and develop theory from my observations (Fine 1999). Data were collected during two research phases with different study objectives. The first phase used participant observation techniques to allow for total immersion in the context of academic

chemistry. This allowed me to detail the complex interactions and decision making that took place on a daily basis for my respondents, as well as to familiarize them with my presence and with my project. The second phase employed in-depth, semi-structured interviews to focus specifically on expertise, authority, and impression management strategies. I used these two complementary methods as a way of offsetting the shortcomings of each methodology. Knowing that my presence in lab and research meeting settings could influence the interactions that I observed, I asked specific questions about how participants believed my presence had affected their experiences. I also used my own observations of each participant to add to, temper, and enrich their own personal narratives.

Due to my interest in interaction, for this research project, I chose to observe only those groups with six or more members. I was also interested in observing groups that varied in terms of their gender demographics; thus, I sought to observe research groups that were directed by both men and women faculty members and groups that varied in their proportion of women.[1] Some subfields in chemistry commonly employ greater numbers of students and postdoctoral fellows (such as Organic Chemistry and Chemical Biology), while others (such as Physical Chemistry) usually have much smaller research groups; thus my desire to observe groups with six or more members constrained the type of research group I observed to some degree. Indeed, three of the groups shared a great deal in terms of their research goals and topic. As a result, many of the graduate students

[1] Using Rosabeth Moss Kanter's (1977) guidelines to define majority/minority ratios in my labs, I identified any lab with fewer than 35% women as "tilted," or as having a low proportion of women (including women postdocs, graduate students and undergraduate students), and any lab with more than 35% women as gender "balanced." I used these ratios to identify the research groups I researched; however, the frequent transfers of personnel between groups resulted in all but one of the groups shifting between identifications over the course of the nine months that I observed them.

I observed and interviewed had experience with two or more of the faculty members and labs in my study, as well as relationships with graduate students in these other labs. While I had not planned this outcome in my research design, these relationships and insights proved fortuitous and provided additional information that I would not otherwise have had access to.

My dissertation aimed to examine the day-to-day experiences of men and women graduate students in chemistry, with a particular focus on their gendered interactions with their students, peers, and faculty advisors. Thus, I began with ethnographic observations of their time spent engaged in research, teaching, and recreation. The research activities I observed included group meetings, laboratory procedures and interactions, practice job talks, and lab clean-up days. Teaching observations included both traditional discussion-style classes and laboratory courses. Finally, I attended group parties, birthday cake breaks, and lunch hours. In each setting I took notes about students' and postdocs' interaction with others, as well as how they presented themselves physically, emotionally, and intellectually. To provide additional context for my observations, I also conducted a brief content analysis of research group websites and printed materials (such as laboratory safety manuals). These helped to supplement my understanding of the culture of chemistry, as well as of each research group.

The second phase of my research study consisted of semi-structured interviews which were conducted after the majority of my observations were complete. I had planned to interview only graduate students, but after several postdoctoral fellows expressed interest in my study, I expanded my interview protocol to include them as well. These additional interviews with postdocs provided insights into graduate socialization

and experiences at universities other than the one I observed, information about teaching and research at the postdoctoral level, and corroboration of my findings about the graduate students and faculty I observed from members of the research community who had unique positions within the groups' hierarchies. While postdocs entered the groups with more training and credentials than the majority of the members of each research laboratory, as novices in the group they often also lacked knowledge about the functioning of the group itself. As a result, they were treated with varied levels of respect and esteem by graduate students. The interviews I conducted with both graduate students and postdocs were particularly rich since the majority of my participants were familiar with me and with my project. My interviews explored five main topics: advisor relationships and style, research group interactions, teaching, self-presentation, and overall images of scientists.

Methodological Considerations

In a methodological article describing research in a physics laboratory, Doing (2004) clearly outlined the two different types of laboratory (or more broadly, science) ethnographies that have commonly been conducted. The first type involves former scientists who have become trained as sociologists (or other forms of social scientists) who then return to a scientific context to study it (e.g., Harry Collins). These authors argue that their knowledge of the field they study allows them to more fully understand laboratory processes and the social interactions that occur. The other form of laboratory study involves a naïve observer who enters the laboratory and/or scientific context with little scientific knowledge and learns about the site during the process of observing it (e.g., Sharon Traweek). These scholars argue that it is their very lack of knowledge that

helps them to be better researchers in scientific environments since they are less likely to take for granted the social or political implications of what they witness. Given the contradictory nature of these arguments, Doing commented, "It seemed to me that, somehow, you needed to be versed and awkward at the same time" (Doing 2004; p. 301-2.)

Nevertheless, for this study, I engaged primarily in the latter method of observation. I have very little personal background in the natural sciences and frequently had little understanding of the technical details discussed by my research participants. This caused difficulties for me at times: I struggled at first to take notes when I could not understand the minutiae of participants' presentations and conversations which moved quickly were fairly difficult to follow. However, there were many advantages to my ignorance of the specifics of chemistry. First, given my interest in interpersonal interaction, I did not get bogged down in the details of technical jargon, but rather, was able to focus on who was treated with the most respect, who talked the most, etc. Second, knowing that I was not "in the loop," respondents often tried to help me out so that I benefitted from explanatory data that I might not have otherwise received. For example, students passed notes to me explaining what specific terminology meant during meetings or whispered explanations to me about names that had been raised in conversations. During my subsequent interviews, they also gave careful explanations about departmental and disciplinary politics, described chemical and technical processes thoroughly but in an elementary manner, and because of my own knowledge and expertise, focused more on presentational and interactional topics, rather than on their chemistry.

It is important to note, however, that though I was a naïve observer in terms of science, I was also a "native" graduate student and academic. I benefitted from many of the positive aspects of being presumed by my participants to be somewhat similar to them in terms of age, academic experiences, and lifestyle. Shared experiences came up frequently in informal conversations during my observations, as well as in my more formal interviews. At times, my participants' assumptions about the similarities in our experiences were unfounded: these conversations quickly established major differences in our disciplines' publication frequency and timing, regard for teaching and coursework, and norms of collaborative publication and research. Still, the shared culture of graduate school and early adulthood allowed for an informality and rapport with many of my participants that was both quick to establish and eased the potential awkwardness of my presence. On the other hand, it is possible that my familiarity with graduate student life and experiences also occasionally caused me to fail to follow up or probe further about topics that my participants or I took for granted.

I have spoken about the effects of my age and academic identity on the rapport I built with my participants, but it is also likely that other social identities, most notably my gender, race, and nationality, played a significant role in the way that my participants perceived and interacted with me. Initially, I worried that my identity as a white, U.S. born woman might skew my interview sample; however, I found that the demographics of the 40 graduate students and postdocs who volunteered to speak with me closely resembled the demographic make-up of the overall groups I observed. There is evidence that using same-gender interviewers is preferable, especially when discussing topics related to sex or gender (Catania et al. 1996; Huddy et al. 1997); yet, given this study's

two-phase design, I felt that interviews would be richer if they were conducted by the same researcher who spent time with the research groups.

It is possible, however, that given the relationship between gender, expertise, and science, women felt more comfortable speaking openly with me, a woman, than men did. On the other hand, these interviews varied greatly in terms of emotional depth; both men and women opened up about some of their most frustrating and worrisome experiences, and it is difficult to know whether the men I spoke with would have opened up as fully with another man (or if they simply would have shared differently). In several instances I also felt that participants assumed that my project focused on gender because I am a woman, despite the fact that my research protocol did not highlight my particular interest in the topic. Given this belief, I felt that my participants were especially careful about their characterizations of inequality: it seemed that the majority of them did not want to represent their discipline, research group, or classes unfairly, and were quite circumspect in their answers. Finally, while I did not experience any hostility due to my project or my presumed feminist politics, I did face a few instances of patronizing comments about my interview questions and topics (which seemed gendered to several of my participants given my focus on clothing and emotions). These comments usually began with a phrase like, "no offense, but…" and were only made by men graduate students, postdocs, and faculty.

Finally, there were some methodological challenges that arose due to the topic I was studying, impression management, and my own professional circumstances. Given my interest in self-presentation, I felt that it was important that I dress in clothing that was as neutral and similar to the students I observed as possible, especially during

interviews, so that my own clothes would not create a distraction or cause the participants that I spoke with to focus too much on the contrast between my clothing and their own. However, during the time that I conducted these observations and interviews I also worked as a graduate student instructor in sociology and research associate at a nearby hospital. Thus, I often faced a quandary about what to wear: I was expected to dress quite professionally while not conducting my research, and did not always have time to change out of the more casual jeans that I wished to wear to conduct interviews.[2] In general, it seemed that I was successful in dressing fairly inconspicuously, since my participants did not often seem to notice or remark upon my clothing. When they did, these comments (always made by women students and postdocs) were usually in the context of compliments about my sweaters or shoes, rather than commentary about how disciplinary differences affect clothing choice. Also, many of my observations occurred during warm months, when open-toed shoes were my normal attire. Thus, when conducting observations in chemistry laboratories, I had to remember to bring close-toed shoes at all times or face the possibility of missing out on important observations. As a result, during the nine months that I conducted this study, I thought more carefully about my own clothing than I ever had before.

This Dissertation

This dissertation includes three distinct articles exploring the experiences of graduate students and postdoctoral fellows in chemistry ("chemists-in-training") using a gendered, interactionist perspective. In the first chapter, I examine expectations of expertise for men and women graduate students and postdocs in chemistry, as well as the

[2] In these cases, I usually settled upon wearing khaki pants, which were both dressier than the clothing that women students in chemistry wore and too casual to wear to my own workplace.

consequences of these expectations. Given that knowledge and expertise are key factors in determining scientific influence and authority, gender differences in the methods of expressing and demonstrating knowledge can have significant consequences for women in STEM fields.

In the next chapter, I examine the link between masculinity and science more closely. I focus on gender performance by exploring the socialization process experienced by graduate students and postdoctoral fellows. I compare the socialization I observed in chemistry to the highly competitive, masculinized socialization described by Sallee (2011), Traweek (1988), and others. This chapter looks more closely at masculinity in a scientific context that is gradually becoming less (numerically) male-dominated to investigate the different ways that masculinity can be enacted by men and women and offer a more nuanced view of gendered performance.

The final chapter in my dissertation focuses more closely on impression management strategies. In it, I ask "How do men and women graduate students and postdocs demonstrate their expertise and authority in chemistry to others?" and "Which, if any, of the impression management strategies I observed differ by gender, and in what ways?" This research topic is particularly well suited for a research population like chemists-in-training, given that they are neither students, nor faculty, but must occupy a space somewhere in-between. As such, they experience varied amounts of challenges to both their expertise and authority and must prove themselves in both arenas. This chapter explores the impression management strategies that graduate students and postdocs use to demonstrate and perform their expertise and authority.

I conclude by discussing some of the contributions of my findings to both research and institutional policies. I also describe several limitations of this study, as well as the future research that could be implemented to ameliorate these shortcomings.

References

AAUW. 2011. "The Simple Truth about the Gender Pay Gap." 20(81):321. Retrieved (http://www.aauw.org/learn/research/simpleTruth.cfm).

Beede, David, Tiffany Julian, and David Langdon. 2011. *Women in STEM: A Gender Gap to Innovation*. Washington, DC.

Blickenstaff, Jacob Clark. 2005. "Women and Science Careers: Leaky Pipeline or Gender Filter?" *Gender and Education* 17(4):369-386.

Catania, Joseph A. Diane Binson, Jesse Canchola, Lance M. Pollack, Walter Hauck, and Thomas J. Coates. 1996. "Effects of Interviewer Gender, Interviewer Choice, and Item Wording on Responses to Questions Concerning Sexual Behavior." *Public Opinion Quarterly* 60:345-375.

Clancey, William J. 2006. "Observation of Work Practices in Natural Settings." Pp. 127-145 in *Cambridge Handbook on Expertise and Expert Performance*, edited by A. Ericsson, N. Charness, P. Feltovich, and R. Hoffman. New York: Cambridge University Press.

Connell, R.W. 1987. *Gender and Power: Society, the Person and Sexual Politics*. Stanford, California: Stanford University Press.

Davies, Bronwyn, and Rom Harre. 1982. "Positioning: The Discursive Production of Selves." *Journal for the Theory of Social Behaviour* 20(1):43-63.

Davis, Fred. 1992. *Fashion, Culture, and Identity*. Chicago: University of Chicago Press.

Doing, Park. 2004. "'Lab Hands' and the 'Scarlet O': Epistemic Politics and (Scientific) Labor." *Social Studies of Science* 34(3):299-323.

Donaldson, Mike. 1993. "What is Hegemonic Masculinity?" *Theory and Society* 22(5):643-657.

Ericsson, K. Anders. 2006. "An Introduction to the Cambridge Handbook of Expertise and Expert Performance: Its Development, Organization, & Content." in *The Cambridge Handbook of Expertise and Expert Performance*, edited by K. Anders Ericsson, Neil Charness, Paul Feltovich, and Robert R. Hoffman. Cambridge: Cambridge University Press.

Ferreira, Maria. 2003. "Gender Issues Related to Graduate Student Attrition in Two Science Departments." *International Journal of Science Education* 25(8):969-989.

Fine, Gary A. 1999. “Field Labor and Ethnographic Reality.” *Journal of Contemporary Ethnography* 28(5):532-539.

Fischer, Agneta H. 1993. “Sex Differences in Emotionality: Fact or Stereotype?” *Feminism & Psychology* 3(3):303-318.

Fox, Mary Frank. 2001. “Women, Science, and Academia: Graduate Education and Careers.” *Gender & Society* 15(5):654-666.

Gilligan, Carol. 1982. *In a Different Voice: Psychological Theory and Women’s Development*. Harvard University Press.

Goffman, Erving. 1963. *Stigma: Notes on the Management of Spoiled Identity*. Englewood Cliffs, New Jersey: Prentice Hall.

Goffman, Erving. 1959. *The Presentation of Self in Everyday Life*. New York: Double Day.

Hill, Catherine, Christianne Corbett, and Andresse St. Rose. 2010. *Why So Few? Women in Science, Technology, Engineering, and Mathematics*. Washington, DC.

Hirshfield, Laura E., and Tiffany D. Joseph. Forthcoming. “‘We Need a Woman. We Need a Black Woman’: Gender, Race & Identity Taxation in the Academy.” *Gender and Education*.

Hochschild, Arlie Russell. 1983. *Managed Heart: Commercialisation of Human Feeling*. Berkeley and Los Angeles: University of California Press.

Huddy, Leonie, Joshua Billig, John Bracciodieta, Patrick J Moynihan, and Patricia Pugliani. 1997. “The Effect of Interviewer Gender on the Survey Response.” *Political Behavior* 19(3):197-219.

Hunt, Scott A, and Kimberly A Miller. 1997. “The Discourse of Dress and Appearance: Identity Talk and a Rhetoric of Review.” *Symbolic Interaction* 20:69-82.

Jacoby, Sally, and Patrick Gonzales. 1991. “The Constitution of Expert-Novice in Scientific Discourse.” *Issues in Applied Linguistics* 2(2):149-181.

Johnsrud, Linda K. 1995. “Women in Graduate Education: Reviewing the Past, Looking to the Future.” *New Directions for Student Services* 72:69-80.

Kanter, Rosabeth Moss. 1977. *Men and Women of the Corporation*. Basic Books.

Martin, Karin A. 2003. “Giving Birth Like A Girl.” *Gender & Society* 17(1):54-72.

Mast, Marianne Schmid, and Judith a. Hall. 2004. "Who Is the Boss and Who Is Not? Accuracy of Judging Status." *Journal of Nonverbal Behavior* 28(3):145-165.

Mieg, Harald A. 2006. "Social and Sociological Factors in the Development of Expertise." in *The Cambridge Handbook of Expertise and Expert Performance*, edited by K. Anders Ericsson, Neil Charness, Paul J. Feltovich, and Robert R. Hoffman. Cambridge: Cambridge University Press.

Pratt, Michael G., and Anat Rafaeli. 1997. "Organizational Dress as a Symbol of Multilayered Social Identities." *The Academy of Management Journal* 40(4):862.

Rafaeli, Anat, Jane Dutton, Celia V. Harquail, and Stephanie Mackie-Lewis. 1997. "Navigating by Attire: The Use of Dress by Female Administrative Employees." *The Academy of Management Journal* 40(1):9.

Ridgeway, Cecilia L. 2011. *Framed by Gender: How Gender Inequality Persists in the Modern World*. Oxford University Press, USA.

Ridgeway, Cecilia L. 1997. "Interaction and the Conservation of Gender Inequality: Considering Employment." *American Sociological Review* 62(2):218-235.

Sallee, Margaret W. 2011. "Performing Masculinity: Considering Gender in Doctoral Student Socialization." *Journal of Higher Education* 82(2):187-216.

Sandler, Bernice Resnick. 1991. "Women Faculty at Work in the Classroom, or Why it Still Hurts to be a Woman in Labor." *Communication Education* 40(1):6-15.

Sonnewald, Diane H. 2008. "Scientific Collaboration." *Annual Review of Information Science and Technology* 41(1):643-681.

Sprague, Joey, and Kelley Massoni. 2005. "Student Evaluations and Gendered Expectations: What We Can't Count Can Hurt Us." *Sex Roles* 53(11-12):779-793.

Thorne, Barrie. 1993. *Gender Play: Girls and Boys in School*. New Brunswick, NJ: Rutgers University Press.

Traweek, Sharon. 1988. *Beamtimes and Lifetimes: The World of High Energy Physicists*. Harvard University Press.

Trudgill, Peter. 2001. *Sociolinguistics: An Introduction to Language and Society*. London: Penguin.

Turner, Stephen. 2001. "What is the Problem with Experts?" *Social Studies of Science* 31(1):123-149.

Uggen, Christopher, and Amy Blackstone. 2004. “Sexual Harassment as a Gendered Expression of Power.” *American Sociological Review* 69(1):64 -92.

Wenneras, Christine, and Agnes Wold. 1997. “Nepotism and Sexism in Peer-Review.” *Nature* 387:341-343.

Williams, Christine L. 1991. *Gender Differences at Work: Women and Men in Non-traditional Occupations*. University of California Press.

Chapter 2

Who's the Expert?: Gendered Conceptions and Expressions of Expertise by Chemists-in-Training

Introduction

While there have been measurable improvements in the climate of the academic sciences, women still face numerous hurdles in their attempts to succeed at the same levels as their men peers. As a result, their salaries are lower (Sosin, Rives, and West 1998; Toutkoushian and Conley 2005; Winkler, Tucker, and Smith 1996), they are promoted more slowly (Valian 1998), and they drop out of science, technology, engineering, and math (STEM) majors, graduate programs, and careers at higher rates (Bair and Haworth 1999; Herzig 2004; Hirt and Muffo 1998; Smith 1993). One of the most prominent theories used to describe women's difficulties in math and science examines the STEM pipeline, along which women "leak out" at many points. Rather than focus on "leakage" from this pipeline, this study will explore the experiences of women during their day-to-day lives as scientists to investigate features of the scientific context that may affect their success. Specifically, I investigate the professionalization of academics during graduate school and in postdoctoral fellowships, to examine how gender impacts conceptions and expressions of expertise.

Research shows that women graduate students and postdoctoral fellows (postdocs) in the sciences face barriers to success that their men peers do not. Women graduate students in traditionally male disciplines (which include many natural science fields) are at a much greater risk of experiencing gender discrimination and harassment (Hirt and Muffo 1998; Xie and Shauman 1998). Women faculty members in STEM fields are burdened with extra formal and informal service responsibilities (a form of gendered cultural taxation) (Hirshfield and Joseph forthcoming; Misra et al. 2011). They also receive substantially less mentoring than their men colleagues (Johnsrud 2002; Martin 1994; Sonnert and Holton 1995). On a more global level, there is also evidence that gendered stereotypes lead to lower expectations for women's overall ability than for men's and that women's research and teaching accomplishments are evaluated more harshly (Ridgeway 1997; Steinpreis, Anders, and Ritzke 1999; Wenneras and Wold 1997; Anderson and Smith 2005). More generally, knowledge and expertise are socially constructed (Collins 1992). Indeed, rather than being unbiased and neutral topics, sociologists of science have shown how various types of knowledge are considered more valuable at particular times and some types of expertise are deemed more important in specific settings (*ibid*). Since acknowledgement, expression, and employment of both expertise and knowledge depend on particular social and gendered contexts, it is important to examine more fully how expertise and power are linked, as well as how these links might impact women's success in academia and science (Evans 2008).

In this paper, I explore the patterns and consequences of expectations of expertise in men and women chemists-in-training to investigate an important avenue through which women scientists can face barriers to success. Using data from over 120 hours of

participant observation and 40 semi-structured interviews with graduate students and postdoctoral fellows, I focus in particular on how expertise is established, portrayed, and interpreted in daily interactions, and whether gender plays a role in these processes. Indeed, given the importance of knowledge and expertise within the field of science, varied methods of expressing and demonstrating knowledge can diminish women scientists' ability to compete with their men peers. I argue that men chemists are more likely to be seen as experts, both by other men and by their women peers. This is because they are more likely to be viewed as highly knowledgeable or as "star" students because of their confidence and manner of speaking, they are more likely to gain specialized knowledge about new machinery or instruments, and they are more likely to volunteer their knowledge or to accept others' definitions of their expertise in group settings. Some women are also more likely to be seen as experts regarding knowledge that is related to successfully navigating the academic program, the research group, or the laboratory itself.

Literature

Graduate Training

Academic disciplines train students to specialize not only in the relevant knowledge bases, but also in the different norms, work patterns, and interpersonal interactions that take place within these disciplines (Anderson, Louis, and Earle 1994; Becher 1987; Evans 2008). Further, graduate school socializes students on a variety of levels: they must learn to become members of the graduate student community, of the academic community as a whole, and of their discipline or field (Austin and McDaniels 2006). Although graduate school is intended to prepare students for the academic job

market, as well as for life as a faculty member, most graduate students find their preparation to be lacking (Austin 2002). In fact, though they find themselves prepared to conduct research, graduate students in a variety of fields do not feel confident about their abilities to obtain grants or funding *(ibid)*.

Women who enter graduate school, especially in STEM fields, face additional challenges. Women graduate students face personal safety concerns and are more likely to experience sexual harassment by their professors, their peers, and their own students (Wiest 1999; Schneider 1987). Women graduate students are more likely to face financial concerns related both to supporting their spouses and to their own programs (Wiest 1999; Johnsrud 1995). They are also less likely to report that they feel taken seriously, that they are seen as experts in their field, or that they are respected by faculty compared with their men peers (Fox 2001; Johnsrud 1995). A related concern is that women graduate students feel that they receive less mentorship than their men peers (Kuck et al. 2007). They also have far fewer same-gender role-models and mentors than their men peers in these fields, which can lead to social and intellectual isolation (Wiest 1999; Johnsrud 1995). Additionally, potential women mentors may not be in an ideal position for mentoring based on their own challenges. Women mentors are more likely than their men peers to become burned out or to experience difficulties with promotion or advancement due to their increased advising responsibilities (Aguirre 2000; Haag 2005; Samble 2008). Further, women faculty members receive less mentorship from their senior colleagues than do men faculty members (August and Waltman 2004). Women graduate students are also more likely to receive mentorship from women faculty; thus, it is likely that lack of mentorship, or at the very least, insight into academic networks,

could be a self-perpetuating problem for women faculty. In sum, perhaps due to the confluence of many of these factors, women graduate students are more likely to leave graduate school before completing their degree (Cooke, Sims, and Peyrefitte 1995; Herzig 2004; Ferreira 2003).

Expertise

Throughout the process of developing particular skills and knowledge, individuals move through five stages: novice, advanced beginner, competent, proficient, and expert (Dreyfus 2004). Within groups, knowledge and expertise is often linked with status. Indeed, a professional's power and authority are rooted in both her specialized knowledge and her control over interpersonal situations (Larson 1979). Thus, interactions with other group members and their judgments of an individuals' knowledge and expertise can become key factors in determining who will have status and power within a group. However, experts do not always need a record of excellent performance to convince others of their abilities or knowledge, but can use impression management to project self-confidence to imply to others that they are highly skilled (Shanteau 1988).

Experts are often defined as such only in contrast to non-experts (Mieg 2006); however, expertise can also be understood as a series of mastered skills with increasing levels of difficulty in a particular area of functioning (Ericsson 2006). Context is key; expert status may shift such that in some contexts individuals are experts, while in others they are not (Jacoby and Gonzales 1991). There are several key ways that individuals' expertise is judged. First, an individual's credentials, which might include certification, course-work, or graduate degrees, help to provide information about her degree of expertise. Second, an individual's track record, or demonstrations of previous success in

a given field, is another excellent way of proving one's expertise. Finally, long-term participation or experience in the field may be the best way to judge an individual's expertise, especially given that it may be difficult to establish track records in some domains or credentials and successes in others may be difficult to achieve (Collins and Evans 2007).

One of the most important distinctions in scholarship about knowledge was Polanyi's description of explicit versus tacit knowledge (Polanyi 1966). Explicit knowledge is knowledge that is easily classified, recorded, and communicated through formal (often written) language (Polanyi 1966; Nonaka, Toyama, and Nagata 2000). It is easy to acquire, tends to be embedded in standardized procedures, and is easily transferable (Polanyi 1966; Dhanaraj et al. 2004). In contrast, tacit knowledge involves the unspoken rules that exist in nearly all areas of knowledge acquisition. It is not easily transmitted, tends to be abstract and obscure, and can be communicated much more easily through active interaction with others (Polanyi 1966). Examples of tacit knowledge include principles involving the meaning of mathematical notations, instrument skills, or how to ice skate (Collins 1974). Tacit knowledge can have a great impact on laboratory scientists; rather than variations in "skill" or "ability" at conducting experiments, which is often thought to be related to hand-eye coordination, it may be that one of the reasons for scientists' greater talent with experiments is their greater amount of tacit knowledge in their respective fields (Collins 2001). This type of knowledge can be passed from scientist to scientist, but it cannot be acquired from written or verbal descriptions (*ibid*). Another key type of knowledge that influences the laboratory sciences is known as local knowledge, or the information that is specific to the limited

laboratory context within which the individual scientists work (Knorr-Cetina 1981; Cambrosio and Keating 1988).[3] This knowledge might include information about where to find certain kinds of glassware, how a particular piece of troublesome machinery works, the bureaucratic structure of the workplace, or how best to approach peers and advisors for help.

In science, new graduate students often come into graduate school with some skill or tacit knowledge about how to conduct experiments or work in a lab. They enter their program with some explicit knowledge of chemistry in general; however, their training throughout graduate school provides a more thorough program of knowledge acquisition that will help them to become better prepared to be professional, academic chemists.[4] As they gain the explicit, tacit, and local knowledge that will help them become chemists, their goal is to become experts in their chosen fields.

Gendered Expectations

There is significant evidence that individuals are inclined to classify themselves and others into various social groups and categories, such as race, gender, or religion. These classifications can lead to in-group biases, where individuals are more likely to favor the members in their own social categories (Tajfel and Turner 1979). Individuals frequently show a preference for others in their own gender, racial, or educational group, i.e., homophily (McPherson, Smith-Lovin, and Cook 2001; Roth 2004; Ibarra 1992). This type of in-group favoritism is more likely to occur in smaller groups than larger ones

[3] It should be noted that while local knowledge is usually treated as a separate form of knowledge, it is in fact a subset of both explicit and tacit knowledge.

[4] It is important to note that while graduate programs in chemistry have a strong emphasis on training graduate students to continue on in academia, there is also an acknowledgement among administrators and principal investigators (PIs) that not all students are on an academic track. Thus, support and training is also provided for students who are planning to enter industry, as well.

(Brewer and Brown 1998), and can affect a variety of social and occupational settings (Brewer and Brown 1998; Fiske 1998; Reskin 2000)

Gendered preference has been commonly observed in both educational settings and in the workplace. It has been shown to affect hiring and promotion, or "homosocial reproduction" (Gorman 2005; Kanter 1977), wage gaps (Cohen and Huffman 2007; Cullen and Luna 1993), and workplace performance assessments (Roth 2004; Tsui and O'Reilly 1989). Further, gendered expectations about what kinds of educational, career, and behavioral choices are appropriate cause men and women to be differently understood and evaluated by their students, peers, and superiors (Valian 1998). Given the common gender segregation in the university by discipline, area of research focus, and social networks, especially within the natural sciences, men are much more likely to compare themselves to other men and women to other women (*ibid*; Etzkowitz et al. 2000). In interaction, men and women are subject to gender status beliefs, or "widely held cultural beliefs that evaluate one sex as generally superior and diffusely more competent than the other" (Ridgeway 1997, p. 221). Gender status beliefs have several important consequences. First, they create implicit expectations amongst people of both genders that men are more competent than women, which in turn affects women's self-confidence, assertiveness, and success (*ibid*). Second, they create a condition in which individuals are compensated for their status: as a result, men, who have a higher status in our society, expect higher rewards in situations where everything else is equal (*ibid*; Wagner & Berger 1997). Finally, given that gender status beliefs overwhelmingly favor men, they have no motivation to pay attention to information that contradicts gender status beliefs (Ridgeway 1997). While these differences in interaction styles occur at an

individual level, it is essential to note that they are motivated by structural inequalities *(ibid)*.

While previous research has explored definitions of expertise and gendered experiences in sciences, few studies have brought these areas of research together and no study I know of has conducted an examination of how gender influences access to and expressions of expertise in graduate science setting. Thus, in this paper I ask, "How do men and women in chemistry training programs (i.e., graduate students and postdoctoral fellows) conceptualize expertise and knowledge? How do these men and women chemists-in-training express their knowledge and expertise to others? How do principal investigators and fellow graduate students and postdocs identify experts? And, in what ways are these conceptualizations, expressions, and identifications different for men and women chemists-in-training?" Given previous research demonstrating that women feel that they are less likely to be seen as experts and that they receive less respect from faculty than their men peers (Fox 2001; Johnsrud 1995), qualitative research exploring knowledge and expertise in these settings is important for understanding these processes more completely. Further, insight into the development of gender differences in expressions of expertise has significant implications for women's success in academic science.

Method

The research site for this project was five research laboratories in the chemistry department at a large research university. The project draws upon nine months of ethnographic observation of the five research groups, 40 in-depth semi-structured interviews, and select content analysis of lab manuals and websites. I chose to focus on

one department as a case study (Babbie 2009), which allowed for an in-depth examination of knowledge and expertise in a scientific discipline. Limiting my analysis to this particular field allowed for a richer description of the experiences of the graduate students and postdocs in this department. The case-study approach, which acknowledges that it must exchange breadth for depth, has become more commonly accepted in recent scholarship, especially in the field of sociology of science and the sociology of work (Lincoln 2010; Fernandez and Sosa 2005; Bird 2011), since the depth they afford provides a superior opportunity to expand upon, elaborate, or create new theories and hypotheses.

I concentrated my analysis on chemistry because it was a discipline that was still quite male-dominated, with the majority of its practitioners in industry, academia, and doctoral programs being men (Hill, Corbett, and St. Rose 2010). On the other hand, women were making significant headway in the field. In fact, though women still made up only one-third of all chemists, biology was the only discipline with a higher proportion of women *(ibid)*. There is still a concern about the "leakage" that exists between graduate school and beyond (i.e., industry or academia) (Kuck 2001), however the improvement in the proportion of women in chemistry has been steady (Hill et al. 2010). As such, the field of chemistry provided a unique case to explore knowledge and expertise in a gendered context that was shifting from one that was (numerically) masculine to one that was more gender balanced.

At the time of my study, the chemistry program I observed was consistently highly ranked by US News and World Reports magazine and was selective in its acceptance of applicants. The department was also quite committed to issues of gender

diversity. The proportion of women faculty in chemistry at this university was fairly low (approximately 25%), but just as this proportion had been improving nationally, it had likewise improved within this particular department. In fact, within the past eight years, the proportion of women had doubled. Further, women graduate students represented nearly half of the total graduate student population (49.2%) at the time of my study, which was above the national average. In contrast, the department was not very racially diverse: of the graduate students in the department, roughly 84% were White, 5% were Asian, 4% were Latino/Hispanic, 4% were Black or African-American, 1% were American Indian/Native American, and 1% were unknown/unreported (NSF 2009).

Given my interest in gender, I selected research groups for my study based upon their gender breakdown and size. It was important that the groups that I observed had both men and women students in them, and that I observed groups led by both men and women principal investigators (PIs). In choosing the groups I hoped to observe, I identified each research group that had more than six students in it, as well as a principal investigator/faculty advisor who was early in his or her career.[5] I then sent email requests to each professor asking that I be permitted to observe. In total, I emailed thirteen professors whose groups roughly fit my criteria asking that I be permitted to observe, and five principal investigators and their groups agreed to be involved in my study.[6] Of these groups, two were led by men (Professors Mitchell and Moore) and three by women (Professors West, Williams, and Worth); for the sake of ease, I have used pseudonyms that begin with the letter "M" to denote the professors who are men, and pseudonyms

[5] I was advised about faculty members' rank by an informant in the chemistry department.
[6] The professors' ranks ranged from assistant to full professor; however none of the professors had been at the university for more than 10 years.

beginning with a "W" to denote professors who are women. The smallest group I observed had nine members in it (not including the PI), and the largest had twenty-one.

Ethnographic Observation

The first phase of my data collection involved ethnographic observations which occurred over the course of nine months, between July 2009 and March 2010, comprising over 120 hours. Using an inductive approach, during my observations I noted interactions between the members of the research group, the ways that presenters and group members presented themselves in meetings and in the lab (physically, emotionally, and intellectually), and the variations in style of teaching or mentoring modeled in each group. I paid close attention to interactions between the principal investigator and their students and postdocs, as well as among the students and postdocs themselves. I also noted students' and professors' choice of attire when they taught and during group meetings. During ethnographic observations, I sat with the group members or in an inconspicuous and safe[7] place in the laboratory, taking thorough field notes as unobtrusively as possible. At times, I shadowed graduate students around the lab, accompanying them to break rooms for meals, followed them around the lab during group clean-up days, or gathered with the group during parties. Field notes were transcribed and annotated as soon as possible afterwards. Finally, I conducted a brief content analysis of laboratory websites and printed materials (such as the lab safety manual) to complement my understanding of the culture of each research group, group success, group cohesiveness, and the way that each PI managed lab dynamics.

[7] By "safe" I mean a reasonable distance away from any individuals using caustic, dangerous chemicals, as well as out of the way of commonly used passageways within the labs.

Over the nine months that I conducted my observations, the personnel shifted somewhat in each lab. Since I began some of my observations over the summer, several of the REU students (undergraduate research assistants) stopped attending meetings, and at the beginning of the fall semester, a new crop of "rotators,"[8] or first-year graduate students, began working in the lab. Likewise, in January, at the change of the semester, these rotator students shifted labs and began their new rotations. Due to the overlap in several of the groups I chose, however, several of the rotation students I observed simply shifted from one of the groups in my sample to another.

In total, I observed 56 graduate students and nine postdocs, as well as their five principal investigators. The groups I observed varied quite a bit in the percentage of women members (23% - 60%). Additionally, there was a fair amount of variation in terms of race and ethnicity. In this sample, ethnic and racial variation was highly correlated with international status; there was one student of color from the United States and 23 international students. Finally, research groups tended to be fairly diverse in terms of the level of the scientists-in-training represented in each. While one of the groups I observed did not have any postdocs, the other four each had two or three, and all of the labs had incoming students ("rotators" or first-years), novice-level students (second- and third-years), and advanced students (fourth- and fifth-years).

Interviews

[8] This university uses a "rotation" system in which first-year students spend a semester in at least two labs to get better acquainted with prospective advisors and research groups before choosing which laboratory group they would like to join. As the departmental brochure states, "laboratory rotations in the first year provide a jump-start on research and allow students to explore their individual areas of interest before committing to a research lab and a dissertation topic." It is not uncommon for incoming students to contact professors who they are especially interested in working with to see if they can do a "summer rotation." In these cases, students may have a chance to do three rotations, and also may have a higher chance of joining the lab they worked in over the summer.

I also conducted 40 semi-structured interviews with graduate students and postdocs, all of whom worked in the labs I observed. I recruited interview participants in two ways: through announcements at lab meetings in the five labs I was observing and through emails sent to these labs. Participants were given $25 gift cards to compensate them for their time. My primary focus was on graduate student training and experiences, so the majority (n = 37) of my interviews were with graduate (PhD) students; however, after several of the postdoctoral fellows in the labs asked me about my project, I expanded my interview protocol to include them, and interviewed three about their experiences in both graduate school and in their postdoctoral programs. Of these 40 graduate students and postdocs, 19 were men and 21 were women. While race and other social factors such as age, class, and sexual identity likely also impact the negotiation of knowledge and expertise, I was unable to limit the possible pool of respondents based on these factors due to issues of access, and as a result, the generalizability of these findings are somewhat limited. On the other hand, I was able to interview over half of the population I observed, irrespective of their social identities. Additionally, I recorded relevant demographic information using a short demographic survey and these factors were considered during analysis.[9] Further, ten of my respondents were international students, which is similar to the percentage of international students in the chemistry department as a whole. By contrast, all but one of the domestic students I interviewed were white.

[9] These characteristics included sexual identity, socioeconomic status, religion, etc. I have not reported information about these demographic variables, however, due to concerns regarding confidentiality and anonymity.

Interviews lasted roughly one to one-and-a-half hours and the majority were conducted in private office spaces.[10] All of the interviews were digitally recorded and fully transcribed. Since all of the interviews took place after I had completed my observations in the labs, many were particularly rich because my interviewees were more familiar with me than they would have been with an interviewer they had just met. Additionally, my own status as a graduate student often helped create rapport with my participants given our many overlapping experiences with academic training and because of my similar age. Topics discussed in the interviews included the following: participants' entry into science, chemistry, and graduate school; the process of choosing their lab/advisor and their relationship with their current (and past) advisor(s); lab dynamics and relationships within their research group; experiences with teaching and authority in the classroom; attire in various academic contexts; emotions and emotion management in their interactions with their advisors and peers; and their overall images of scientists. Given the possibility that my presence in research group meetings and classes might have affected interactions between graduate students, their advisors and their students, I was also careful to address these possible effects in my interviews. In general, I was told that students usually forgot that I was observing them and did not feel that their interactions were impacted in any significant way.

Analysis

My analytic strategy involved open and focused coding (Emerson, Fretz, and Shaw 1995). Rather than beginning my analysis with a hypothesis, I started my review of my data with general themes I knew that I was interested in and looked to see what

[10] Of the interviews that were not in the chemistry building, three were conducted in a private office in the sociology department, while several others were conducted in local coffee shops.

emerged as the most salient trends (Karp, Holmstrom, and Gray 1998). Specifically, I reviewed all transcripts and fieldnotes, noted patterns of recurring themes, and coded transcripts and notes for these themes using NVIVO8, a qualitative software program. The themes that I looked for included the following: the impact of advisor style; students' and post docs' use of impression management techniques (such as clothing choices, use of authoritative or diminutive phrases and terms, and emotional expression or management); and group members' interactions. Themes that emerged from the data included the use of authority and expertise in graduate experiences, teaching methods, group norms, and student mentorship. Given my interest in social inequality and identity, I paid particular attention to any patterns that emerged regarding gender, race, or nationality. Lastly, within the themes and trends I explored, I was careful to look for disconfirming evidence and occasions when the patterns I expected did not emerge.

Results

In examining expertise in a scientific lab, I paid particular attention to who graduate students and postdocs turned to for help or advice in solving problems in their work. Because individuals are likely to seek advice only from those they deem likely to have sufficient knowledge, I assumed that those individuals to whom students turned for advice were viewed as experts by those seeking help (Haythornthwaite 2006). Given that scholarship on interdisciplinary groups (the area of scholarship that most commonly describes research advice) has often explored the relationship between specialized expertise and the practice of asking for help within research teams, I felt that this method was useful in the absence of direct ascriptions of expertise *(ibid)*. Further, these studies have demonstrated the importance of clear communication about "who knows what," as

well as how individuals' standing as an expert can become crystallized within a group, both of which were addressed by this study (Wegner 1986; Haythornthwaite 2006). The graduate students and postdocs I observed described a variety of factors that they used to determine whom they should go to for advice about their chemistry. These factors included proximity, determinations of overall skill, talent, and intelligence, and assumptions about specialized knowledge and expertise regarding both chemistry and local knowledge.

Briefly, the simplest factor by which chemists-in-training determined whom they should ask for help was basic proximity: students often look to those around them for support. For example, as Sean explained, the people whom he asked questions of (and who asked his advice), were most often those nearby: "Joseph, people directly in my lab…Marisol is my bench mate, so she's just kind of as a proximity thing (#31, Mitchell Lab, white man)." Further, many laboratories were designed to accommodate students' desire to speak to those close by, such that students who worked on similar projects were often seated together at desks and work benches. However, although factors such as proximity often influenced who students talked to about their work, ascriptions of expertise were the primary factors through which students (and postdocs) determined who to go to for support. There were often several others in close proximity, but who one chose to talk with was determined by whom was seen as most expert. Specifically, students assessed the following: evaluations of overall skill, talent, and intelligence; conjectures about specialized knowledge regarding particular instruments or subtopics within chemistry; and expertise about individual research groups, departments, or career-paths (i.e., local knowledge). These three factors all also include assumptions of

knowledge and expertise that are greatly affected by gendered patterns of presentation and interaction in group settings.

Overall Skill, Talent, or Intelligence

Since willingness to ask individuals questions is evidence of an implicit assumption on the part of the questioner that the person being questioned has sufficient knowledge to answer, I used students' and postdocs' responses to "who do you go to for help?" as a way to explore their perceptions of expertise within their research group. When they were asked this question, unsurprisingly, many respondents replied that they looked to the most senior students or postdocs in their labs for advice about chemistry.

Sarah explained, in terms of science-related questions, "But yeah, I do think there's definitely a seniority thing there where, you know, again, Anthony is a senior member. So you'll see a lotta times, you know, Anthony, Steven, Chad, I'm forgetting one of them, Kyle, are kinda the senior members right now, and so you tend to gravitate to those people, I think (#2, Williams lab, white woman)." There was a clear link in participants' minds between the seniority of graduate students and their overall skill in the lab. The most advanced graduate students in each lab were expected to be the most knowledgeable and to be the "best" chemists in the groups. Indeed, this understanding of expertise in chemistry highlighted the association in many of my participants' responses between scientific skill and overall knowledge about the field. However, at times the hierarchy of senior student as expert broke down.

In one instance, most of the senior graduate students in a lab were frequently absent so the more junior students had to become more creative in seeking advice. Chase

had some previous research prior to graduate school, so his fellow first-years treated him as an expert:

> "In the Wagner lab I got many more general knowledge questions, and I felt like that was a large part because there wasn't a really strong senior graduate group that would like answer all those questions. I mean I was kind of the most senior person there … But I mean now in the Mitchell group there's a plethora of senior grad students, so [it's different]."
>
> - #30, Chase, Mitchell lab, white man

In this case, even though Chase was also a first-year graduate student, his peers saw him as someone capable of answering their questions and helping them out where their knowledge was lacking. Interestingly, though the incoming cohort of men and women first-years in my sample had all had similar amounts of research experience in their previous research groups and undergraduate programs, men graduate students were more likely to describe instances of being treated as an expert in their new groups. This was likely related to differences in the way that they exhibited and expressed their knowledge and confidence with chemistry (see chapter 4 for more detail).

Although expertise was often associated with the length of time individuals had spent in graduate school, students also articulated that other factors, such as being a "really excellent scientist" shaped their choices for experts and helpers. This issue was illuminated by Joseph when he described why he and his fellow cohort mates were frequently sought out for advice:

> Well, I think certainly, for me and Ahmed because we're now the oldest members of the group. Ross, I think, he doesn't spend as much time in lab. And I don't, it's not like he wouldn't help somebody, but I definitely would just go out and help somebody if they didn't specifically ask and I saw they had a problem, whatever.
> *And why does Sean gets asked, do you think, if he's sort of a younger [student]?*
> I think he's probably just proven himself as, I mean he's definitely very smart, and he's quite knowledgeable at a lotta different techniques in lab,

and I think people recognize that and see.

- #25, Joseph, Mitchell lab, white man

As Joseph explained, students often cite the fact that a peer is "really good" at science when they make decisions about who to go to for advice about chemistry. In this case, he thought that students likely sought out the most senior students in the lab or Sean, another smart, strong, and technically proficient chemist who was not as senior. Another key reason that Joseph believed that he, Ahmed, and Sean were often sought for advice was because they have not only demonstrated their expertise, but also their willingness to help others.

Kira corroborated this view of Sean's skill and proficiency, describing him as one of the students who others tend to listen to and go to for advice. When I asked her to tell me more about why students go to him for help, Kira said, "He's so good…he's phenomenal. I'm just like gosh, how does he know all this stuff? He [asks] such good questions (#36, Kira, Mitchell lab, white woman)". Kira implied in this comment that she was extremely impressed by Sean's knowledge and ability. Andrea's comments about two of the students in her lab were very similar in sentiment:

> There's a student who is actually a third- or fourth-year, and I'm a fifth-year…And he's brilliant. And he gives me advice all the time… [He] is very, very knowledgeable. He's also brilliant. It kinda makes me see these people who are just so damn smart, and I'm like man, I feel like I'm a moron, you know.
>
> - #14, Andrea, West lab, white woman

Both Kira and Andrea suggested that they were intimidated by their (men) peers at times, a sentiment that was not echoed by the men in these groups. In fact, several men students described their confidence about asking for advice from anyone in the lab. For example, Marcus said, "I'd feel pretty comfortable asking just about anyone in the lab any kind of

question" (#33, Marcus, Mitchell lab, white man).

Kira's earlier comment that Sean asks "such good questions" also highlighted one of the ways that students and postdocs use group meetings: to elicit information about how "smart they are" or "how good at chemistry they are." Quan explained this phenomenon, judging students or postdocs' intelligence or skill during group meetings, more fully:

> We have new postdocs coming in all the time. After a week people start to realize whether or not he's good, what field he's really good at, and also people will look at the old papers he published, the old work he had been working on. … people will realize whether or not [you're] good or which area you are good at really quick. And we have group meetings, so people ask questions, people get feedback, and you can always have a good idea about how good a person [is].
>
> - #3, Quan, Williams lab, Asian man

Since postdocs enter research groups with higher credentials than the graduate students in the group, but often have less direct knowledge about the specific instruments or reactions that each group works with on a regular basis, they face a unique set of challenges to their expertise. Thus, group meetings, especially postdocs' first presentation to their new research group, are an important opportunity for them to demonstrate their expertise to the group and for the rest of the members of the group to determine whether they are worthy of being considered experts.

In the course of my observations in group meetings, in the lab, and in my interviews, I frequently overheard comments or was told directly about group members' varied skill in the lab. Interestingly, of the approximately eight "stellar" scientists described to me, or who I overheard being called "so good", all were men, with the exception of one junior-level woman scientist in the Williams lab. Within most of the groups, at least one graduate student was clearly seen as superior to the others by other

group members, as well as by his or her principal investigator. In the case of the woman graduate student, her role as "superior" or "star" of the lab was shared with at least one other man student.

While students were usually sought out for their help because they were thought to be "so smart" and such excellent chemists, the inverse also occasionally occurred. Interview participants were also asked if there were people that they did not tend to go to for help, and some suggested that there were students who they felt would not be able to help them out because they did not have the expertise to guide them. Julie characterized this sentiment most bluntly, saying: "I guess I've never really asked [student's name] a question. But that's just because, this is really mean, but I just don't think he's that smart. And like his candidacy practice talk was ridiculously bad. Anyway, [laughs] anyway, let's not get into that… (#32, Williams lab, white woman)." Since group members attend not only group meetings, but practice talks for presentations, qualifying exams, and dissertation defenses, they become intimately acquainted not only with their colleagues' work, but with their presentation styles, their work ethics, and their ability to think on their feet. It is not uncommon, then, that students and postdocs judge each other, at times harshly, for their abilities not only in the realm of chemistry, but also in presentation and style.

Specialized Knowledge & Expertise

When graduate students and postdocs required help with their chemistry, another factor that they used was to determine which of the students in the lab had previously worked with the particular compounds, reactions, or syntheses that they needed help with. They generally employed one of several methods of gaining this knowledge about

others' expertise, including asking around the lab, recalling presentation topics, and relying on principal investigators' assessments.

The simplest way for a group member to determine who they should ask for help was to simply ask around the lab. Usually this occurred in small one-on-one conversations, but sometimes it also involved more public conversations such as the one Joseph described:

> …something will come up, and I'll just mention out loud, like Ahmed, Jun, whoever else is around, do you guys know anything about whatever. Somebody'll say 'oh, I know that Maria from the Moore group did that, you should go ask her.' So I would go ask her.
>
> - #25, Joseph, Mitchell lab, white man

In the process of asking around the lab, students may gather both information about who has done what reaction, as well as discuss who is particularly adept at working with specific compounds, running columns, or using instruments.

A second way that graduate students and postdocs sought out group members with expertise on topics they need help with was to think about what chemical reactions other people in the group have presented about in group meetings. Group meetings are designed to provide students and postdocs an opportunity to practice presenting their research, as well as to receive feedback from their principal investigator and peers. As a side benefit, they also provide a chance for group members to learn what the rest of the people in their lab are working on. As Michelle explained, "Yeah… from group meetings we get a good feel of what other people's projects are, so if you can sort of keep track of that in your head, there's very much, you can just get a feeling of who [a topic is] most relevant to (#4, Williams Lab, white woman)." The most common model for research meetings was one in which the members of the group presented their research on

a rotating basis.[11] Given the size of the groups (and periodic interspersed practice talks and literature meetings), each student or postdoc usually presented their work at most once a semester (and in the bigger groups, every year). In this model, it was difficult at times for students and postdocs, especially those who were new to the group, to learn what all of the group members were working on. In fact, the only way that people could share their knowledge or establish their expertise was through their questions and comments.

Additionally, several of the graduate students in these labs were asked to become experts about specialized topics or, more commonly, machines or instruments needed in the lab. While it was common for both men and women students and postdocs to be assigned roles and responsibilities in the labs, which often included responsibility for machines used in group chemistry, when members of the group or the principal investigator decided that a new machine or instrument should be purchased, men students more often took the lead in becoming knowledgeable about safety and best practices for the machines. There are two possible reasons that these students were more likely to be men. First, there is evidence that boys are more likely than girls to be exposed to computers and technology during childhood and adolescence (Abbiss 2008). Second, there is a strong cultural association between men and technology (Clegg, Trayhurn, and Johnson 2000). This link is related to stereotypes about gendered differences in technological skill and ability. Accordingly, men graduate students seemed to be more likely to be aware of new technologies (and to recommend to their PIs that they purchase

[11] Other models include additional group meetings such as "literature meetings," which involve gatherings to discuss recent literature related to research explored by the group, practice talks given by group members preparing for qualifying exams or candidacy presentations, or "sub-group meetings" which are meetings that involve part or all of the group during which students discuss recent reactions, progress, and future research plans.

them). Men were also more likely to be viewed as experts about current instruments in their research groups.

When graduate students were asked to learn more about a particular machine, their role as expert in the lab was usually made clear to the entire group during group meetings. In most of these cases, the student taking on the role of expert had expressed a particular interest in a process or instrument, received training on that process or machine (either at the University or at a seminar elsewhere), and returned to the group to answer questions and teach them more about it. In these instances, the faculty members became students, as well.

For example, in the Mitchell group, Joseph was the driving force for the group's purchase of and move towards using a new analytic instrument. As he explained,

> I have had the opportunity to try different things that we haven't normally done in our group and to try to like gain expertise and move certain things forward. So like our group in the future can be able to do [different things]. And I wanted to use a specific method that we were just completely unfamiliar with, but [Prof. Mitchell] allowed me to try it and get into it. It's taken a few years just to get to a point where we feel like we know what the hell we're doing, but it's been really good because I've been [able] to learn, you know, some on my own. [Prof. Mitchell's] learned with me. You know, like I'll go down and talk to [Prof. Williams] about it or other professors in the department and learn from them, too. And I don't think that I would've gotten that freedom from other professors. They would've just, whatever their expertise was, that's what I would've done.
>
> - #25, Joseph, Mitchell lab, white man

After they got the new machine, Joseph, who had gone to a training to learn more about these machines, was asked to give the group an update about how to use the instrument and what it was most useful for (Mitchell Group Meeting 10.15.09). In so doing, he was designated as the clear expert about the machine and engaging in research using the machine. Joseph also highlighted his expert status by frequently mentioning the

instrument to students as an alternative to the methods they had used to collect data. By bringing up these alternatives, he again drew attention to his knowledge about the machine.

The West group also nominated several students to become experts about several machines. For example, Andrea ordered a machine that was used to create specific kinds of samples. While ethnographic notes indicate that Andrea did periodically mention this machine in group meetings when discussing her research project, she did not advertise the machine or her knowledge of it frequently. However, when I asked her about when students come to her for advice, she explained that while they did not come to her often, they did ask questions about this machine:

> … There's another instrument that I just recently authorized, well I didn't authorize the purchase of, but I requested the purchase of and my adviser authorized the purchase, this particular packing instrument. … And basically I set this thing up, I've got everything running. It's all working. I just did that yesterday, so they will come to me.
>
> - #14, Andrea, West lab, white man

Andrea spearheaded the process of purchasing and setting up this instrument, and, as she explained, students in the lab were more likely to approach her with questions about its use than to approach others.

In contrast with Andrea's reserved approach, when two other graduate students in this lab, Todd and Shing, were asked to become experts on a second instrument, they made a presentation about their discoveries to the group and confidently expressed their expertise. This instrument was one that the entire group was likely to need in the upcoming months, so, after a group debate about whether it made more sense for the entire group to get trained on the machine or for a select few to go to the training seminar, the principal investigator and group members decided to delegate two members

to go to the training weekend and report back to the group. Todd and Shing were thus sent to this seminar, and both reported back to the group to teach the others how to use the instrument. Both students answered Professor West and the other group members' questions, but Todd spoke with greater certainty, was quicker to answer, and overall took the more dominant role as expert during the meeting (West Group Meeting 11.11.09). He also frequently said things like: "the guy said_____, but I'm not sure I'm convinced by that..." In so doing, he successfully positioned himself as an expert not only in comparison to Shing, but also when compared with the seminar leader himself.

The third way that graduate students and postdocs could learn about others' knowledge was that the PI could direct them to the group member whose expertise was most related to the topic of concern. This happened most frequently in the Williams lab, especially during group meetings. This also particularly solidified the sense that specific people in the lab were (and should be) considered the experts in specific topics or fields. Professor Williams' repeated emphasis of this fact made students' and postdocs' expertise seem especially strong. Quan explained, "[If] a [particular chemical] or some of the reagents I might be using might be helpful for other students, [Prof. Williams] will suggest [it to] them and they will come and talk to me" (#3, Williams lab, Asian man). While Professor Williams privately told her students to seek help from their peers in her individual meetings with them, she also asked particular students to give their help in group meetings. In the process, she announced their expert status to the entire group. In some cases, she simply advised students who had previously done similar work to help their more junior colleagues so as not to "reinvent the wheel." For example, during one group meeting (Williams Group Meeting 7.31.09), Professor Williams turned to Ethan

(the most senior member of the group) to ask him why he thought something was happening in the presenter's results. It was clear that the work the presenter was doing was related to Ethan's work, and Professor Williams felt Ethan could give some insight into some strange results. Similarly, in a group meeting several months later, the entire group had a long discussion about how to use a particular method for synthesis that Joanna, the presenter, was struggling with:

> Professor Williams asked Steven how he did something so that he could pass along this information to Joanna. He hadn't done it. She then asked Quan how he did it. He hadn't done it either. Then Steven said that Adriana had done it and so Professor Williams turned to her and Adriana explained how she did it to Joanna.
>
> -Field notes, Williams Group Meeting 10.8.09

Professor Williams' goal here was to elicit information for Joanna to help her to better understand how to successfully complete a synthesis. In this situation, Professor Williams did not seem particularly interested in gaining knowledge about the information for herself, but was interested in making sure that the information was passed on. She was also implicitly providing information to her group members about the specific graduate students she called upon. In calling upon these students, she marked them as people who she expected to have had experience with the process they were discussing (though they had not), and also as people whose knowledge and advice was worth listening to. Another interesting aspect of this exchange was that throughout the conversation, Adriana, who was the only person in the group who actually *did* have experience with the method the group was discussing, did not speak up and describe her experience until she was specifically called upon by Professor Williams.

I also noted several instances during the West group's meetings where Professor West singled out one student in particular as an expert. In these cases, rather than

directing her students to him for advice, Professor West seemed to see Todd as a useful consultant herself. In these cases, Professor West would turn to Todd for clarification or additional insight. In one such instance, a more advanced student was giving a presentation on his work, and Todd asked him a clarifying question about it (West Group Meeting 11.30.09). The advanced student, Li, said, "Yeah, yeah, I know." In response, Professor West turned to Todd and asked him several questions about how the process that Li described worked:

> Prof. West: So this makes it bigger?
> Todd: It actually makes it smaller because …[technical explanation]…
> Prof. West: Oh, I see.

In this case, rather than treat the presenter as expert, Todd, who was a less advanced student, was granted the role of expert. When principal investigators turn to less advanced students for clarification and insight, not only are these junior students granted an elevated status within the group, but the student (or postdoc) whose work was the current focus during the group meeting or presentation is also devalued in the process.

Later in the same meeting (West Group Meeting 11.30.09), Todd was granted expert status again, this time with a different topic and a different presenter. Zhi was presenting, and Professor West expressed surprise about one of Zhi's findings. When Zhi paused and did not adequately respond to Professor West's remark, Todd chimed in with a comment about related experiences in his own work. Professor West then asked him follow-up questions about the process. In this instance, again, Todd was considered the expert while his peer, who was the original person presenting the methodology, was given less credence. Todd had some previous industry experience and thus had additional knowledge that many of the students in the chemistry department did not.

However, one of the other women graduate students in the group, who was at roughly the same stage of the program as he was, had similar industry experience, and was rarely treated with the same degree of esteem by her advisor and research group.

There were also cases in which groups of lab members, rather than individuals, were asked to help out presenters when they were struggling or when a question arose during a presentation. In these instances, members were identified as experts in a particular area and were asked to speak up. For example, during one meeting in the Williams Group I noted the following exchange:

> Professor Williams: Do any of the organic folks know?
> Adam starts to talk, but Professor Williams interrupts and asks, "where's Sachi? Didn't you do your seminar on…"
> Sachi waffles a bit in her answer.
> Adam looks like he wants to talk and Kyle says, "Adam looks like he wants to pop out of his seat."
>
> - Williams Group Meeting 9.10.09

In this case, Professor Williams first identified a group of experts ("the organic folks") who might be able to answer a question that the presenter had, but she then focused her attention on Sachi when she remembered that she had explored a topic similar to this one in her seminar. However, Sachi seemed unwilling to speak to the issue. Adam, a postdoc who was new to the group, was anxious to share his knowledge; however, given that Professor Williams knew a lot less about his knowledge base, she was much less likely to call upon him for advice in meetings.

Similar to Adriana's reluctance to speak up until called upon, Sachi was uncomfortable acting as the expert regarding a topic that was in her area of expertise. This type of reticence was not uncommon amongst the female members of the group. I noted multiple instances in which women in the group did not speak up about a topic,

despite the fact that it was clear (usually through subsequent discussion or sometimes through quiet discussions that I overheard) that they were a qualified expert on the topic. Often, the women I observed seemed both less invested in expressing their expertise, as well as less confident in the level of knowledge they needed to have to speak up. In other words, similar to other educational contexts, men seemed much more confident speaking up with incomplete or incorrect answers, while women did not (Lundeberg, Fox, and Puncochar 1994). However, because women often waited to display their expertise until they were called upon, the gender balance of expressions of expertise was greatly affected.

Professor Williams also used a group of experts to help resolve a debate that emerged when Sarah raised a question about a presenter's hypothesis (Williams Group Meeting 9.4.09). She asked, "What do you guys think? Calculations people? Chad?" While she originally opened the question up to the entire group, she narrowed her focus to a specific group of people that she felt would be best suited to addressing the question, the so-called "calculations people," who she deemed to be experts in this topic. By following up her request by specifically naming Chad, she highlighted both his membership in this group and his specific expertise and ability. By singling him out, she granted him importance; it seemed that his answer would be given more weight than the answer of someone else, even if they were also a "calculations person." Chad did speak up in response, as did Patrick (another "calculations person").

It is clear from these results that one of the key ways that individuals are deemed experts is through interactions with others: people are told that a labmate is particularly knowledgeable about a specific chemical or reaction, they learn about who knows the

most about instruments during group presentations and announcements, and principal investigators are often involved with identifying individuals' expertise during one-on-one exchanges and in larger group meetings. These interactive methods of expertise labeling are gendered in several ways, however. First, given the cultural association between technology and masculinity, it is not surprising that men were more likely than women to become the experts on new technologies within these lab spaces. However, given that knowledge of new instruments and machinery generally affords graduate students expertise beyond their principal investigators', the greater likelihood for men to gain these skills is an important gender difference in graduate students' training. Second, men graduate students and postdocs are more likely than their women peers to volunteer their chemistry knowledge in group contexts. More importantly, when others identify them as experts, they are more likely to accept others' definitions of their expertise.

Local Knowledge

When graduate students and postdocs were asked whom they commonly went to for help, many respondents discussed the importance of advice about the way that the lab worked, how to handle the PI, and getting a job in nearby chemical industries, all examples of local knowledge rather than specialized information about how to do chemistry techniques. These questions involve professional advice and support and a level of mentoring beyond the kind of basic technical assistance that peers more commonly provide for one another. I found that women students were much more likely to be the ones whose expertise in these areas was requested by their peers. For example, Jennifer explained,

> People come to me for advice usually like when they're getting ready to graduate. So like I went through Sun Hee's CV [Curriculum Vita], and I

> gave her contacts at different companies and like, yeah, and like head hunters that I've worked with and said oh, you should contact this person, and this is how you get your stuff out there, and this is what you do if you wanna go into industry. I don't know a whole lot about academia. But I think that's typically my role.
> *Why did they think that that was your role?*
> I think because I've done it. And for the position that I was in, it was pretty successful. And I think I still have a lotta contacts in that specific area.
>
> - #12, Jennifer, West lab, white woman

Jennifer had professional experience prior to her time in graduate school, but so had her colleague, Todd. While they were both often asked to comment about their time in industry during group meetings, in contrast to Jennifer, Todd was not approached for this type of help outside of group settings.

Women were also more likely to be asked to give advice about lab dynamics and interactions across multiple settings within the groups. These women students and postdocs were expected to give career and school advice, support others with their work, and provide insight into group dynamics. Lindsay explained that when she needed help with her science, she tended to go to one of the more advanced men in the group, Ahmed, but when she wanted to better understand group conversations, interactions, and jokes, she spoke with Carrie, a woman who sat near her. She described this dynamic:

> So I guess it's different aspects with different people. So in terms of like general where stuff is, explaining to me lab dynamics and conflicts, and more social things, the girl that sits next to me, her name is Carrie, she's been really great….
> *What kinds of stuff did you need insight about that Carrie…?*
> Oh, just like, 'is that a joke?' [laughs]
> *So people would be teasing each other or something, and you'd say, 'what's going on?'*
> Yeah. They're very, they had this thing, like especially Kira and Sean, where they'd try to say things as deadpan as possible. I'm not so good at … I'm like 'are they kidding or not?' [laughs]
>
> - #24, Lindsay, postdoc, Mitchell lab, white woman

As a new member of the Mitchell group, Lindsay explained that it was difficult at times to adapt to the way that things worked differently in the group than they had in her previous research group. She found that Carrie's help in interpreting the nuances of her colleagues' interactions helped her to feel more comfortable and less out of place overall. It was clear in our conversation that she valued this support nearly as much, if not more, than she did the scholarly help she received from the advanced men students in the group. For her part, Carrie also seemed to feel that her relationship with Lindsay was mutually beneficial. When I asked her what it was like having the new postdocs around, she replied,

> Yeah. It's been nice with Lindsay just because we have started talking. I mean from the beginning we were talking a lot because, you know, she would ask me about my chemistry and give me advice on my chemistry, and I would be able to tell her like where things were and certain procedures that we do differently than how they do it. Or like, you know, she didn't have, like there were flasks that she wasn't used to using and stuff like that. So it actually was really good and very helpful, I think, for me and probably for her, too, just like getting integrated into the lab.
>
> - #27, Carrie, Mitchell lab, white woman

Carrie's view on their relationship centered more on her ability to help orient Lindsay to where things were in the lab and on the differences in the ways that things are done in each different lab, yet these "housekeeping" tasks are important aspects that are a key part of making Lindsay feel like an integrated member of the Mitchell lab.

Several of the women students described relationships with other women students that sounded as if they helped give each other guidance on how to successfully navigate the academic program as well. This mentorship between students occurred at times in mixed-gendered settings, but seemed to be most common, and most thorough, with woman-woman pairs. For example, when I asked who tended to come to her to ask

questions, Zhi told me that a second year grad student who worked with her when she did her rotation, "[comes to me] when she has questions, because she's doing all the things that I have done before, like candidacy, making poster for the conference, and how to label things, and she comes to me a lot (#39, West lab, Asian woman.)" In this case, the supervisory role of mentor to rotation student extended beyond teaching the younger student basic information about chemistry techniques and using instruments to academic mentorship. A similar form of mentorship was obvious in the Moore lab, as well. When I asked Erica who she went to for help, she replied,

> Monica. I ask Monica for a lotta help and guidance. Yeah, 'cause she's the only that has done it in our lab and the only one I can honestly look up to. I mean I can't look up to the guys in my other lab. [laughs] But like going through [the qualifying exam], Monica was willing to proofread my work and gave me suggestions. … [And] it was dead on. It was crazy. And so I'm kinda scared going through the thesis process next year 'cause she'll be gone.
>
> - #11, Erica, Moore lab, white woman

Erica's worry about who she will go to for help was especially interesting given her experience as a support system for others. Erica was a joint student and therefore a member of two research labs. When I asked her to talk about who she went to for help, and who came to her for help, she described a more in-depth version of mentorship that she felt pressured to perform in her other lab:

> In my other lab, I'm safety monitor and basically the lab mother. I can't wait until that job's over. [laughs] Like, I don't wanna be the lab mother.
> *What do you mean by that?*
> Well, I had two male lab mates who were opposite of the boys in the Moore lab. They weren't arrogant, they were irresponsible and immature and needed someone to hold their fucking hand. One graduated. He didn't get a job. We don't know what happened to him. He just left. He won't respond to my emails. And the other one, I helped him till he got a job, and I'm done. His thesis is due Wednesday, which frustratingly enough, he sent me five chapters to proofread on Friday. It's due Wednesday. It was Easter. … This is what I've been dealing with for four years. It would be

> nice to not have to constantly babysit them…But I am a safety monitor, so I'm like safety czar for the lab. And because I'm the organic synthesis or inorganic chemist, the engineers have been asking me to help them with synthesis, and they ask me for help a lot. So I'm basically the lab mother.
>
> - #11, Erica, Moore lab, white woman

Erica's role as "lab mother" seems to have evolved out of her assigned duty as "safety czar," a role that is assigned in nearly every one of the groups I observed. However, in Erica's case, the fact that she was so frequently the go-to person for safety for two of the more advanced men members of her lab created a dynamic in which they began turning to her for clerical and professional support as well. Unfortunately, they were not willing to offer this support in return. Further, none of the men who are in charge of safety in the other labs have described additional mentorship responsibilities that echo Erica's experience in any way. Erica explained that when she asked these lab mates for editing support and advice when she needed it, they did not come through for her. Rather than trading support for the help she needed, she was expected just to give the support with no benefit to herself. Interestingly, while Erica did provide this support for the men in her lab, she chose to turn to a woman member in her other research group for the support and mentorship she needed. When that student graduated, she found herself with no one to help her out. Within these labs, it was clear that women were more likely than men to be approached by others for help dealing with issues pertaining to local knowledge, the information that applies specifically to interactions within their group, progression through their specific chemistry program, or information about functioning within their own specific laboratory context. While this type of expertise is immensely important to both graduate students and postdocs while they are in their particular training contexts, it will also be less valued in their future careers than the expertise associated with explicit

and tacit knowledge that men students and postdocs were much more likely to both express and be associated with.

Conclusion

Chemists-in-training use several different factors to identify sources of peer support and expertise to guide them during their time in graduate school, including interactions with other group members and with their principal investigators. Unfortunately, women graduate students are far less likely to be viewed as, or to view themselves as, experts within these research groups. While men and women seem equally likely to turn to the peers that are near them for help, several explained that they sought out people with whom they had a closer bond because they felt more comfortable showing their lack of knowledge to them. There is also evidence from several studies that women may be more likely to use the latter strategy because they fear reinforcing negative stereotypes about women in science (Major and O'Brien 2005; Hirshfield 2010). Unsurprisingly, men and women often approach the most senior students in the lab for advice, because there is a strong belief among the members of these groups in the correlation between time in the program and skill and/or overall expertise. However, there are also several students in these groups who are known to be especially strong students. All but one of these students were men. Additionally, several women students expressed feelings of intimidation when comparing themselves with these "star" students.

Men and women students' expressions of expertise also diverge in several ways. First, perhaps because of cultural associations between men and technology, men were more likely to become clear, obvious experts of new instruments in the group, and in the process, gain an expertise beyond that of even the principal investigator. Next, when PIs

identify specific members within the group as experts, men tend to be more willing to speak up and embrace their knowledge and expertise. This is not surprising given previous studies that reported women feel less comfortable than men speaking up in group meetings in general (Fox 2001). However, as a consequence, women are not seen by others, including their principal investigators, as competent and confident. Finally, women are more likely to be expected to act as the experts in a variety of forms of local knowledge, including advising about lab interactions, proofreading work, and help with graduate school requirements.

Taken together, these findings show that, in day-to-day interactions, men are more likely to be seen as experts in chemistry, both by their men and women peers. When they are asked to be experts by their peers and by their principal investigator, they are able to practice one of the most important skills of faculty members in their discipline: thinking through a question in their field, applying it to the topic at hand, and answering it with confidence. Women, on the other hand, are less frequently seen as experts by themselves or others. Consequently, they benefit from far less training and practice in the actual work of being a professor of chemistry. Additionally, because women are more likely to be seen as experts in local knowledge, they are also expected to shoulder more of the burden of this type of work within their research group. Just as this type of mentorship is not recognized or rewarded among faculty members (Joseph and Hirshfield 2011; Porter 2007; Olsen, Maple, and Stage 1995), it is also not rewarded among graduate students. Thus, women graduate students are more likely to be caught using their time being asked to help their peers in ways that do not benefit them in their careers, while their men peers are being asked to help in ways that do.

An additional consequence of my findings involves the relationship between graduate students, postdocs, and their PIs. As faculty advisors, PIs are given the task of offering mentorship, guidance, and references to their students and postdocs as they complete their doctoral programs or fellowships. The differences I have described in the way that men and women act and thus, are likely to be perceived, is likely to greatly impact the types of jobs that faculty believe are appropriate.

Academic science depends greatly on the knowledge and expertise of its faculty. Therefore, if women do not gain the same amount of practice and training in engaging with and expressing their scientific expertise as their men peers, they may be at a disadvantage in their later careers. Further, time pressures associated with the expectations of being experts in local knowledge may be detrimental to their success. These elements have likely affected women's advancement in science and are a key feature of gender inequality in the STEM pipeline that calls for further study.

References

Abbiss, Jane. 2008. "Rethinking the 'Problem' of Gender and IT Schooling: Discourses in Literature." *Gender and Education* 20(2):153-165.

Aguirre, Adalberto Jr. 2000. "Women and Minority Faculty in the Academic Workplace: Recruitment, Retention, and Academic Culture." in *Higher Education Report, Volume 27, Number 6*.

Anderson, Kristin J., and Gabriel Smith. 2005. "Students' Preconceptions of Professors: Benefits and Barriers According to Ethnicity and Gender." *Hispanic Journal of Behavioral Sciences* 27(2):184-201.

Anderson, Melissa S., Karen Seashore Louis, and Jason Earle. 1994. "Disciplinary and Departmental Effects on Observations of Faculty and Graduate Student Misconduct." 65(3):331-350.

August, Louise, and Jean Waltman. 2004. "Culture, Climate, and Contribution: Career Satisfaction Among Female Faculty." *Research in Higher Education* 45(2):177-192.

Austin, Ann E, and Melissa McDaniels. 2006. "Preparing the Professoriate of the Future: Graduate Student Socialization for Faculty Roles." Pp. 397-456 in *Higher Education: Handbook of Theory and Research, Vol. XXI*, vol. XXI, edited by J.C. Smart. Netherlands: Springer.

Austin, Ann E. 2002. "Preparing the Next Generation of Faculty: Graduate School as Socialization to the Academic Career." *The Journal of Higher Education* 73(1):94-122.

Babbie, Earl R. 2009. *The Practice of Social Research*. Belmont, CA: Wadsworth Publishing.

Bair, Carolyn Richert, and Jennifer Grant Haworth. 1999. "Doctoral Student Attrition and Persistence: A Meta-Synthesis of Research. ASHE Annual Meeting Paper." 3-43.

Becher, Tony. 1987. "The Disciplinary Shaping of the Profession." Pp. 271-302 in *The Academic Profession: National, Disciplinary, and Institutional Settings*, vol. 15, edited by Burton R. Clark. Berkeley: University of California Press.

Bird, Sharon R. 2011. "Unsettling Universities' Incongruous, Gendered Bureaucratic Structures: A Case-study Approach." *Gender, Work & Organization* 18(2):202-230.

Brewer, Marilynn B., and Rupert J. Brown. 1998. "Intergroup Relations." Pp. 554-594 in *The Handbook of Social Psychology*, vol. 15, edited by Daniel T. Gilbert, Susan T. Fiske, and Gardner Lindzey. New York, NY: McGraw-Hill.

Cambrosio, Alberto, and Peter Keating. 1988. "'Going Monoclonal': Art, Science, and Magic in the Day-to-Day Use of Hybridoma Technology." *Social Problems* 35(3):244-260.

Clegg, Sue, Deborah Trayhurn, and Andrea Johnson. 2000. "Not Just For Men: A Case Study of the Teaching and Learning of Information Technology in Higher Education." *Higher Education* 40:123-145.

Cohen, Phillip N., and Matt L. Huffman. 2007. "Working for the Woman? Female Managers and the Gender Wage Gap." *American Sociological Review* 72(5):681-704.

Collins, H.M. 2001. "Tacit Knowledge, Trust and the Q of Sapphire." *Social Studies of Science* 31(1):71-85.

Collins, H.M. 1974. "The TEA Set: Tacit Knowledge and Scientific Networks." *Social Studies of Science* 4(2):165-185.

Collins, Harry M. 1992. *Changing Order: Replication and Induction in Scientific Practice*. University of Chicago Press.

Collins, Harry, and Robert Evans. 2007. *Rethinking Expertise*. University Of Chicago Press.

Cooke, Donna K, Randi L Sims, and Joseph Peyrefitte. 1995. "The Relationship Between Graduate Student Attitudes and Attrition." *The Journal of Psychology* 129(6):677.

Cullen, Deborah L., and Gaye Luna. 1993. "Women Mentoring in Academe: Addressing the Gender Gap in Higher Education." *Gender and Education* 5(2):125-137.

Dhanaraj, Charles, Marjorie A. Lyles, H Kevin Steensma, and Laszlo Tihanyi. 2004. "Managing Tacit and Explicit Knowledge Transfer in IJVs: The Role of Relational Embeddedness and the Impact on Performance." *Journal of International Business Studies* 35(5):428-442.

Dreyfus, Stuart E. 2004. "The Five-Stage Model of Adult Skill Acquisition." *Bulletin of Science, Technology and Society* 24(3):177-181.

Emerson, Robert M., Rachel I. Fretz, and Linda L. Shaw. 1995. *Writing Ethnographic Fieldnotes*. Chicago: University Of Chicago Press.

Ericsson, K. Anders. 2006. "An Introduction to the Cambridge Handbook of Expertise and Expert Performance: Its Development, Organization, & Content." in *The Cambridge Handbook of Expertise and Expert Performance*, edited by K. Anders Ericsson, Neil Charness, Paul Feltovich, and Robert R. Hoffman. Cambridge: Cambridge University Press.

Etzkowitz, Harry, Carol Kemelgor, and Brian Uzzi. 2000. *Athena Unbound: The Advancement of Women in Science and Technology*. Cambridge, UK: Cambridge University Press.

Evans, Robert. 2008. "The Sociology of Expertise: The Distribution of Social Fluency." *Sociology Compass* 2(1):281-298.

Fernandez, Roberto M., and M. Lourdes Sosa. 2005. "Gendering the Job: Networks and Recruitment at a Call Center." *American Journal of Sociology* 111(3):859-904.

Ferreira, Maria. 2003. "Gender Issues Related to Graduate Student Attrition in Two Science Departments." *International Journal of Science Education* 25(8):969-989.

Fiske, Susan T. 1998. "Stereotyping, Prejudice, and Discrimination." Pp. 357-411 in *The Handbook of Social Psychology*, vol. 15, edited by Daniel T. Gilbert, Susan T. Fiske, and Gardner Lindzey. New York, NY: McGraw-Hill.

Fox, Mary Frank. 2001. "Women, Science, and Academia: Graduate Education and Careers." *Gender & Society* 15(5):654-666.

Gorman, Elizabeth H. 2005. "Gender Stereotypes, Same-Gender Preferences, and Organizational Variation in the Hiring of Women: Evidence from Law Firms." *American Sociological Review* 70(4):702-728.

Haag, Pamela. 2005. "Is Collegiality Code for Hating Ethnic, Racial, and Female Faculty at Tenure Time ?" *The Education Digest* 15:57-62.

Haythornthwaite, Caroline. 2006. "Learning and Knowledge Networks in Interdisciplinary." *Journal of the American Society for Information Science* 57(8):1079-1092.

Herzig, Abbe H. 2004. "Becoming Mathematicians: Women and Students of Color Choosing and Leaving Doctoral Mathematics." *Review of Educational Research* 74(2):171-214.

Hill, Catherine, Christianne Corbett, and Andresse St. Rose. 2010. *Why So Few? Women in Science, Technology, Engineering, and Mathematics*. Washington, DC.

Hirshfield, Laura E. 2010. "'She Won't Make Me Feel Dumb': Identity Threat in a Male-Dominated Discipline." *International Journal of Gender, Science and Technology* 2(1):5-24.

Hirshfield, Laura E., and Tiffany D. Joseph. Forthcoming. "'We Need a Woman. We Need a Black Woman': Gender, Race & Identity Taxation in the Academy." *Gender and Education*.

Hirt, Joan B., and John A. Muffo. 1998. “Graduate Students: Institutional Climates and Disciplinary Cultures.” *New Directions for Institutional Research* (98):17-33.

Ibarra, Herminia. 1992. “Homophily and Differential Returns: Sex Differences in Network Structure and Access in an Advertising Firm.” *Administrative Science Quarterly* 37(3):422.

Jacoby, Sally, and Patrick Gonzales. 1991. “The Constitution of Expert-Novice in Scientific Discourse.” *Issues in Applied Linguistics* 2(2):149-181.

Johnsrud, Linda K. 2002. “Measuring the Quality of Faculty and Administrative Worklife: Implications for College and University Campuses.” 43(3):379-395.

Johnsrud, Linda K. 1995. “Women in Graduate Education: Reviewing the Past, Looking to the Future.” *New Directions for Student Services* 72:69-80.

Joseph, Tiffany D., and Laura E. Hirshfield. 2011. “‘Why Don’t You Get Somebody New to Do It?’ Race and Cultural Taxation in the Academy.” *Ethnic and Racial Studies* 34(1):121-141.

Kanter, Rosabeth Moss. 1977. *Men and Women of the Corporation*. Basic Books.

Karp, David A., Lynda Lytle Holmstrom, and Paul S. Gray. 1998. “Leaving Home for College: Expectations for Selective Reconstruction of Self.” *Symbolic Interaction* 21(3):253-276.

Knorr-Cetina, Karin. 1981. *The Manufacture of Knowledge - An Essay on the Constructivist and contextual Nature of Science*. Oxford: Pergamon Press.

Kuck, Valerie J. 2001. “Refuting the Leaky Pipeline Hypothesis.” *Perspective* 79(47):71-73.

Kuck, Valerie J., Cecilia H. Marzabadi, Janine P. Buckner, and Susan A. Nolan. 2007. “A Review and Study on Graduate Training and Academic Hiring of Chemists.” *Journal of Chemical Education* 84(2):277-284.

Larson, M L. 1979. “The Rise of Professionalism.” *Pediatrics* 63:490.

Lincoln, Anne E. 2010. “The Shifting Supply of Men and Women to Occupations: Feminization in Veterinary Education.” *Social Forces* 88(5):1969-1998.

Lundeberg, Mary A., Paul W. Fox, and Judith Puncochar. 1994. “Highly Confident But Wrong: Gender Differences and Similarities in Confidence Judgments.” *Journal of Educational Psychology* 86(1):114-121.

Major, Brenda, and Laurie T. O'Brien. 2005. "The Social Psychology of Stigma." *Annual Review of Psychology* 56:393-421.

Martin, Joanne. 1994. "The Organization of Exclusion: Institutionalization of Sex Inequality, Gendered Faculty Jobs and Gendered Knowledge in Organizational Theory and Research." *Organization* 1(2):401-431.

McPherson, Miller, Lynn Smith-Lovin, and James M Cook. 2001. "Birds of a Feather: Homophily in Social Networks." *Annual Review of Sociology* 27(1):415-444.

Mieg, Harald A. 2006. "Social and Sociological Factors in the Development of Expertise." in *The Cambridge Handbook of Expertise and Expert Performance*, edited by K. Anders Ericsson, Neil Charness, Paul J. Feltovich, and Robert R. Hoffman. Cambridge: Cambridge University Press.

Misra, Joya, Jennifer Lundquist, Elissa Dahlberg Holmes, and Stephanie Agiomavritis. 2011. "The Ivory Ceiling of Service Work." *Academe - Bulletin of the AAUP* 97(1):22-26.

NSF. 2009. "Survey of Graduate Students and Postdoctorates in Science and Engineering." Retrieved (http://www.nsf.gov/statistics/srvygradpostdoc/).

Nonaka, Ikujiro, Ryoko Toyama, and Akiya Nagata. 2000. "A Firm as a Knowledge-creating Entity: A New Perspective on the Theory of the Firm." *Industrial and Corporate Change* 9(1):1-20.

Olsen, Deborah, Sue A. Maple, and Frances K. Stage. 1995. "Women and Minority Faculty Job Satisfaction: Professional Role Interests, Professional Satisfactions, and Institutional Fit." *The Journal of Higher Education* 66(3):267-293.

Polanyi, Michael. 1966. *The Tacit Dimension*. Garden City, New York: Double Day & Company, Inc.

Porter, Stephen R. 2007. "A Closer Look at Faculty Service: What Affects Participation on Committees?" *The Journal of Higher Education* 78(5):523-541.

Reskin, Barbara F. 2000. "The Proximate Causes of Employment Discrimination." *Contemporary Sociology* 29(2):319-328.

Ridgeway, Cecilia L. 1997. "Interaction and the Conservation of Gender Inequality: Considering Employment." *American Sociological Review* 62(2):218-235.

Roth, Louise Marie. 2004. "The Social Psychology of Tokenism: Status and Homophily Processes on Wall Street." *Sociological Perspectives* 47(2):189-214.

Samble, Jennifer N. 2008. “Female Faculty: Challenges and Choices in the United States and Beyond.” *New Directions for Higher Education* (Fall):55-62.

Schneider, Beth E. 1987. “Graduate Women, Sexual Harassment, and University Policy.” *The Journal of Higher Education* 58(1):46-65.

Shanteau, James. 1988. “Psychological Characteristics of Expert Decision Makers.” *Acta Psychologica* 68:203-215.

Smith, Dean O. 1993. “Gender Disparity in the Academic Pipeline: Women in Neuroscience.” *Synapse (New York, N.Y.)* 14(4):332-4.

Sonnert, Gerhard, and Gerald Holton. 1995. *Who Succeeds in Science? The Gender Dimension.* New Brunswick, NJ: Rutgers University Press.

Sosin, Kim, Janet Rives, and Janet West. 1998. “Unions and Gender Pay Equity in Academe: A Study of U.S. Institutions.” *Feminist Economics* 4(2):25-45.

Steinpreis, Rhea E., Katie A. Anders, and Dawn Ritzke. 1999. “The Impact of Gender on the Review of the Curricula Vitae of Job Applicants and Tenure Candidates: A National Empirical Study.” 41(7/8):509-528.

Tajfel, Henri, and John Turner. 1979. “An Integrative Theory of Intergroup Conflict.” Pp. 33-47 in *The Social Psychology of Intergroup Relations*, edited by W. G. Austin and S. Worchel. Monterey, CA: Brooks/Cole.

Toutkoushian, Robert K, and Valerie Martin Conley. 2005. “Progress For Women in Academe, Yet Inequities Persist: Evidence from NSOPF: 99.” 46(1):1-28.

Tsui, Anne S., and Charles A. O’Reilly. 1989. “Beyond Simple Demographic Effects: the Importance of Relational Demography in Superior-Subordinate Dyads.” *Academy of Management Journal* 32(2):402-423.

Valian, Virginia. 1998. *Why So Slow? The Advancement of Women.* Cambridge: The MIT Press.

Wagner, David G, and Joseph Berger. 1997. “Gender and Interpersonal Task Behaviors: Status Expectation Accounts.” *Sociological Perspectives* 40(1):1-32.

Wegner, Daniel M. 1986. “Transactive Memory: A Contemporary Analysis of the Group Mind.” Pp. 185-208 in *Theories of group behavior*, edited by B. Mullen and G. R. Goethals. New York: Springer-Verlag.

Wenneras, Christine, and Agnes Wold. 1997. “Nepotism and Sexism in Peer-Review.” *Nature* 387:341-343.

Wiest, Lynda R. 1999. “Addressing the Needs of Graduate Women.” *Contemporary Education* 70(2):30-3.

Winkler, Julie A., Donna Tucker, and Anne K. Smith. 1996. “Salaries and Advancement of Women Faculty in Atmospheric Science: Some Reasons for Concern.” *Bulletin of the American Meteorological Society* 77(3):473-490.

Xie, Yu, and Kimberlee A. Shauman. 1998. “Sex Differences in Research Productivity: New Evidence about an Old Puzzle.” *American Sociological Review* 63(6):847.

Chapter 3

Gender, Competition, and Collaboration in Chemistry: Are Women's Masculine Behaviors More Constrained than Men's?

Introduction

One of the key projects of feminist scholars of science has been to demonstrate the important relationship between science and masculinity (Keller 1985; Harding 1991). In both their theoretical and empirical work, they have identified the ways in which Western culture equates objectivity with masculinity (*ibid*). They explain that the "historically pervasive" link between science and masculinity is problematic because while these two structures continue to be intertwined, science is affected by systems of patriarchy and sexism, and masculinity is imbued with the value placed on science (Keller 1985). As a consequence, a hierarchy is perpetuated in which the dominance of "masculine" is perpetuated by the high status accorded to science *(ibid)*. The high proportion of men in the sciences also adds to this association, such that science is symbolically masculine partly because our culture connects science with men and masculinity and sees science as a masculine pursuit (Etzkowitz, Kemelgor, and Uzzi 2000).

In practice, the link between men and science is also widely apparent. Women are still less likely than men to get higher degrees (e.g., M.S.s and Ph.D.s) in science,

technology, engineering and math (STEM), and this lack of STEM credentials may be one of the leading causes of the gender wage gap (Beede, Julian, and Langdon 2011; Davies and Guppy 1997; Machin and Puhani 2003; Weinberger 1998; Jacobs 2003; Institute for Women's Policy Research (IWPR) 2004). Indeed, though this wage gap is shrinking, women in the United States still make only 77% of what men do (AAUW 2009). The gender wage gap in STEM careers is lower than it is in non-STEM careers, however, so encouraging women to enter these fields has been suggested as an important means through which the overall gender wage gap could be ameliorated (Beede et al. 2011). In addition, since scientific jobs are among the most prestigious in this country, the fact that women face significant barriers to getting these types of jobs means that women may be less likely than men to be viewed as agentic, powerful, or influential.

In a recent study, Sallee (2011) found that men in aerospace and mechanical engineering were socialized to be competitive, hierarchical, and to objectify women during the course of their graduate education. Sallee argues that through this socialization not only are students taught these masculine values, but they are also taught that these particular values are associated with success in their discipline (Sallee 2011). Other studies of STEM disciplines similarly demonstrate that graduate students in the sciences are socialized to learn masculine values such as aggressiveness and competition (Traweek 1988; Ferreira 2003). However, most of these studies of graduate education have focused on scientific disciplines where women are severely underrepresented. Yet some scientific disciplines, like biology and chemistry, have made headway in including women, despite progress being stalled at various points. For example, chemistry, though still employing men more than two-thirds of the time, is the STEM field with the second

largest proportion of women (after biology). Further, the proportion of women in the field, especially among graduate students, is steadily increasing (Hill, Corbett, and St. Rose 2010). With changing demographics such as these, it is important to explore the consequences of the relationship between masculinity and science for women in disciplines that have larger proportions of women, but remain male dominant.

Thus, in this paper, I explore gender performance by examining the scientific socialization of graduate students and postdocs in a chemistry department at a top U.S. research university. Using ethnographic methods, I argue that the competitive socialization processes described by Sallee and others are still at work in chemistry; however, they function differently for men and for women. Since men and male bodies are associated with science and academia, they do not face the same pressures that women do to prove their right to be in academic, scientific spaces. Thus, they are more likely to experience the freedom to perform masculinity in a more complex way than women. In contrast, women, whose presence in these spaces is still new, must work harder than men to fit into the norms of their field, since they do not embody the clear link between science and masculinity in the way that their men peers do.

Literature Review

Graduate Student Socialization

The process through which individuals learn the values, norms, and behaviors associated with success in a given organization is called professional or organizational socialization (Merton 1957; van Maanen 1976). Socialization can be characterized as "the processes through which [an individual] develops his professional self, with its characteristic values, attitudes, knowledge, and skills, fusing these into a more or less

consistent set of dispositions which govern his behavior in a wide variety of professional (and extra-professional) situations" (Merton 1957). More succinctly, socialization is the development of knowledge about an organization's culture *(ibid)*. One of the key points of socialization occurs during training to become a professional. For example, in a groundbreaking study of medical students, Becker and his colleagues demonstrated how students learned not only how to function successfully as students (by focusing on pleasing their professors), but also how they slowly integrated the medical values and norms associated with becoming a doctor and learned how to negotiate hospitals and clinics (Becker et al. 1961). Thus, in this process, their training to become doctors involved not only information specifically related to medicine, but also to the norms and values associated with their future careers. Professionalization of graduate students occurs in much the same way.

Indeed, doctoral students learn much more over the course over their doctoral programs than the skills and knowledge associated with their discipline. Throughout the years of the program, they also learn the norms and rituals associated both with academia and their particular field. This socialization process has been documented by dozens of higher education scholars (Gopaul 2011; Merton 1957; van Maanen 1976; Weidman, Twale, and Stein 2001). In the process of socialization, graduate students are asked to reformulate their self-image, attitudes, and thinking processes (Egan 1989). Socialization takes place primarily through interaction with others (Merton 1957): the main source of socialization comes from interactions with faculty members (Merton

1957; Sweitzer 2009)[1], but recent research has also demonstrated the strong impact of peer effects (Weidman et al. 2001). For graduate students in the hard sciences, the research group is another important influence. As Conefrey (1997) explains, "participating in a laboratory is crucial to succeeding in science because it socializes novice scientists into what is valued by their laboratory and by the larger community of scientists to which they aspire to belong (p. 253)."

One of the most important aspects of graduate student socialization is the process of learning to understand not only the appropriate norms, values, and behaviors associated with being a graduate student, but also the norms, values, and behaviors associated with being a professional in a particular academic field. Several scholars have focused on differences between disciplines in the use of collaborative versus competitive methods and the ways that graduate students are socialized to use these methods in their work. For example, in her study of sociology graduate students, Kleinman (1983) found that graduate students are taught by their faculty advisors to work alone and distinguish themselves from their peers, thus eliminating student's leanings towards collective culture. More recent studies of sociological research patterns have demonstrated that collaboration between authors is becoming more common (Leahey and Reikowsky 2008), though it is still significantly less common in social sciences like sociology, anthropology and history than it is in "hard" sciences (such as physics, chemistry, and biology) (Sonnewald 2008). However, despite the commonness of collaboration, there is clear evidence that the dominant culture in many scientific departments emphasizes competition, aggression, and cut-throat behavior. For example, in her research on

[1]In contrast with the majority of studies on graduate student socialization, Sweitzer (2009) focuses her attention on the influence of faculty members who are not the committee chairs or advisors of the graduate students she studied.

particle physicists, Traweek (1988) found that while the scientists she observed described themselves as cooperative and as "working as a unit," there was also an unspoken belief that graduate students and postdoctoral fellows (postdocs) must be competitive and individualistic to "make it big" and succeed (pgs. 88-89). This mixed message created confusion and frustration for many scientists-in-training who learned too late that they were expected to be competitive from the beginning. One of the other key transitions that graduate students must make is to learn independence. While students may grow accustomed to direct instruction and apprenticeship, one of the most important aspects of graduate socialization is the movement to a more solitary means of discovering knowledge (Egan 1989). These studies also reveal that gender is another important factor in the process of graduate student socialization in the sciences.

Gender in Science

Though qualitative research studies focusing on gender and the social context of science are still comparatively rare, several studies provide insight into the ways that gender beliefs play a role in the experiences of men and women graduate students in the natural sciences. One important recurring finding is that scientific contexts tend to be intensely masculine and competitive. Women in science frequently describe the culture of their departments as aggressively competitive and rife with 'macho-ness'; faculty members in these departments often try to prove themselves superior to others, are fiercely combative, and ignore other people's ideas (Schiebinger 1999). Indeed, in a study exploring graduate student attrition from a biology and chemistry department, Ferreira (2003) highlighted the ways in which the chemistry department she observed was highly competitive, work expectations were extremely high, and students needed to

aggressively seek out help from their advisors to succeed. Traweek's (1988) account of the training in the particle physics community described equally masculine characteristics. She claimed, "self-assertion and bravado" were key ingredients in the way that particle physicists were socialized to become strong scientists.[2] Finally, Sallee's (2011) recent study of men doctoral students in an engineering program highlighted the masculine value systems that were commonplace in their graduate socialization. In addition, Salle stated that these students were taught to be both competitive and hierarchical, and in the process, they learned to associate these principles with success in engineering (*ibid*).

Gender Beliefs

Gender beliefs are the "widely held cultural beliefs that define the distinguishing characteristics of men and women and how they are expected to behave" (Ridgeway and Correll 2004, p.511). Common gender beliefs about masculinity lead us to associate boys and men with competitiveness, competence, and aggressiveness (Thorne 1993; Ridgeway 1997; Donaldson 1993; Ridgeway 2011), while in contrast, we see girls and women as nurturing, empathetic, and compliant (Connell 1987; Thorne 1993; K. A. Martin 2003; Gilligan 1982; Ridgeway 2011). Women are also generally thought of as more communal, while men are expected to be more instrumental and agentic (Eagly, Wood, and Diekman 2000). Gendered beliefs also persist about leadership, science, and teaching. For example, stereotypes about men's and women's leadership styles cause us to view women as more collaborative, intuitive, cooperative, and less-hierarchical than men (Book 2000; Helgesen 1990; Roesner 1995), yet most of the scholarship on

[2] It should be noted that she described this aspect of masculine professionalization as happening just after graduate school, in the postdoc/early research scientist phase of scientific socialization.

gendered leadership does not support these beliefs (Eagly and Johannesen-Schmidt 2001; Powell 1990). Science is perceived as a masculine activity rather than a feminine one: boys are more likely than girls to report that they see themselves as similar to scientists and children are much more likely to draw scientists as men (Etzkowitz et al. 2000; Finson 2002). Being a professor is associated with being a man as well, so women faculty members are more likely to be judged more harshly by their faculty chairs, their peers, and their students (Wenneras and Wold 1997; Steinpreis, Anders, and Ritzke 1999; Anderson and Smith 2005; Basow 1995). Indeed, students' evaluations are harshest when professors' behaviors do not align with gender-specific expectations (Sprague and Massoni 2005). Women faculty members are also expected to be more accessible to students and are more often sought out for emotional support (*ibid*). As a consequence, when they are seen to fall short in these areas, they are criticized, even when they do more of this care work than their male peers (Chesler and Young 2007).

Masculinities

My examination of gender and gender beliefs up to this point has been about "normative" masculinity and femininity, not in the sense of how many people embody or enact the form of masculinity or femininity described, but instead what our society considers typical or normal for men or women (Kimmel 1987). This type of normative masculinity is often described as hegemonic and is society's "ideal" form of masculinity (Pyke and Johnson 2003).[3] The gendered behaviors associated with this type of masculinity are ones that facilitate men in their attempts to win and hold power; these

[3] It is important to note that notions of the appropriate behaviors that are associated with hegemonic masculinity do shift over time (P. Y. Martin 1998). I would argue, however, that current conceptions of hegemonic masculinity do align with the traits that I previously described (aggressiveness, competitiveness, etc.)

behaviors help to provide men with the dominant position in society and at the same time, they subordinate women (Donaldson 1993; Connell 1995). Masculinity and femininity are practices rather than simply categories; thus they are dynamic, changeable, and fluid (Connell 1987, 1995; Collinson and Hearn 1994). Importantly, gender theorists have highlighted the fact that there is no single, monolithic type of masculinity (Connell 1995; P. Y. Martin 2001). Masculinity is nearly always assumed to be associated with men's bodies, "to be inherent in a male body, or to express something about a male body" (Connell 1995). Nevertheless, female bodied individuals do embody and perform masculinity, as well (Halberstam 1998; Sedgwick 1995). In fact, despite the strong association in our society of masculinity with male bodies and femininity with female bodies, it is possible for men and women to engage in both masculinity and femininity (P. Y. Martin 1998; Pascoe 2007).

To further investigate masculinity and gender performance, I examined the socialization of graduate students and postdoctoral fellows in chemistry. I asked, "Are men and women socialized to perform masculinity in chemistry in the same way?"

Methods

Context

The discipline of chemistry is still fairly male-dominated, with the majority of practicing industrial chemists, faculty members, and doctoral students in the field being men (Hill et al. 2010). However, though less than one third of chemists are women, chemistry is far from the discipline with the most skewed proportions of men and women; in fact, its proportions are the second highest in all STEM fields *(ibid)*. Further,

the proportion of women in the field (especially amongst graduate students) has been growing *(ibid)*.

For this project, I conducted a qualitative, ethnographic study of chemistry graduate students and postdocs at a highly ranked university. By focusing on one department as a case study (Babbie 2009), I was able to engage in an in-depth examination of the experiences of the graduate students and postdocs in a particular scientific discipline. Case-study approaches such as this one have recently become more popular in both qualitative and quantitative research studies, as scholars have noted that the depth they provide allow for a greater ability to improve, expand upon, and moderate theories or to develop new hypotheses (Lincoln 2010; Bird 2011; Fernandez and Sosa 2005).

The data for this study include ethnographic fieldnotes, transcripts of semi-structured interviews, and content analyses of selected documents collected during my time spent observing five research groups over the course of nine months. The chemistry program I observed was highly selective; at the time of my study it was highly ranked by US News and World Reports magazine (U.S. News and World Reports 2010)[4] and only a very small number of applicants were accepted to the program each year. The department included strong faculty members in six traditional research areas: Analytical Chemistry, Chemical Biology, Inorganic Chemistry, Materials Chemistry, Organic Chemistry, and Physical Chemistry. Like most departments in STEM at this university, the proportion of women faculty members is quite small in the department of chemistry, in which only about a quarter of the faculty are women. However, this proportion has

[4] The school has consistently been ranked in the top 20 programs over the time that the graduate students and postdocs I observed have been in this program.

improved dramatically over the past few years: since 2004 the number of women in the department doubled. The chair of the department was also a woman. In contrast with the low number of women faculty members, the graduate student population was quite evenly divided by gender: just under half (49.2%) of the graduate students in the program at the time of my study were women, which was above the national average. The higher proportion of women graduate students may reflect this particular department's commitment to gender diversity. Yet the department was not particularly racially diverse: roughly 84% of the graduate students were White, 5% were Asian, 4% were Latino/Hispanic, 4% were Black or African-American, 1% were American Indian/Native American, and 1% were unknown/unreported (NSF 2009).

First year graduate students in this department perform research rotations in at least two different laboratories during their first year so that they may find a professor and research group they would most like to work with for the remainder of their graduate career.[5] At the end of their first year, both "rotators" and faculty members rank their top choices, and a pseudo-"matching" process occurs. The rotation program is fairly unique to this university in terms of the length of its duration; however, the majority of chemistry programs employ similar systems of application to get into faculty members' labs. These processes can be quite confusing, can begin before students even become students at their respective universities, and can be one of the most stressful aspects of programs in the laboratory sciences.

[5] It is not uncommon for graduate students to perform three research rotations, beginning their research during the summer before they enter their first year of graduate school. In these cases, students may repeat a rotation in the same lab twice, or spend time in three different labs. Further, students occasionally forgo their two rotations, choosing to remain in one research lab for their entire first year. In these cases, they must ask for a dispensation from the chemistry department.

An additional aspect of this program is that first-year graduate students are often assigned "mentor" students within the research groups they rotate in who are expected to help guide them through their research project. These student mentors' roles are predominantly to help their assigned mentees to conduct the experiments they were assigned to successfully; thus, despite their description, their assigned duties do not involve those usually attributed to mentors. In other words, they are not formally expected to "provide advice and counseling, provide psychological support, and advocate for" their mentee (University of Michigan ADVANCE 2004, p. 13). Often these student mentors do take on these types of additional mentorship roles, though, providing guidance about more than the project itself (e.g., relationships in the lab, norms about the program, etc.). However, this type of mentorship is not always provided by the assigned student mentor.

Data/Sample

For the purposes of this study, I chose to observe only in those groups with six or more members. I observed groups that had both men and women students in them and groups led by both men and women principal investigators. Additionally, given that the amount of time that faculty members have to guide and mentor students is strongly related to their seniority and rank, I attempted to control for this factor as much as possible by focusing on principal investigators who were early in their career.[6] I emailed requests to each professor whose groups roughly fit my criteria (n=13) asking that I be permitted to observe. Five principal investigators and their groups agreed to be involved

[6] I was advised about faculty members' rank by an informant in the chemistry department.

in my study.[7] I have used pseudonyms that begin with the letter "M" to denote the professors who are men, and pseudonyms beginning with a "W" to denote professors who are women; Professors Williams, West, and Worth are women, while Professors Moore and Mitchell are men. The groups ranged in size from nine (not including the PI) to twenty-one members.

I focused my observations on interactions between group members, so the majority of my time was spent observing research group meetings, but I also spent time observing interactions in the lab, watched practice job talks and seminars, attended lab parties and observed lab clean-up days. These observations occurred over the course of nine months, between July 2009 and March 2010, and comprised over 120 hours. In each setting I noted what students and postdocs wore in the laboratory, classroom, and to group meetings, how they interacted with others, and how they presented themselves physically, emotionally, and intellectually. I also recorded information about methods of teaching, presentation, and mentorship that were modeled in each group. While observing, I attempted to be as inconspicuous as possible; this was generally quite easy given that most of the contexts that I studied (e.g., practice job talks, group meetings, and chemistry classes) were spaces in which watching quietly while taking notes was the norm. In other cases, I shadowed students while they conducted experiments in the lab, spent time with group members while they ate lunch in their lab "break room," observed them while they engaged in group "clean-up days" in the lab, or spent time with the groups during parties. In all cases, fieldnotes were taken during my observations or

[7] The professors in my final sample ranged from assistant to full professors, however none of the professors had been at the university for more than 10 years. Variation in faculty members' seniority did not seem to be associated with the desirability of their lab; indeed, the difficult research group to get a position in was Professor Williams', who was tenured, but had been at the university for fewer years than several of the other professors in my sample.

immediately thereafter, and my handwritten notes were transcribed and annotated as soon as possible afterwards. I also conducted a content analysis of laboratory websites and printed materials (such as laboratory safety manuals) to supplement my insight into the culture of each research group and the way that each advisor managed lab dynamics and influenced graduate student socialization.

The personnel in these labs shifted a bit over the course of the nine months that I observed them due mainly to rotations and to the hiring of several new postdoctoral fellows. Interestingly, due to the overlap in several of the groups I chose, several of the rotation students I observed simply shifted from one of the groups in my sample to another. Overall, I observed 56 graduate students and nine postdocs, as well as their five principal investigators. The proportion of women members in the groups I observed varied a good deal (23-60%). Additionally, there was a fair amount of variation in terms of race and ethnicity in the groups that I observed. In this sample, ethnic and racial variation was highly correlated with international status; there was only one student of color from the United States and 23 international students (the majority of whom were Chinese or Korean).

After the majority of my observations were complete, I followed up my observations with a set of 40 semi-structured interviews. I recruited interview participants in two ways: 1) by making an announcement in each group meeting that I would be conducting follow-up interviews, and 2) by sending emails to each of the groups with a request for participants. Participants were given a 25$ gift card to compensate them for their time. Since the main focus of my study was on graduate student socialization, I conducted the majority of my interviews with respondents who

were currently in graduate programs (n=37). However, after several postdoctoral fellows (postdocs) expressed interest in my study, I expanded my interview protocol to include them as well (n=3). Nineteen of my respondents were men and twenty-one were women. Ten of my respondents were international students, which is comparable to the proportion of international students in the chemistry department as a whole. While my sample was quite representative of the population within the chemistry department overall, given the lack of ethnic and racial diversity, the generalizability of my findings is somewhat limited.

I used a semi-structured format to conduct these forty ethnographic interviews, which were particularly rich given the familiarity the majority had with me following the time I spent observing their research groups. Interviews lasted roughly one to one-and-a-half hours and nearly all were conducted in a private office in the chemistry building. Interviews were designed to focus on several main topics: advisor relationships and style, research group interactions, teaching, self-presentation, and overall images of scientists. In addition, interview participants filled out a short survey describing several demographic details such as socioeconomic status and sexual identity prior to their interviews, which were then used to orient both the interviews themselves and later analyses. However, I have not reported information about these variables due to concerns regarding my participants' confidentiality and anonymity. All interviews were digitally recorded and professionally transcribed.

I chose to use these two complementary research methods as a way of balancing out the limitations of each methodology. I was aware that my presence in lab and research meeting settings might impact the interactions that occurred, so I addressed

these effects in my interviews with participants by asking specific questions about how they believed my presence had affected their experiences. Overall, participants said that they usually forgot that I was observing them, and did not feel that interactions changed in meaningful ways due to my presence. I also used my own observations of each participant to add to, temper, and enrich their own personal narratives.

Analysis

I conducted my analysis through the process of open and focused coding, using NVIVO8 qualitative software program (Emerson, Fretz, and Shaw 1995). In other words, rather than beginning with a hypothesis, I started my analysis by examining my data for the general themes I knew that I was interested in and looking to see what emerged as the most noticeable trends (Karp, Holmstrom, and Gray 1998). Specifically, I reviewed all of my interview transcripts, observation fieldnotes, and laboratory materials noting patterns of recurring themes, and coded data for these themes. Some of the themes that I looked for included advisor style, students' and post docs' use of impression management techniques (such as clothing choices, use of authoritative or diminutive phrases and terms, emotional expression and management, etc.), and group members' interactions. Some of the themes that emerged from the data were authority and expertise in graduate experiences, teaching methods, group norms, and student mentorship. Given my interest in social inequality and identity, I paid particular attention to any patterns that emerged regarding gender, race, or nationality. Finally, I noted instances where expected patterns or themes did not emerge and noted all examples of disconfirming evidence.

My focus in this study was on chemistry, since it is a discipline in which the proportion of women has steadily increased over the years, but that they are still a minority. This unique case allowed for an interesting comparison to previous studies of masculinity in STEM disciplines such as those conducted by Traweek, Sallee, and others; however, given that only one case was studied, it is difficult to know whether other cases would produce different results. Indeed, further research should explore what patterns of gendered socialization look like in STEM disciplines that are more numerically woman-dominated, such as biology or medicine, to see what effects greater disruption of the link between masculinity and science has on this process. In this study I also concentrated on the socialization process; thus, I paid particular attention to graduate students and postdocs in my ethnographic observations and they composed the entirety of my interview sample. Future studies might expand this focus to include the viewpoints of the principal investigators who were involved in creating laboratory dynamics, as well.

Note about the Labs

I would like to begin by discussing some characteristics of the research groups that I observed to help contextualize my results (please also see Table 1 for a visual representation). Professors Moore, Mitchell, and Williams studied quite similar topics; thus, many of their graduate students had spent time as rotation students in the others professors' labs. These graduate students often had taken a class with, taught for, or been advised by one of the other three professors while writing their theses, as well. Graduate students were also likely to be friendly with students in one of the other two labs, especially since friendships were most commonly formed in their first rotations. Further, although Professors West and Worth's research areas did not intersect with the other

three professors, there was still a good deal of overlap amongst the entire group of graduate students I observed.[8]

During our first meeting, Professor Williams briefly described her research group and the students who had joined her lab. In an off-handed comment, she explained that the first group of students in her lab had all been women "because they were the only ones who were willing to join [her] group." She said that Professor West (and a third young woman faculty member not in my sample) had experienced similar problems recruiting men into their labs. At the time that I observed Professor Williams' group, this first cohort of women had graduated, but their legacy was still obvious. I heard their names constantly in the context of stories about mentorship, friendship, and scholarship in general. Overall, this group had a reputation as being "intense" and a bit "clique-y." Both of these terms were frequently used when describing the group, both by members of the Williams group and by graduate students in other labs.

In contrast with the Williams group, the earliest members in Professor Mitchell's group were predominantly men. While he had joined the chemistry department after Professors Williams, Moore, and West, Professor Mitchell was slightly more senior than them, having begun his career at another institution. Professor Mitchell made a very concerted effort to recruit heavily during his first year as a faculty member in the department. The four men who were his first cohort of new students in the lab helped to shape the group's dynamic greatly. One of their legacies was the schedule of group meetings, which were held early on Saturday mornings so that students who had season tickets to football games could attend games. (On weeks when the football team did not

[8] To be specific, two first-year students and several of the more advanced students performed rotations in these two labs.

play, group meetings were held later in the afternoon). A term sometimes applied to this group was the "jock group," in part because of the large proportion of men in the group.

Other than one woman who defended her dissertation while I conducted my interviews, all of the senior students and postdocs in Professor Moore's lab were men. However, I was told that at one time, the Moore lab's advanced students had been more diverse in terms of gender. At least two women graduate students had left the program: one due to a shift in career priorities and another because of conflicts in the lab with other students. The members of this group were not particularly close with one another; as one respondent explained "we're more like a confederacy than like friends."

As Professor Williams noted, Professor West initially had difficulty recruiting students, especially men, into her lab. Of all five of the groups I observed, hers had the highest proportion of international students, especially students from China and Korea. As an (non-Asian) international professor herself, Professor West may attract more international students because students feel that she is more understanding of their needs and more flexible about their travel. The chemistry techniques that the West group uses may also be better suited to non-native English speakers. Finally, one of Professor West's first graduate students was an international student from China who was considered particularly charismatic and warm by her colleagues. Several of the current students in Professor West's research group felt that this student's personality and the strong word-of-mouth network that exists between the international students in the department made Professor West's lab an especially desirable place for international students. Thus, it is likely that students within the international student community were more likely to hear about Professor West's lab through these students, were likely to feel

that there would be other students "like them" in the lab to provide guidance and mentorship, etc. Another key characteristic of the West research group that was frequently noted by its members was that it was "more laid back" and that students spent fewer hours engaged in their research than in the other groups I observed.[9]

Professor Worth's group was the newest group of those that I observed. While each lab other than Professor Worth's had had students complete their degrees, no students had as yet done so in the Worth lab. Rather, those students who had set up the lab and begun their degrees during Professor Worth's first year were still conducting their research. Like Professor West's group, Professor Worth's group had a fairly large proportion of international students.

Table 1. Research Group Characteristics[10]

Research Group	Gender of PI	Total Number of Members	Number of Women Members	Similar Research	Other Notes
Mitchell	Man	14	3	X	"jock group"
Moore	Man	12	5	X	"confederacy"
West	Woman	10	6		"laid back" many international students
Williams	Woman	21	10	X	"intense" ; "clique-y"
Worth	Woman	9	5		newest group

[9] Rather than the approximately 60-hour work week cited by the majority of students in the rest of the research groups I observed, students in the West group told me that they generally spent about 40 hours on research per week. Further, due to the nature of their research they were more likely to be able to work outside of the laboratory.

[10] As I noted earlier, personnel in these research groups shifted slightly over the nine month period that I observed them. Thus, I have reported the gender proportions of each group during the time-period during the majority of my observations.

Results

Though masculinity and science are symbolically linked in Western society, and previous research has demonstrated the ways that graduate student socialization in science departments heavily favors masculine norms, my findings suggest that men and women may experience this professional scientific socialization in different ways. These differences are clearly demonstrated by how they approached and interpreted the hours that they work in the lab, their choices of research groups, and their mentorship of their peers.

Hours

A frequently touchy subject, the time students spend in lab is commonly used as an indicator of the effort that a student is putting into their work and their investment in the group. Laboratory hours are particularly important for rotation students, since they are often considered in the determination of whether or not a student is "good," a hard worker, and therefore a desirable addition to the lab. While professors ultimately have the final say in these decisions, advanced students' opinions about rotators are an important factor, and the opinions of the mentors of rotation students are particularly respected. Rotation students who are interested in competing for the best research groups must work hard to balance the heavy demands that are placed upon them: they are expected to take multiple classes, teach (run laboratory or discussion sections), and work in the lab, all while moving to a new city and adapting to new social groups. Also, though the department and several of the labs' handbooks state that classes, teaching, and research are all considered equally important, rotation students quickly discover that they must focus on their research if they want to get into a strong research group. This

information is nearly always disseminated from student to student. However, the candor of these conversations varied between men and women graduate students.

Several first-year women graduate students recounted conversations they had had with more advanced women graduate students about the amount of time they were spending in the lab. They explained that given the lack of clarity they felt about the expectations that their advisors had for them, they were happy to be told explicitly that they should be putting in more hours in the lab. For example, Marie said,

> You just kind of find out from, well, you do hear that research is the most important. And kind of from other students you hear that you should be spending as much time as possible doing research. …A friend who was a third-year told me, "you know, you should probably spend more time." …She was nice and she said, "you know, I think you'd be good here, I like your work, I think you just need to put more effort in." And so I think that was good to hear, that you need to do a little more. I think it's just hard how it's set up, 'cause it's all a little vague, and you don't really know what's expected, but there's pressure.
>
> - 29, Marie, Williams lab, white woman

Marie's friend wanted her to get into her highly competitive group, so she gave her advice about how to do it: "spend more time in the lab" and "put more effort in." Likewise, Julie had a similar experience in her first rotation. She explained,

> Brenda in the Woods lab actually told me halfway through the semester "you aren't working hard enough." And I was probably working in lab like 40 hours a week on top of my classes. And so it was kind of like a kick in the pants, I guess. And it just kinda shot me off so I would work about 60 hours a week on top of my classes because it was just not enough.
> *How did she tell you that?*
> Straight to my face, just blunt, like "you're not coming in enough. If you ever wanna join a lab, you're gonna have to start working more because what you're doing right now is not good enough." And actually I thank her for that because you just don't know what they want. Nobody tells you. "Just tell me what you want, and I'll do it, no problem." Nobody does.
>
> - #32, Julie, Williams lab, white woman

Julie's student mentor, also a woman, similarly told her to put more time and work in so that she might have a shot at getting into the lab of her choice. In both Marie and Julie's experiences, their mentors' advice linked time and effort. However, many students explained that time spent in the lab was not actually related to efficiency or output: simply spending all day in the lab did not necessarily guarantee that a student would have anything to show for it. Still, spending hours in the lab demonstrated commitment and hard work to others, especially in the earliest stages of the program, where students were not expected to be as efficient with their projects. Thus, when Julie and Marie were told to "put more time in," some of what they were being told to do was become more visible to their lab mates as hard workers who put time and energy into their work.

In contrast, none of the first-year graduate student men that I spoke with described any conversations with others in which they were explicitly told about the hours that they should spend in the lab. However, it did not seem to be the case that this was because they were spending more time in the lab than the first year women. When men graduate students did talk about being advised to work harder, they said that they preferred that they be given this advice in a more implicit manner. In a conversation about how many hours he spent in the lab, Marcus told me:

> I wasn't used to the pace of research here. I mean I was slower when I was getting my master's. And so, you know, Dan was a little easier on me in terms of pace. And by no means was Sean like hard, you know. But he did push me a little bit more. You know, if stuff needed to get done, then he would get on me to get it done. And looking back on it, I mean he was right to do that. It needed, you know, we really needed to get done. So I learned from that more the pace that's expected. And I feel like now I can kind of pace myself at a reasonable pace.
> *Did he ever say explicitly "you need to be here more", or would he just say "Can you get this done for me?"*
> No. Yeah, it was more like "this is where we need to be, let's get this."
> *So he never sort of explicitly said—* [No.] *–you're not here enough or…*

If someone told me I wasn't here enough, I'd… [laughs].

- # 33, Marcus, Mitchell lab, white man

Marcus felt that while he appreciated gentle nudging from Sean when he needed to get more work done, he would not have liked being told that he needed to spend more time in the lab. Like several of the other men I spoke with, Marcus felt that he had a good sense about how many hours he needed to spend on his research to compete adequately with his peers. Overall, unlike the explicit advice about the number of hours and amount of work that the women graduate students were given by their advanced women mentors, the first year graduate student men in my study were not given clear guidance from the men that mentored them. If they had been, it is possible that they would have found this sort of blatant feedback problematic or condescending. Further, none of their mentors seemed to feel the need to advise them to demonstrate their effort by spending many hours in the lab as Julie and Marie's mentors did.

The advice that the first year women received here helped them to enter into a competitive and at times, aggressive, rivalry amongst the graduate students in chemistry and give them as much of a leg up as possible. In contrast, the men graduate students were not socialized by their peers to engage with this competition; further, those that spoke about working in the lab for a particular amount of time to prove themselves seemed to find the concept distasteful. In this case, women students' mentors, who themselves were predominantly advanced women graduate students, chose to provide advice to their women advisees about how to be competitive within the graduate program, or, in other words, how to enact masculinity in the context of chemistry so that they would be successful. Conversely, perhaps because they were men and assumed to inherently understand the type of competition necessary to flourish in these research

groups, men graduate students were not given this type of explicit mentorship and guidance. Indeed, they stated that if they had been offered this type of advice, they would have felt insulted or possibly felt that their masculinity was being threatened.

Choosing Labs

Men and women graduate students also differed in the way that they engaged in competitive behaviors over the course of their graduate education. One significant context in which this occurred was in their method of choosing research groups and teaching opportunities. Several men students demonstrated collegiality in their description of how they chose their permanent lab groups during their first or "rotation" year, while women graduate students tended to take a more standard (at least in terms of their field) competitive approach. One of the particular benefits of the rotation year at this university is that it allows principal investigators (PIs) and more advanced group members to get a sense of how hard individual first-year students work, how intelligent they are, and how much of an asset they could be to the group overall. As noted earlier, at the end of the year, first year students rank the labs they would like to join and the PIs rank the students that have rotated with their lab; students are thus matched as satisfactorily as possible. I was often told throughout my observations and interviews that certain labs were "competitive" and "difficult to get into." Some students completely avoided rotating in those labs so that they would not have to worry about whether or not they would be accepted into those labs. Others, specifically several men, described choices that they made to allow their peers to have more of an opportunity to get into those labs.

Dan, for example, discussed his thought process in choosing between three labs

whose PIs focus on very similar topics. He explained,

> Plus I guess there was a lot of, many, many people in my class were very interested in the Williams lab. … I wasn't [as] interested in joining the lab… There would've been somebody else potentially that would've not had a chance to work in there [and] they would've been pretty upset if someone was there and not interested…
>
> - #13, Dan, Moore lab, white man

While Dan explained that he did not really see much of a difference between the three labs, he felt that he should be careful not to rank the Williams lab as number one out of concern that he would get a spot in this very popular lab when he was less anxious to get into it than his peers. When making his decision about which lab to rank as number one, Ross used similar logic to Dan. He said,

> I mean honestly it was a little bit of a flip of a coin. …like I knew there was three people who wanted to be in the Moore lab for sure and because I didn't care as much I think that was part of the motivating factor for choosing the Mitchell lab. Because I knew that if I got into the Moore lab then one of those people probably wouldn't fit. It was like if I don't care which lab I end up in but they do and they are going to get bumped to something that's completely unrelated…
>
> - #35, Ross, Mitchell lab, white man

In both of these cases, there was a concern that a space would be taken from one of the students who cared more than either Ross or Dan did, so these students chose labs that were less popular or competitive so that their colleagues would have a better chance of getting into their preferred groups.

Like Ross, who felt that both of the labs he rotated in were excellent, Chao did not feel that there was much to distinguish between his two semesters' experiences. In fact, he chose to make the decision of which lab to join based on his fellow first-years choice of lab: whichever lab they chose, he would pick the other one. He explained,

> [My choice] did not depend on [the] advisor, actually. It did not depend on the colleagues because I actually had a good working relationship with

> both. It depend[ed] on my friends, my first-years. So I ask them, who do you wanna join? Mitchell. Who do you wanna join? Mitchell. So the natural choice is for Moore.
> *[confused] So you wanted to work with your other rotating, the other first-years…?*
> Oh, no. Because, so I enjoy[ed] both labs. I had a hard time choosing both lab[s]. So I asked my friends. So everybody's dying to join one lab I'll join the other. So it's like, so I had a hard time deciding, so I depend on my friends. Whichever group they join, I'll join the other one…
>
> - #28, Chao, Moore lab, Asian man

While all three of these students described choices that sound altruistic, Chao's choice was the most obviously dependent on his peers'. Rather than not choosing a lab that others wanted to attend, he watched which lab his peers or friends preferred and chose the other lab.

Despite Dan, Ross, and Chao's seeming indifference, choices about which research group to join have major implications for students' careers. While the research groups they were choosing between do share many similarities in terms of their research focus, there were distinct differences in each principal investigator's management style, group demographics, and degree of funding, which have implications for their overall experiences in graduate school and beyond.

Brett described a very similar decision-making process in the way that he went about choosing the type of class that he would teach during his first year. Chemistry students generally have two options of courses that they can be teaching assistants for: lab-style courses or lecture-style courses. Early in their first year, new teaching assistants declare their interest in either type of course, and the ones who plan to lecture do a practice lecture in front of the associate chair (who coordinates the undergraduate teaching program in chemistry). Students usually have one of two reactions to this process: some students prefer the lecture-style classes, while some find the lab format

much less intimidating. Nearly everyone agrees that lecturing helps prepare graduate students better for future teaching positions, however. When choosing his class assignment, Brett explained his decision:

> When we first got here you could … ask to do one of the lecture classes and I chose not to do that because I knew people wanted to be professors … and so I did not think it was really a good idea for me to take one of those spots, so basically I was like, I'm happy doing the labs.
>
> - #34, Brett, Moore lab, white man

Just as many of Brett's peers were generous in the way that they chose their labs, Brett chose to not deprive those with a stronger preference of the opportunity to teach lecture-style courses. Brett cared less about the classes he taught and about teaching in general, so he felt that it was important to leave those spots for the people who cared more. However, just as the lab you join has consequences for your future career, the class you teach likewise affects the types of careers that a graduate student or postdoc is qualified to apply for. While Brett does not currently plan to become a faculty member like several of his peers do (instead planning to pursue a career in chemical industries, perhaps), his willingness to give his peers their first choice limits his own options in the future. The men graduate students described here demonstrated a decision making behavior that is more often associated with women: a relational approach (Cross and Madson 1997). Rather than follow a stereotypical, competitive style of choosing their labs and teaching assignments, due to their comfort in their roles as scientists, these men graduate students felt at ease taking on more feminine behavior patterns.

In contrast with the collaborative, collectivistic approach described by several men, a majority of the women graduate students described the approach they took when choosing their research group as much more individualistic and personally proactive.

Unlike Dan, Ross, and Chao, who seemed fairly indifferent about which group they hoped to join, several of the women students I spoke with had specifically come to this chemistry department to work with a particular faculty member. Professor Williams, who frequently speaks at conferences and departmental colloquia nationwide, is a highly visible woman chemist, thus it was not uncommon for women students to mention that they had heard of her before entering their graduate program. Several explained that they came to this university hoping to work with her, because, as Jill explained, they were looking for a "good-role-model-kinda thing." Noting that much of the field of chemistry was dominated by men, a few of the women in this sample felt that it would be helpful to have a woman as their advisor, and they worked hard to make that happen.

One of the key areas that this hard work took place was during their choice of research group and advisor. Unlike the men graduate students, many of the women described the effort and strategy that they used to ensure that they got into the labs that they most wanted to be in. Unfortunately, the process of matching and rotation student selection was a bit unclear at times. During a discussion about the rotation system, Marie told me that she had not gotten into her top ranked lab at first. Concerned that she would lose her chance at a position in the research group that she most wanted to be in, she diligently tried to determine what seemed to be working for the other students:

> I was pretty sure from what I heard that the people that Professor Williams picked first semester all came to her group meetings. And so they, you know, showed interest, and so then the three people she picked first semester were from that group. …I hadn't [gone to her meetings] and so halfway through the first semester, I started going to [them] and kind of trying to show interest. And I think that definitely helped in me getting in, at least to rotate. … I know that [the professors] talk a lot and learn from other professors how we do and if we work hard or anything like that. … But then by second semester and by the time you start to pick a lab it's a lot of, just did you work hard, did you think of your own ideas and stuff

> like that. …Research is just really pushed 'cause you're competing almost with your classmates, your lab mates, the first years, to try to get the spot that you both want. … I think sometimes it felt more like, 'let's see what data and results you can push out'. At the same time, the professor can learn what kind of worker you are…
>
> - #29, Marie, Williams lab, white woman

While the process Marie described here is not particularly aggressive, it *is* competitive. As she explains, the professors judge the individual rotation students to see who the best are: the strongest students, the hardest workers, and the best individualistic thinkers. There was no question throughout our conversation about this process that Marie heartily disliked having to engage in it. However she felt that she had to to get what she wanted. In the long run, Marie's choice to attend group meetings and devote the majority of her time to research, therefore mimicking the behaviors of the students who had successfully gained access into the group she wished to be in, worked for her: she got a spot in the Williams lab.

Julie, a rotator also competing to get into the Williams group, felt similarly confused about the expectations for rotation students:

> Rotating is a really weird thing because they don't tell you what they want. I mean they still don't tell you what they want, but I'm working maybe like 70 hours a week right now. [Then] I was working 70 hours a week in lab plus classes. And so that's like 90. It gets ridiculous, 'cause you don't know where to stop. …So you get in at 9:00 to do your class, and then you work until like midnight or so because you just, like how much are you supposed to get done? You have no idea. …If you want something, you just do everything you possibly can. That is very close to killing yourself, but I knew what lab I wanted to get into, and I don't know exactly what you have to do, but I know you have to work a lot and get a lot of results to get into especially that lab because it's really competitive…. I just did everything physically possible to get in there, and it worked. So it's totally fine. If I had not gotten in there, I might be a little upset. [laughs]
>
> - #32, Julie, Williams lab, white woman

Julie and Marie both feel that it was incredibly important to focus on their research to

demonstrate to their prospective advisors and the advanced students in the labs they hope to work in that they were strong scientists and hard workers. In Julie's case, she stated that she was willing to almost "kill herself" to ensure that she managed to do this. In fact, as we talked through the hours that she put in and the time she spent on the tasks in the rest of her life, she told me that what she sacrificed most often during her first year of graduate school was sleep. Luckily, this hard work paid off for her, as it did for many of the other women in my sample. If it had not, I was told by several of the women I spoke with, they likely would have left the university and transferred to a different department instead.

Thus, unlike the men graduate students I described earlier, who decided upon their research group largely by determining the desires of their friends, the women in my sample exhibited single-minded attempts to engage in the competitive process they observed amongst their peers. Further, if they failed in the competition, the consequence would have been leaving the program. Similarly, Jennifer displayed a propensity towards assertiveness during her application process. Having decided to attend graduate school rather late in the year for personal reasons, she was unable to follow the usual mechanisms when she applied. Thus, she decided to contact a professor she happened to know at the University, and asked him to do what he could to get her application to the necessary people. She said,

> I know that he took my stuff to the graduate committee and at least put my stuff on the desk of the right people. 'Cause [the online system] said 'it's closed, you can apply for next year.' I'm like 'I'm not waiting till next year, I wanna do it now.' [laughs] And I don't know that he would've really done a whole lot with it, but I kind of became a little bit of yip yip dog, 'cause I figured the squeaky wheel gets the grease. So I just kept calling and stopping by and emailing him until finally something happened.

- #12, Jennifer, West, white woman

Unlike the majority of her peers, who applied to multiple schools months in advance, Jennifer applied only to the one school she wanted to attend and did everything she could to make sure she got into the highly competitive program she had chosen. In her words, she became a "yip yip dog," nagging a professor she knew only slightly to advocate for her so that she had a better chance in the admissions process.

The process of choosing which courses to teach and which research group to join can be both bewildering and immensely important for graduate students' subsequent experiences in graduate school and their later careers. Women graduate students often feel pressure to do whatever they can to get into the best labs, teach the "right" courses, and work with the most helpful advisors, while men graduate students seem to feel more comfortable allowing other priorities to govern their choices. Indeed, many men graduate students used relational strategies to determine their choice of lab or teaching position; in other words, they thought about others' needs while making their decisions rather than thinking simply about their own. These findings are particularly surprising given research on gender differences in the use of relational versus independent approaches to decision making, which demonstrate that women are more likely to use relational methods (Cross and Madson 1997). However, gendered contexts such as chemistry, in which men's masculinity is reinforced by their work, may provide opportunities for men to feel more flexibility in their gender performance at the same time that women feel less.

Mentorship

Although masculinity is often associated with being competitive and aggressive, the men scientists-in-training in my sample tended to act in a collegial manner towards

their peers. This often took the form of informal mentorship by the more advanced graduate students and postdocs of the newer graduate students. A mild version of this type of informal mentorship took the form of simple encouragement during nervous students' group meeting presentation. For example, though he was not the direct supervisor on Christian's project, Spencer spent Christian's entire presentation in a group meeting encouraging him quietly and warmly. He nodded along while he spoke, smiled reassuringly, and even mouthed a word to prompt him when Christian forgot it. This type of support was common, and it was often displayed by advanced graduate students, especially men, who were not directly supervising junior graduate students in the lab.

The collegial behavior displayed by men graduate students also went beyond simple encouragement. Several more advanced men graduate students and postdocs explained that they felt that it was their duty to provide informal mentorship to their peers, and they made it a high priority to expand their colleagues' knowledge base. Jeffrey, a postdoc from the Moore lab, said "I always tried to help. I wonder if [people in the lab] thought I was being a little pushy and stuff. But I always wanted to help and, you know, see them succeed (#16)." Jeffrey's comment demonstrates his feeling that it is the role not only of the faculty advisor, but also of the advanced students and postdocs, to teach and train the newest graduate students in the lab. This hierarchical socialization of graduate students was evident throughout my observations, but the men and women students and postdocs I observed tended to teach their students using different styles and stressed different values and norms.

In the Mitchell research group, men graduate students and postdocs' informal mentorship was most clearly observed during their group problem set presentations. It

was common for the less advanced students to work through problems on the board at the end of some of their group meetings. This practice of working through problems on the board was cited by several of the first year students as extremely helpful, though nerve-wracking, and a feature of being in the Mitchell group that they very much appreciated. When I asked Brett how he knew that the rotators and less advanced students were the ones who were supposed to go up and work through these problems, he said:

> Well the older people definitely said that. I definitely heard [that] multiple times early on. Like, "rotators it's nice if you guys go up there", and certainly none of the older students get up until the rotators have had a chance to go up there and do it if they want.
>
> - #34, Brett, Moore lab, white man

In this case, the advanced students in this group, who are predominantly men, explicitly share their desire for their "younger" colleagues to publicly practice working through difficult chemistry problems. While some students might find this "opportunity" to demonstrate their knowledge in front of the entire group daunting, it is clear that graduate students see this as something they likely "want" and that older students want to make sure they "have a chance" to do.

When it is time for the rotators to present their solutions, several of the more advanced men students and postdocs frequently jump in before Professor Mitchell and begin to take on the role of a teacher giving students hints about how to do the problems if they have struggled with them (Mitchell Group Meeting 10.29.09). In these moments, they carefully help the less advanced students to reflect on and correct their errors in a much gentler manner than Professor Mitchell does.

In fact, during a discussion about a student in the lab whose work he has consistently found "terrible," Omar described an interaction in group meeting where he

and Ross "protected" the student from looking bad in front of the rest of the research group.

> One time [Prof. Mitchell] was actually quite mean to her, and it was quite awkward in group meeting to the point where Ross and I actually talked and we did this thing where if she goes up to the board to write a mechanism down, before [Prof. Mitchell] jumps in there, Ross and I will jump in and guide her through it. Because if [Prof. Mitchell] does it, it's just going to be disastrous. And I mean, and that one time he was actually quite, I think probably as abrasive as he's ever been to her in the sense that he would just ask her questions, really normal questions, but I mean he would do the wait and see what she says and then she would keep digging herself into a hole. And so it was one of those things where it got worse and worse and worse, and so now Ross and I, we like made a pact that if this happens, we're just gonna jump in and guide her through it because it's just too awkward to watch and too awkward to sit through.
>
> - #20, Omar, Mitchell lab, Asian man

Leading into this story, Omar had complained that he found this specific student particularly frustrating to mentor, given that he felt that the advice he shared with her often went unheeded and as a consequence, felt wasted. Throughout his recounting of his (strained) relationship with this colleague, Omar's frustration with her was clear. Nevertheless, given the leadership role he and Ross had taken upon themselves within the Mitchell group, he put aside these feelings and treated his colleague with sensitivity and consideration for her feelings. Overall, the advanced men graduate students and postdocs in this group have set out to shield their colleagues from any embarrassment or discomfort they might feel displaying their lack of knowledge in front of the rest of the group and their advisor. They have thereby created an environment for their less advanced peers that is more comfortable and conducive to learning.

In contrast to their male peers, women in the natural sciences face many stereotypes about femininity and emotionality which conflict with their chosen field. Perhaps in response, women in this sample discussed the fact that their female peers and

mentors seemed to push them particularly hard to compete with their fellow junior colleagues.

Andrea described an experience in a lab she had been in prior to the West lab where the student assigned to be her mentor, a fellow woman scientist, refused to give her any help at all. This caused Andrea such difficulty, since she needed advice and data from the advanced student, that she eventually went to her PI:

> I said look, she's not helping me a bit. She's not giving me any information. She wouldn't even give me her paper that she had written. I had to go to him to get her paper that she had written that, it was accepted to a journal but it wasn't published yet. She refused to give it to me. And so I got the paper from him. [My advisor] was glad; he gladly gave it to me. But I had to keep it under wraps that I had it.
>
> - #14, Andrea, West lab, white woman

Andrea was really frustrated by her senior student's unwillingness to help her, and felt unhappy that she had to hide her advisor's support from this student to keep tempers from flaring. Andrea also faced similar hostility from the senior women students in the Madden lab, the other lab she worked in prior to the West lab. In Professor Madden's lab she struggled again to get help from a woman graduate student who was assigned to be her mentor:

> She basically told me that I was a moron and that I didn't deserve to be in Dr. Madden's lab. ... All I wanted was some help. And I asked her, you know, 'I'm sorry, I just don't know how to do this calculation, I just don't get it'. I was a freshman [first year grad student]. You know, god forbid that I don't know how to do something. And she was basically like 'you know what, I don't have time for this, I'm gonna graduate soon. If you don't know it, then ask somebody else'. And I really, really upset about the way that she treated me. And that was one good reason of why I didn't wanna be in that lab.
>
> - #14, Andrea, West lab, white woman

Andrea experienced hostility and lack of willingness to help in both of the labs she was a member of prior to her current group. In both cases, her supervising student was a

woman and seemed to place extremely high expectations upon her. While this had negative consequences for Andrea, this trend (female mentors placing high expectations on other female students) was common and was not always experienced negatively.

Women graduate students also described times that the mentorship they received from their women mentors was not always ideally suited to their preferences. In particular, Kira did not feel that the way that she was trained and supervised was very successful for her. She explained:

> I'm not the kinda person that likes to like put myself out there and ask questions when there's like people five years ahead of me that know what's going on. And Ruchi wanted me to ask questions to put myself out there and ask questions, and I was just like no, I wanna do, I don't wanna do that. I'll just ask people later. And she told me that she wasn't gonna answer my questions if I had them because she wanted me to put myself out there [to other people]. So in the end, I didn't end up really discussing much with anybody. And I feel like that was not such a good decision on her part.
>
> - #36, Kira, Mitchell lab, white woman

For Kira, Ruchi's pressure to speak out in group meetings, as well as her high expectations elsewhere in the lab got to be too much for Kira. Thus, the more laid back atmosphere of the Mitchell group (and her male mentors in that lab) were a relief to her. In contrast, Adriana, a member of the Williams lab, found that Ruchi's approach to mentorship worked extremely well for her. While explaining one of the reasons that she felt that she had been so successful early on in her lab, she noted, "Ruchi kind of took me under her wing and basically like mentored me a lot…. [She] did push me hard… (#10, white woman)." This close, tough mentorship was a boon for Adriana and was the main reason for her decision to remain in the Williams lab. Sarah took a similar approach to Ruchi's while mentoring Stacey, an undergraduate research student who worked in the

lab over the summer. Stacey was asked to present some of her work to the research group at the end of the summer:

> As the talk was about to begin, [Professor Williams] said, "Usually when we have undergrads give talks we let them go without interruptions. Are you pro- or anti-interruptions?" Stacey shrugged and sort of responded with a bland, uncomfortable look. Sarah said confidently, "I think she can handle it."
>
> - Fieldnotes, Group Meeting 8.4.09, Williams Group

During the course of the presentation, Stacey did manage to hold her own, but seemed fairly flustered when she was interrupted with questions, and more often than not, Sarah answered the questions for her. It should be noted that these kinds of dyadic mentor-mentee relationships were common in all of the labs I observed; however, this style of demanding mentorship seemed more common among the women I observed than the men.

In contrast with common gendered stereotypes describing men as highly competitive and women as collaborative, men and women graduate students in chemistry displayed behaviors incongruent with gender norms. Just as they advised their mentees about staying competitive with the hours they spent in the lab, women graduate students pushed their fellow women peers to be assertive, self-confident, and driven so that they could compete with the men in their research groups. Given the strong relationship between science and competition, this type of clear coaching behavior was an important method through which women were able to guide other women students through a process that they might not feel came as naturally to them as it did to graduate students who were men. Men graduate students' style of mentorship differed greatly, on the other hand. Since competitiveness and masculinity are so intertwined, these students seemed much more comfortable teaching their students a more collaborative and cooperative

style of interaction within the lab. Rather than demonstrate ways of acting competitively with their peers, these men graduate students modeled collaborative methods of interaction to both men and women students who they worked with. Sometimes this took a gendered form as men saw "protecting" women (from harsh critique) as a form of collaboration with the women in their group. For them, masculine behaviors such as competitiveness and engaging with hierarchies are not essential wisdom that need to be conveyed. Indeed, as men, it is likely that they do not recognize the importance of learning these skills *because* of this link.

Alternative Competition

While I have depicted the men that I observed and interviewed as cooperative and collegial with one another, their day-to-day lives did contain a fair amount of competition. However, the competition that they described and that I observed often did not unfold in the manner previously described in research on masculinity in scientific contexts (Sallee 2011). Instead, competition was used as either a form of entertainment or self-motivation. This was particularly true for the Mitchell research group. For example, Ross described one day in lab when nearly the entire research group (excluding their advisor) had decided to hold a push-up contest for fun:

> We do laughable things like push-up contests for nothing essentially. ... You didn't know about the push-up contest? We had a push-up contest last year which happened to fall on Omar's birthday so he bailed out of it. It wasn't a head-to-head across the board. … A large chunk of the lab did it, including the girls.
>
> - #35, Ross, Mitchell lab, white man

In this case, the group competed against one another in an extremely and symbolically masculine format, yet, as Ross explains, it was all considered fun entertainment.

Students in the lab also were competitive with their advisor in a teasing, friendly

manner. For their final party at the end of the semester, the Mitchell group decided to go bowling together and invited me to join them. During the party, several of the group members told me that they had decided upon bowling as their end-of-semester party because Professor Mitchell had left a group meeting several weeks earlier to attend a bowling event and had "bragged" about his high score of 200 points to the group.

> The guys said, "Oh my god, no way" and so they were teasing him about that, and so apparently that was part of the reason that they decided to do bowling as their party. So there was a lot of teasing [Prof. Mitchell] and trying to both beat him and see if he actually could bowl 200. Everybody was watching [Prof. Montgomery]. …There was a lot of hooting and hollering and watching what was going on with everybody's bowling skill.
>
> - Fieldnotes, Bowling Party 12.12.09, Mitchell Group

While it was predominantly the advanced students who did the teasing and who were the most competitive with their advisor, the entire group (except the one student who did not come to the party) got into the spirit of competition. This "heckling" mirrored that described as common by Traweek in her study of particle physicists (Traweek 1988). In turn, Professor Mitchell heckled and teased some of his students back, all the while trying to beat their bowling scores. Professor Mitchell also paid attention to many of the students' scores, calling out to others when they did well, and highlighting their bowling achievements, all the while laughing and demonstrating that he was having a good time. In this way, Professor Mitchell reinforced the behavior of his advanced students, demonstrating that friendly competition was positive, appropriate, and fun.

Toward the end of the bowling party, members of the research group discovered that two of the first-year students had bet on the outcome of one of the games, and the entire laboratory group seemed to become invested in the outcome of this bet. At the end, the whole group watched to see who would win the 20 dollars at stake. Later, I was

told that bets were fairly commonplace amongst students in this lab. Peng told me that he frequently made bets with students in the lab (that he frequently lost). Sean also discussed the betting in lab, explaining,

> I have, for instance, several bets, usually for beer, with other group members and it's just kind of a way to push ourselves to get to a publication first or stuff like that. … I would say my relationship with Peng is the most competitive and that's just because we are probably the closest friends of anybody and it's mostly joking around, but I think we both want each other to do very well at the same time we use it as a motivating factor for us to do well at the same time. … There's no instance where I've ever seen where someone would ever wish something would go wrong so that they can come out on top of a competition. We might be having this competition where I want to get the next publication before him and vice versa, but at the same time every week we're discussing ways that we can, you know, "hey this result happened, what do you think that means, what should I do?" And we'll kind of help each other along in that respect. Bounce ideas off each other. "What do you think about this as a certain data point? Is it important, yes or no?" I would say that is kind of the relationship. It's really more of fun and games.
>
> - #31, Sean, Mitchell lab, white man

Though Sean, Peng, and others in the Mitchell group have clearly engaged in competition with one another through the betting process, the type of competition they use is for fun, for entertainment, and for motivation, rather than antagonistic. While this type of competition does relate to their research, Sean and Peng do not work on similar projects, so one student's success does not negate the other's. This contrasts with the type of competition that is generally associated with competition in science, in which research groups often compete to discover and publish important results before other groups do (or risk being "scooped").

Discussion and Conclusion

In this article, I have investigated the link between masculinity and science by examining men and women graduate students in a STEM discipline as they were taught

the "appropriate" values and norms associated with their field. Unlike many previous scholars of graduate socialization in the sciences, who found that men (and a few women) were socialized to be competitive, aggressive, and individualistic, i.e., masculine, to succeed in their research, my results were more complex. Instead, I found that the men I observed and interviewed in chemistry exhibited collaborative, collectivistic behaviors towards their peers and taught others to act similarly. In contrast, the majority of the women I observed "played the game" and competed with their peers to get prime slots in research groups, explicitly gave advice to less advanced women when they were not putting in enough hours in the laboratory, and pushed each other to answer questions and stand out to their advisors. While this competitive spirit amongst the women was not particularly aggressive towards other students, the clear goal in this process was to impress their principal investigators so they could be especially successful in their field. In fact, the norms being taught to and performed by men and women graduate students seemed qualitatively different: women were taught to act classically competitive and aggressively to get to the top, while men were taught to act in a more collaborative style, using team-work and collegiality.

If masculinity and science are so inextricably linked, as so many authors have argued, why did the men I observed demonstrate behaviors that are not generally considered masculine, while the women I observed acted in a more characteristically masculine fashion? Given the fact that men and male bodies are already associated with science and with academia, they are also likely to have more freedom to enact masculinity in a more varied, more complex way than the women attempting to enter scientific contexts. Unlike women, whose presence in scientific contexts is still

symbolically (and in some spaces, numerically) deviant, men expressed more comfort with and felt more welcome in scientific spaces. In contrast, women, who do not embody a clear link between themselves and science, must work harder than the men they work alongside to fit into the norms of their field. Thus, they enact masculinity in a much more hegemonic way (Connell 1987). This can be a major problem for women, since past research has shown that when women fail to enact femininity in their work, they are often judged harshly for not living up to womanly standards (Sprague and Massoni 2005; P. Y. Martin 2003). Further, given new trends in scientific methods that embrace collaborative working styles, such as interdisciplinary working groups and multi-institutional studies, men are more likely to have experience with these research styles than their women peers.

References

AAUW. 2009. "State Median Annual Earnings and Earnings Ratio, by Gender, 2009." Retrieved (http://www.aauw.org/learn/research/statedata/upload/gendergap2009_data.pdf).

Anderson, Kristin J., and Gabriel Smith. 2005. "Students' Preconceptions of Professors: Benefits and Barriers According to Ethnicity and Gender." *Hispanic Journal of Behavioral Sciences* 27(2):184-201.

Babbie, Earl R. 2009. *The Practice of Social Research*. Belmont, CA: Wadsworth Publishing.

Basow, Susan A. 1995. "Student Evaluations of College Professors: When Gender Matters." *Journal of Educational Psychology* 87(4):656-665.

Becker, Howard S., Blanche Geer, Everett C. Hughes, and Anselm L. Strauss. 1961. *Boys in White: Student Culture in Medical School*. Chicago: University of Chicago Press.

Beede, David, Tiffany Julian, and David Langdon. 2011. *Women in STEM : A Gender Gap to Innovation*. Washington, DC.

Bird, Sharon R. 2011. "Unsettling Universities' Incongruous, Gendered Bureaucratic Structures: A Case-study Approach." *Gender, Work & Organization* 18(2):202-230.

Book, Esther Wachs. 2000. *Why the Best Man for the Job Is A Woman: The Unique Female Qualities of Leadership*. Harper Paperbacks.

Chesler, Mark, and Alford A. Young Jr. 2007. "Faculty Members' Social Identities and Classroom Authority." *New Directions for Teaching and Learning* 111:11-19.

Collinson, David, and Jeff Hearn. 1994. "Naming Men as Men: Implications for Work, Organization and Management." *Gender, Work & Organization* 1(1):2-22.

Conefrey, Theresa. 1997. "Gender, Culture and Authority in a University Life Sciences Laboratory." *Discourse & Society* 8(3):313-340.

Connell, R.W. 1987. *Gender and Power: Society, the Person and Sexual Politics*. Stanford, California: Stanford University Press.

Connell, R.W. 1995. *Masculinities*. Berkeley: Blackwell Publishers.

Cross, Susan E., and Laura Madson. 1997. "Models of the Self: Self-Construals and Gender." *Psychological Bulletin* 122(1):5-37.

Davies, Scott, and Neil Guppy. 1997. "Fields of Study, College Selectivity, and Student Inequalities in Higher Education." *Social Forces* 75(4):1417-1438.

Donaldson, Mike. 1993. "What is Hegemonic Masculinity?" *Theory and Society* 22(5):643-657.

Eagly, Alice H., Wendy Wood, and Amanda B. Diekman. 2000. "Social Role Theory of Sex Differences and Similarities: A Current Appraisal." Pp. 123-174 in *The Developmental Social Psychology of Gender*, edited by T. Eckes and H. M. Trautner. Mahwah, NJ: Erlbaum.

Eagly, Alice H., and Mary C. Johannesen-Schmidt. 2001. "The Leadership Styles of Women and Men." *Journal of Social Issues* 57(4):781-797.

Egan, Janet Malenchek. 1989. "Graduate School and the Self: A Theoretical View of Some Negative Effects of Professional Socialization." *Teaching Sociology* 17(2):200-207.

Emerson, Robert M., Rachel I. Fretz, and Linda L. Shaw. 1995. *Writing Ethnographic Fieldnotes*. Chicago: University Of Chicago Press.

Etzkowitz, Harry, Carol Kemelgor, and Brian Uzzi. 2000. *Athena Unbound: The Advancement of Women in Science and Technology*. Cambridge, UK: Cambridge University Press.

Fernandez, Roberto M., and M. Lourdes Sosa. 2005. "Gendering the Job: Networks and Recruitment at a Call Center." *American Journal of Sociology* 111(3):859-904.

Ferreira, Maria. 2003. "Gender Issues Related to Graduate Student Attrition in Two Science Departments." *International Journal of Science Education* 25(8):969-989.

Finson, Kevin D. 2002. "Drawing a Scientist: What We Do and Do Not Know After Fifty Years of Drawings." *School Science and Mathematics* 102(7):335-345.

Gilligan, Carol. 1982. *In a Different Voice: Psychological Theory and Women's Development*. Harvard University Press.

Gopaul, Bryan. 2011. "Distinction in Doctoral Education: Using Bourdieu's Tools to Assess the Socialization of Doctoral Students." *Equity & Excellence in Education* 44(1):10-21.

Halberstam, Judith. 1998. *Female Masculinity*. Durham and London: Duke University Press Books.

Harding, Sandra. 1991. *Whose Science? Whose Knowledge?: Thinking from Women's Lives*. Ithaca, NY: Cornell University Press.

Helgesen, Sally. 1990. *The Female Advantage: Women's Ways of Leadership*. Doubleday Currency.

Hill, Catherine, Christianne Corbett, and Andresse St. Rose. 2010. *Why So Few? Women in Science, Technology, Engineering, and Mathematics*. Washington, DC.

Institute for Women's Policy Research (IWPR). 2004. "Women's Earnings Fall: U.S. Census Bureau Finds Rising Gender Wage Gap." Retrieved (http://www.iwpr.org/pdf/WageRatioPress_release8-27-04.pdf).

Jacobs, Jerry A. 2003. "Detours on the Road To Equality: Women, Work and Higher Education." *Contexts* 2(1):32-41.

Karp, David A., Lynda Lytle Holmstrom, and Paul S. Gray. 1998. "Leaving Home for College: Expectations for Selective Reconstruction of Self." *Symbolic Interaction* 21(3):253-276.

Keller, Evelyn Fox. 1985. *Reflections on Gender and Science*. Binghamton, NY: Yale University.

Kimmel, Michael. 1987. *Changing Men: New Directions in Research on Men and Masculinity (SAGE Focus Editions)*. Sage Publications, Inc.

Kleinman, Sheryl. 1983. "Collective Matters as Individual Concerns: Peer Culture among Graduate Students." *Journal of Contemporary Ethnography* 12(2):203-225.

Leahey, Erin, and Ryan C. Reikowsky. 2008. "Research Specialization and Collaboration Patterns in Sociology." *Social Studies of Science* 38(3):425-440.

Lincoln, Anne E. 2010. "The Shifting Supply of Men and Women to Occupations: Feminization in Veterinary Education." *Social Forces* 88(5):1969-1998.

van Maanen, John. 1976. "Breaking In: Socialization to Work." Pp. 67-130 in *Handbook of Work, Organization, and Society*, vol. 15, edited by Robert Dubin. Irvine: University of California Press.

Machin, Stephen, and Patrick A. Puhani. 2003. "Subject of Degree and the Gender Wage Differential: Evidence from the UK and Germany." *Economics Letters* 79:393-400.

Martin, Karin A. 2003. "Giving Birth Like A Girl." *Gender & Society* 17(1):54-72.

Martin, Patricia Yancey. 2003. "'Said and Done' Versus 'Saying and Doing': Gendering Practices, Practing Gender at Work." *Gender & Society* 17(3):342-366.

Martin, Patricia Yancey. 1998. "Why Can't a Man Be More Like a Woman? Reflections on Connell's Masculinities." *Gender & Society* 12(4):472-474.

Martin, Patricia Yancey. 2001. "`Mobilizing Masculinities': Women's Experiences of Men at Work." *Organization* 8(4):587-618.

Merton, Robert King. 1957. *The Student-Physician; Introductory Studies in the Sociology of Medical Education*. Cambridge: Harvard University Press.

NSF. 2009. "Survey of Graduate Students and Postdoctorates in Science and Engineering." Retrieved (http://www.nsf.gov/statistics/srvygradpostdoc/).

Pascoe, C. J. 2007. "Dude, You're a Fag: Adolescent Male Homophobia." Pp. 52-83 in. University of California Press.

Powell, Gary N. 1990. "One More Time: Do Female and Male Managers Differ?" *Academy of Management Executive* 4(3):68-75.

Pyke, Karen D., and Denise L. Johnson. 2003. "Asian American Women and Racialized Femininities: 'Doing' Gender across Cultural Worlds." *Gender & Society* 17(1):33-53.

Ridgeway, Cecilia L. 2011. *Framed by Gender: How Gender Inequality Persists in the Modern World*. Oxford University Press, USA.

Ridgeway, Cecilia L. 1997. "Interaction and the Conservation of Gender Inequality: Considering Employment." *American Sociological Review* 62(2):218-235.

Ridgeway, Cecilia L., and Shelley J. Correll. 2004. "Unpacking the Gender System: A Theoretical Perspective on Gender Beliefs and Social Relations." *Gender & Society* 18(4):510-531.

Roesner, Judy B. 1995. *America's Competitive Secret: Utilizing Women as a Management Strategy*. Oxford University Press, USA.

Sallee, Margaret W. 2011. "Performing Masculinity: Considering Gender in Doctoral Student Socialization." *Journal of Higher Education* 82(2):187-216.

Schiebinger, Londa. 1999. *Has Feminism Changed Science?* Cambridge: Harvard University Press.

Sedgwick, Eve Kosofsky. 1995. "'Gosh Boy George, You Must be Awfully Secure in Your Masculinity!'"Pp. 11-20 in *Constructing Masculinity*, edited by Maurice Berger, Brian Wallis, and Simon Watson. New York and London: Routledge.

Sonnewald, Diane H. 2008. "Scientific Collaboration." *Annual Review of Information Science and Technology* 41(1):643-681.

Sprague, Joey, and Kelley Massoni. 2005. "Student Evaluations and Gendered Expectations: What We Can't Count Can Hurt Us." *Sex Roles* 53(11-12):779-793.

Steinpreis, Rhea E., Katie A. Anders, and Dawn Ritzke. 1999. "The Impact of Gender on the Review of the Curricula Vitae of Job Applicants and Tenure Candidates: A National Empirical Study." 41(7/8):509-528.

Sweitzer, Vicki Baker. 2009. "Towards a Theory of Doctoral Student Professional Identity Development: A Developmental Networks Approach." *The Journal of Higher Education* 80(1):1-33.

Thorne, Barrie. 1993. *Gender Play: Girls and Boys in School*. New Brunswick, NJ: Rutgers University Press.

Traweek, Sharon. 1988. *Beamtimes and Lifetimes: The World of High Energy Physicists*. Harvard University Press.

U.S. News and World Reports. 2010. "Best Chemistry Programs, Top Chemistry Schools, Best Graduate Programs." Retrieved (http://grad-schools.usnews.rankingsandreviews.com/best-graduate-schools/top-science-schools/chemistry-rankings).

University of Michigan ADVANCE. 2004. *Gender in Science and Engineering Report of the Subcommittee on the Faculty Recruitment, Retention and Leadership*. Ann Arbor, MI.

Weidman, John C., Darla J. Twale, and Elizabeth Leahy Stein. 2001. *Socialization of Graduate and Professional Students in Higher Education: A Perilous Passage? ASHE-ERIC Higher Education Research Report*. Jossey-Bass.

Weinberger, Catherine J. 1998. "Race and Gender Wage Gaps in the Market for Recent College Graduates." *Industrial Relations* 37(1):67-84.

Wenneras, Christine, and Agnes Wold. 1997. "Nepotism and Sexism in Peer-Review." *Nature* 387:341-343.

Chapter 4

Gendered Strategies of Impression Management: Authority and Expertise in a Scientific Context

Introduction

Women faculty members in academia are evaluated more harshly than are their men peers (Wenneras and Wold 1997; Steinpreis, Anders, and Ritzke 1999; Anderson and Smith 2005). One possible reason for this is a cultural mismatch between femininity, authority, and expertise, which are qualities necessary for success in academic science. Loosely defined, authority is the power to make and enforce decisions, while expertise involves specialized skill, knowledge, or judgment. Scholarship on gender, authority, and expertise has demonstrated that women in leadership roles are less likely to be taken seriously (Ridgeway, 2001) and women's expertise is more likely to be challenged or ignored (Thomas-Hunt & Phillips, 2004), especially in contexts like science where they women tend to be the (numeric) minority (Eagly and Karau 2002). However, while much of the research that has explored women's experience in the sciences has focused on their entry into or exit out of STEM fields (the "leaky pipeline" metaphor), scholarship about what it is actually like to be a female scientist is lacking, due to the dearth of ethnographic work that explores gender and day-to-day experiences in the academic workplace (Etzkowitz, Kemelgor, and Uzzi 2000; Xie and Shauman 2003).

Further, the studies that do focus on women in science tend to concentrate on only one part of their lives, such as their time spent in the classroom (Clegg, Trayhurn, and Johnson 2000) or in the laboratory (Conefrey 1997), and fail to discuss how these experiences are interconnected.

Rather than focus on characteristics of STEM courses or careers that make women more likely to drop out of the STEM pipeline, this chapter focuses closely on two features of scientific contexts that create obstacles to women's success: authority and expertise. Research has consistently demonstrated that women faculty in STEM fields make less than their men counterparts (Beede, Julian, and Langdon 2011), have a higher service and mentorship burden (Misra et al. 2011), and are promoted more slowly (Winkler 2000). In this chapter, I argue that an additional difficulty that women scientists must overcome concerns the use of expertise and authority in science. Authority and expertise are difficult to navigate in both the scientific classroom (Ingersoll and Perda 2004), and in research groups (Owen-Smith 2001), and this problem is only worsened by being a woman (Bachen, McLoughlin, and Garcia 1999; Martin 1984). Indeed, women faculty are more likely to face challenges to their authority in the classroom than their men faculty peers (Sprague and Massoni 2005; Sandler 1991), which in turn, can affect the likelihood that they receive comparable promotions or tenure (especially in teaching-focused institutions). Women faculty also need to be approximately 2.5 times more productive to be rated as similarly "scientifically competent," i.e., to be seen as equally knowledgeable in their fields (Wenneras and Wold 1997). As a result, women scientists must work harder than their men colleagues to be judged as equally valuable members of their departments.

Thus, this study investigates gender inequality from the perspective of women who have not left science, but face obstacles in their day-to-day experiences. Specifically, this chapter explores how scientific authority and expertise are expressed and challenged in science: in the classroom, in the laboratory, and during group meetings in which research is presented. It focuses in particular on the impression management strategies that scientists-in-training (i.e., graduate students and postdoctoral fellows) use when deciding which emotions to express to others, how to dress and present themselves, and how to interact in the workplace, as well as whether these choices are affected by gender. I have chosen to explore the impression management strategies of graduate students and postdocs because they provide a unique lens through which to explore varied levels of expertise and authority in the scientific, academic setting. Further, their recent socialization into their field (Merton 1957) and liminal status (neither fully students, nor fully professors) (Turner 1969; Willis 1977) allows them deep and intuitive viewpoints into the experiences of impression management in science.

Background Literature

Identity and Impression Management

Impression management is a social performance to convince others of our social identity. Theorists using the symbolic interactionist approach in sociology believe that individuals' identities are produced in interaction; specifically, they are defined, developed, reinforced, and transformed by interactions between people (Cooley 1902; Mead 1934; Hunt and Benford 1994). Goffman expanded this concept of identity further, developing the concept of impression management, and explaining that "when an individual appears in the presence of others, there will usually be some reason to

mobilize his activity so that it will convey an impression to others which it is in his interests to convey" (Goffman, 1959, p.4). In other words, Goffman believed that it is in our best interest to influence others' perceptions of us in order to control their conduct, and more importantly, their reactions to us.

One of the ways that individuals communicate their interpersonal status to others is through the use of their attire and/or accessories (Rafaeli et al. 1997; Pratt and Rafaeli 1997; Mast and Hall 2004; Hunt and Miller 1997). Dress can be a "visual metaphor" for identity through which individuals express information about who they are (Davis 1992; Hunt and Miller 1997). In the workplace, attire is often used to differentiate those in authority (e.g., foremen, inspectors, supervisors, etc.) from laborers and other lower-ranked employees (M. E. Roach and Eicher 1965). Police officers can also use their uniforms, night sticks, and guns as symbols of dominance over others, and doctors' lab coats, medical paraphernalia, and technical discourse help to convince patients of their competence (Rubinstein 1973; Haas and Shaffir 1977).

Another way that people communicate their identities and social statuses is through the emotions they express. One example of this involves established stereotypes about gender and emotionality. Conventional wisdom assumes that women are more emotional and less rational than men (Brody 2000; Shields 2000; Citrin, Roberts, and Frederickson 2004). Just as women perform their gender to coincide with their sex using the clothing and makeup they wear, they also perform their femininity by expressing themselves emotionally more than their men peers. Men, on the other hand, are often judged when they appear to be too sensitive, and crying in men's peer groups is heavily sanctioned (Fischer 1993). Women also do more emotion management and emotional

labor than men do (Hochschild 1983). Men and women are trained during childhood to use and manage emotions differently: girls are taught to master anger and aggression, while boys are taught to use these emotions in the service of maintaining social order, i.e., they are trained to hide any outward signs of fear or vulnerability (*ibid*). Finally, people infer the social status of others through emotional displays. For example, Tiedens, Ellsworth, & Mesquita (2000) found that observers assumed that people who expressed anger and pride were high status, while those who expressed sadness, guilt, and appreciation were lower status. In this way, people often believe that emotions act as a symbol or language through which we may deduce information about others' social standing.

The most obvious way that people communicate their identities to others, however, is through the words and expressions they use. Such discursive practices can be used strategically in the construction and management of individuals' selves (Goffman 1959; Davies and Harre 1982). Individuals use language to communicate their ethnic groups to others through accents or pronunciation, their occupation via the technical jargon they use, or their social class through grammar (Trudgill 2001). In these descriptions, individuals are likely to choose to present information selectively that will make them look especially attractive and downplay or hide information that will detract from their appeal (Leary 1996). In this way people hope to partially control the ways that others view and understand them, using particular forms of speech and language to communicate who they think they are or who they wish to be.

Gendered Impression Management and Performance

Goffman's theory of gender originated from his more general theory of impression management and his belief that people understand one another through categorization of others in ways they believe to be consistent with essential, natural characteristics. He believed that individuals follow "scripts" of masculinity and femininity that identify them as members of their respective gendered groups to others, who are trained from childhood to interpret these enactments appropriately (Goffman 1979). Though they aid in establishing and maintaining social order, in Goffman's view, gender displays are optional and are simply the normalized performances and interactional portrayals of our sexual natures.

In contrast, West and Zimmerman argue that that *all* of our activities and actions are informed by the way that they represent or reflect our gender, and that we read others' actions accordingly (West and Zimmerman 1987). For them, actions are "accountable" because they are expected to be analyzed and characterized based on whether they mesh with normative expectations of specific sex categories. However, these expectations are heavily impacted by social context: the appropriate way to perform gender in informal situations is different, for example, from the way to perform gender at the workplace. These performances are also affected by myriad social characteristics and historical contexts (West and Zimmerman 1987). Because there is accountability in how our actions are perceived, failing to "do gender" appropriately can produce extreme and negative consequences. In other words, we police others' actions according to whether or not they live up to the expectations we have for men and women. When we "do" or perform gender, we theoretically have the option to perform it non-traditionally, but there can be societal sanctions against these types of performances (West and Zimmerman

1987). Though some scholars, most notably Judith Butler, have argued that one of the ways to disrupt gender as an institution is for individuals to dress in non-normative ways (i.e., in drag), West and Zimmerman argue that individual acts of non-traditional gender performance are simply socially sanctioned (Butler 1990; West and Zimmerman 1987).

Gendered performances vary across time: what is socially appropriate for men and women during one time period may not be in later eras (Deutsch 2007; West and Zimmerman 1987). There are also multiple ways that men and women can perform their masculinity and femininity, though there is a hierarchy in societal acceptance of these norms (Connell 1987; Connell and Messerschmidt 2005; Donaldson 1993). Scholars exploring gendered impression management and gender performance have demonstrated that gender is more than simply presentation, role-enactments, or identity; gender is "an institutionalized system of social practices for constituting people as two different categories … and organizing relations of inequality around that difference" (Ridgeway and Correll 2000, p. 110).

Since men and women interact so frequently, a key method through which this system functions to create inequality is through interaction. Scholars on gender differences in interaction styles have debated whether there are variations in the way that men and women speak and interact with one another, and, more importantly, whether these differences, if they exist, lead to gendered disparities (McHugh and Hambaugh 2010). However, there is solid evidence that gendered stereotypes do affect both men and women's patterns of speech and the way that these interaction styles are interpreted. For example, women are more likely to use speech patterns that moderate the strength of their statements or make their comments sound tentative, which can include behaviors

such as hedging or disclaiming expertise (please see Carli 2006 for a more thorough description of these interaction styles). In addition, because men are presumed to be more competent than women, in mixed groups, women are less likely to be heard and are given fewer opportunities to speak (Ridgeway 1993). These differences in interaction style result from the larger, structural inequalities that affect women. Such differences in interactional style, as well as others' evaluation of that style, in turn, have a significant impact on women's experiences. These differential outcomes are particularly common in the workplace, especially in the natural sciences, a context in which cross-gendered interactions occur frequently but masculine norms still predominate.

Scientific Expertise, Authority in the Classroom, and Gender

Several studies exploring gender and the workplace have drawn attention to the relationship between cultural understandings about expertise and their effects on men and women's subsequent success in the workplace. Pierce (1996), for example, conducted an ethnographic study of two law firms, and showed that differential expectations for men and women's emotional skills and abilities was reflected in the firms' hierarchical (and financial) structure. Many of the skills and talents associated with masculinity and men are frequently linked with stereotypes about strong managers and leaders, so women are often rated as less effective and are less likely to be chosen to manage groups in the workplace (Eagly, Makhijani, and Klonsky 1992). Gendered understandings of expertise have an especially important impact on evaluations of scientific disciplines, however, given that we as a culture associate science with men and masculinity and see science as a masculine pursuit (Keller 1985; Finson 2002; Etzkowitz et al. 2000). This is particularly evident in several studies of gender bias in scientific knowledge and ability in

academia. For instance, by manipulating the gender of the names on identical CVs, Steinpreis et al. (1999) found that unconscious gender-bias causes men to be evaluated much more positively and to be more richly rewarded than comparable women. Likewise, Wenneras and Wold (1997) found that a woman had to be roughly 2.5 times more productive than a male colleague to be rated as similarly "scientifically competent," or, in other words, to similarly qualify as an "expert."

Research also demonstrates that gender impacts faculty members' authority in the classroom. For example, Chesler and Young (2007) found that women professors experience more challenges to their authority because of their gender than men do. Martin (1984)'s results were similar, which she explained by discussing the mismatch that women experience between gendered expectations and traditional images of power and authority. In response, women professors are told to follow a more masculine model of success in speech and dress, but not to go "too far" using the male model (Martin 1984). Studies exploring student evaluations of men and women faculty members have also demonstrated that women face challenges in the classroom due to gendered expectations. Kierstead et al. (1988) demonstrated that students expect women instructors to excel in both stereotypically masculine (e.g., competence) and feminine (e.g., warmth) domains, while men are expected only to be competent in their field. There is also evidence that the students' gender affects how well men and women faculty are evaluated: Basow (1995) found that while there was no difference in the way that men faculty were rated by men and women undergraduates, on average, women faculty received their highest ratings from women students and their lowest ratings from men students. Overall, overt challenges in the classroom and lower teaching evaluations can

affect the amount of time women faculty members spend on their teaching in comparison with men, which in turn can affect the likelihood that they will receive promotions or raises; thus obstacles such as these must be explored more fully to ensure greater gender equity for faculty.

Much of the prior literature on women's presence in the STEM disciplines has focused on a single context within their experience, rather than taking a more holistic approach and focusing on the multiple contexts that graduate students and postdocs find themselves in. For example, in a study of Information Systems classrooms, Clegg et al. (2000) examined gendered differences in both the teaching styles of the tutors who taught the help sessions they observed, as well as gender differences in the preferences and interaction patterns of the students. Women tutors tended to be more collaborative, while men tutors were more hands-off, and male students were more likely to ask lengthy questions. In contrast, Conefrey (1997), conducted an ethnography of a life sciences laboratory. She detailed issues that women in the lab contended with, most notably, a chilly or hostile laboratory environment. While these single context approaches are useful for delving deeply into the particular experiences within the career of scientists-in-training, it is also important to think more carefully about how experiences within each context affect each other. Given how intertwined scientific expertise and authority are, insecurities in one arena can seriously impact confidence in another. Thus, in this chapter, I examine the topic of impression management across these contexts and ask, "How are impression management strategies used by graduate students and postdocs in chemistry to establish authority and expertise in their interactions?" and "How does gender affect this impression management?" Given the importance of these impression

management strategies in the ways that undergraduates judge their teaching assistants' (TAs') authority in the classroom and graduate students and postdocs evaluate their peers' knowledge and expertise in their field, as well as the subsequent consequences these assessments can have on graduate student and postdoc success, this study is a preliminary attempt to explore some of the conscious and unconscious impression management that occurs in these contexts.

Methods

Context

My interest in gender and scientific spaces led me to seek a scientific discipline in which there was sizeable proportion of women, but where women were still a minority. Thus, I chose to explore the field of chemistry; though less than a third of current chemists are women, its proportion of women is the second highest of all STEM fields, and the proportion of women in the field is steadily growing, especially amongst graduate students (Hill, Corbett, and St. Rose 2010). I conducted a qualitative, ethnographic study of scientists-in-training, i.e., graduate students and postdoctoral fellows, in chemistry at a research level-1 university, using a case-study approach.[22] This type of approach, which has recently become popular among both qualitative and quantitative research studies, allowed me to thoroughly engage in an examination of both the experiences of and impression management strategies used by graduate students and postdocs in a specific scientific discipline (Lincoln 2010; Fernandez and Sosa 2005; Bird 2011).

For this project, I conducted ethnographic observations, interviewed graduate students and postdoctoral fellows, and analyzed documents that I collected from the

[22] To protect the confidentiality of my subjects, I have not disclosed the names of those I observed and/or interviewed, the university where they work, or the location of the university.

department and research groups that I observed. At the time of my study, the chemistry program that I examined was considered highly selective; US News and World Reports magazine has consistently ranked it as one of the top 20 programs nationally (U.S. News and World Reports 2010), and only a very small number of applicants were accepted to the graduate program each year. Similar to many of the departments in STEM at the University, the proportion of women faculty in the department of chemistry was fairly low (roughly one quarter); however, the number of women faculty has doubled over the past 5 -10 years. Further, at the time of my study, the graduate student population was much more gender-balanced: 49.2% of graduate students were women. On the other hand, the department was not particularly racially diverse: of the graduate students in the department, roughly 84% were White, 5% were Asian, 4% were Latino/Hispanic, 4% were Black or African-American, 1% were American Indian/Native American, and 1% were unknown/unreported (NSF 2009).

My focus in this project was on graduate students and postdoctoral fellows given their distinctive experiences within the scientific context. As trainees, graduate students and postdocs are often in situations in which they have little power, yet when they shift to their role as TAs or professors, they become experts. These extremes, and the various spaces in-between that they inhabit, make them ideal subjects for a project which explores the topic of scientific authority and expertise. In addition, as scientists-in-training who are being professionalized into the academic sphere, but are not as yet fully inculcated into it, they provide a unique perspective into the academy (Becker and Strauss 1956; Merton 1957). In these contexts of recent socialization into academia, it is likely that graduate students are the most likely individuals to detect impression

management in others, particularly when social or professional gaffes are made. Finally, graduate students are a valuable research population because they are a liminal group. Liminality describes the state of transition experienced during rites of passage (van Gennep 1909). This time and context during which liminal individuals are "betwixt and between the positions" assigned to them also makes it possible for social distinctions to be ignored or reversed, and thus allows for greater understanding or, in Paul Willis' term, "penetration" of social structures (Turner 1969, p. 95; Willis 1977). As members of the academy who are no longer fully students, and who are not yet professors, graduate students are liminal actors who can provide us with a rich, insightful, and "penetrating" view into the workings of the academic, scientific enterprise.

Data/Sample

For this study, I chose to observe groups that included at least six members and had both men and women students; these groups were led by both men and women principal investigators. In the interest of controlling for seniority and rank, I chose to contact faculty members who were early in their careers.[23] I sent email requests to all faculty members whose groups fit these criteria (thirteen groups in total), and five principal investigators and their groups agreed to allow me to observe them. Two of the groups were led by men (Professors Mitchell and Moore) and three by women (Professors West, Williams, and Worth); for the sake of simplicity, I have used pseudonyms that begin with the letter "M" to denote the professors who are men, and pseudonyms beginning with a "W" to denote professors who are women.[24] The groups I

[23] An informant in the chemistry department provided me with information about faculty members' rank.
[24] Despite my attempt to control for rank, the professors in my final sample ranged from assistant to full professors; however none of the professors had been at the University for more than 10 years. I did not observe a relationship between principal investigators' seniority and research group desirability, however.

observed ranged in size from nine to twenty-one members (excluding the principal investigator), with a variety of personnel configurations. While each group was composed of a majority of graduate students, some had undergraduate students who attended meetings or worked in the lab (especially during the summer), and most had two or three postdoctoral fellows working with the group.

During the nine months I observed these groups, group membership shifted a bit, mainly due to the first-year rotation program[25] and an influx of new postdoctoral fellows. However, since several of the research groups I observed shared similar research interests, many of the first-year students I observed left one of the groups in my sample only to join another of the groups I observed. Thus, overall, I observed a total of 56 graduate students and nine postdocs, as well as their five principal investigators. The proportion of women in each group varied greatly (23-60%), and there was some ethnic/racial diversity, as well, though this was highly correlated with international status. While there was only one student of color from the United States in these labs, there were twenty-three students from outside of the United States, the majority of whom were from East Asia (especially China and Korea).

I began my data collection with observations of laboratory meetings, laboratory research and interaction, informal gatherings of lab members, and undergraduate course sections or labs led by graduate student instructors. My observations were conducted over the course of nine months, between July 2009 and March 2010, and comprised over

---

While the most senior man faculty members' research group was more popular than his counterparts', amongst the women faculty members, the most desirable lab was led by one of the more junior faculty members, Professor Williams. Indeed, Professor Williams' lab was considered the most desirable (or competitive) group to get into out of all five.

[25] First year graduate students in this department usually perform research rotations in at least two different laboratories during their first year so that they may find a professor and research group they would like to work with for the remainder of their graduate career.

120 hours. Thorough fieldnotes were taken as unobtrusively as possible during the observations, which was usually quite simple since most of the contexts I investigated (e.g., group meetings, practice job talks, and chemistry classes) were spaces in which quiet note-taking was the norm. Given my interest in students' and postdocs' presentation of self, during my observations, I took detailed notes about participants' clothing, accessories, make-up, hairstyles, emotional expressions, interactional styles, and presentational methods. For example, I noted whether or not presenters used pictures in their power point presentations, if individuals raised their voices during group debates, how formal people's clothing was, what type of slide backgrounds individuals used, how often individuals used humor when speaking to the group, etc. I transcribed and annotated my handwritten fieldnotes as soon as possible afterwards. I gleaned as much information as possible about students' and postdocs' reactions to others' impression management, but it was fairly difficult to collect information about these individuals' emotions about their peers. While I did address this issue to some degree in follow up interviews, future studies exploring responses to various types of gendered impression management are needed.

I also gathered written materials associated with both the laboratory groups and the courses I observed whenever possible to supplement my insight into the culture of the laboratory groups and the department. These materials consisted of the following: course syllabi and assignments, email communications between members of the laboratories, research group websites, and official printed laboratory materials (such as safety manuals and handbooks). Syllabi, assignments, and websites were analyzed for the use of emotional language, organization, and authoritative style. Email

communications were examined for similar content, as well as for interaction style and conflicts.

In the second phase of my data collection, I followed up my observations with a set of 40 semi-structured interviews, after the majority of my observations had concluded. I recruited interview respondents by making announcements in each group's meetings and sending emails to each of the group's listservs with a request for participants. Respondents were offered a $25 gift card to compensate them for their time. The majority (n=37) of my interviews were conducted with graduate students, but after several (n=3) postdoctoral fellows expressed interest in the study, I expanded my interview protocol to include them as well. My sample was fairly evenly split by gender (men = 19; women = 21), and the number of international students I interviewed (10) was roughly comparable to the overall proportion of international students in the chemistry department. My sample was generally representative of the population within the chemistry department overall; however, the generalizability of my findings is somewhat limited by the lack of ethnic and racial diversity of those I observed and interviewed.

I used a semi-structured format to conduct these forty interviews, which usually lasted one to one-and-a-half hours and took place in a private office in the chemistry building. I conducted the interviews after the majority of my observations were complete, allowing me to revise my original interview protocol based on preliminary ethnographic findings. Further, respondents' familiarity with me from the hours I spent observing and interacting with them allowed for especially rich interviews. Interviews focused on several main topics: advisor relationships and style, research group interactions, teaching, self-presentation, and overall images of scientists. Additionally,

respondents answered a short survey to provide demographic details. All interviews were digitally recorded and professionally transcribed.

Analysis

Using open and focused coding, I analyzed my data with the help of the NVIVO8 qualitative software program (Emerson, Fretz, and Shaw 1995). To clarify, using an inductive process, I began my analysis by reading through my data with an idea of some of the general themes I was interested in and noted instances in which obvious trends emerged (Karp, Holmstrom, and Gray 1998). Several of the themes that I anticipated and coded for were advising style, students' and postdocs' use of impression management strategies (including choice of clothing, authoritative/subordinate phrases and terms, emotional expression and management, etc.), and group members' interactions. Themes that emerged from the data included authority and expertise in graduate experiences, teaching methods, group norms, and student mentorship. I paid particular attention to patterns that emerged related to gender, race, and nationality. Finally, within themes, trends, or patterns, I was careful to look for disconfirming evidence or places where expected patterns did not emerge.

Results

The men and women chemists-in-training whom I observed engaged in several impression management strategies related to both expertise and authority in their interactions with their advisors, peers, and students, and these strategies often varied by gender. "Professional" clothing was used by both men and women to present an expert and authoritative persona in both classroom and group meeting settings. On the other

hand, aside from their clothing, men and women used distinctly different methods for communicating their expertise in group meetings and authority in the classroom.

Expertise in Group Meetings

One of the most striking differences between men's and women's presentations of self that was apparent in group meetings was that men were more comfortable going out on a limb and making themselves appear to be an expert in their field or subfield. As I have discussed elsewhere (see chapter 2), these meetings are spaces that are devoted to working on developing expertise, so the willingness of students and postdocs to present themselves as such is of particular interest.

Men graduate students and postdocs were much more comfortable than their women colleagues with challenging presenters about their work, and in so doing, the men reinforced their own appearance of knowledge, skill, and expertise. These challenges were also much more common in response to women presenters. In contrast, when women students asked questions of presenters, their questions were more timid, and at times self-deprecating. Further, women graduate students and postdocs were much more likely to make remarks that were overly humble or that put themselves down. While the men students and postdocs did make these types of comments occasionally, they were usually said in jest for laughs.

Students Challenging Peers

It was difficult to tell if men students purposefully challenged their peers in group meetings to present themselves as experts. Regardless, it was a clear consequence of their interaction style. For example, during Isobel's practice talk[26] in the West group,

[26] She was practicing to give a departmental seminar, one of several requirements each student must pass to receive their doctorate in chemistry from this department.

Randall said, “Isobel, you said [scientific details], which is completely untrue. (West Practice Talk, 10.28.09)” The certainty with which Randall spoke made it more likely for the rest of the group to assume that his understanding of what Isobel had spoken about was more accurate than hers. Indeed, afterwards, a man student asked a question about the topic and directed it to Randall, rather than to Isobel, who, as the presenter of the practice talk, was expected to be in an expert role on the topic within days. Though Randall had been in the lab just one year longer than Isobel, and indeed, was far from the most senior member of the group, his knowledge was accepted by the other group members, partly because of the certainty with which he spoke.

A similar situation arose with several of the men graduate students playing the role of expert in a group meeting in the Williams lab. When Jenny, a new summer rotator, gave her presentation to the group, one of the things she presented was a specific result that did not look exactly the way that she or her supervising student had expected it to (Williams Group Meeting 8.14.09). Jeremy, one of the more senior students, challenged her during her presentation and asked whether she and her mentor had interpreted the result correctly or were seeing what they thought they were. In response, Patrick, another (much less advanced) student in the lab said, nodding, “I saw them; they’re clear.” In this conversation, Jeremy and Patrick spoke with utter confidence on opposite sides of this issue, and through their conversation, solidified their status as experts within the group. Indeed, it was obvious that none of the group members questioned Jeremy’s right to challenge Jenny’s interpretation of her results; and likewise, no one questioned Patrick’s ability to read (and verify) such results.

Similarly, during Maria's presentation, Edward asked probing questions about the ways that she had conducted some of her background research, and in the process, made himself seem like a much more capable user of the system he asked her about:

> Maria: I looked this up on [website].
> Edward: How did you look this up on [website]? [*He goes on to explain that it doesn't seem possible that she could have used [website] to look up the reagent if she didn't know its name in the first place…]*
> Maria: Maybe I didn't look this up on [website], but I thought... You know what? I bet it was referenced in the paper.
>
> - Mitchell Group Meeting Fieldnotes, 10.29.09

While Edward did not seem to be asking Maria these questions to embarrass her, his questioning of her use of this product did not serve to improve her research in any way; instead, his comment acted as a mechanism to highlight his own knowledge and expertise (at her expense). On the other hand, Edward's comment might be seen as a "teachable moment" for other students in the group: he could have seen his role in the conversation as important to make sure that less advanced students better understood the program that she used. Regardless of his motivation, the end result of Edward's questioning of Maria was that he demonstrated to others his obvious expertise.

Group meeting presentations, and even more importantly, practice seminars, are settings in which presenters hope to demonstrate their knowledge and expertise to their research group. These examples all illustrated situations where women students' desire to demonstrate their expertise was impeded because of challenges by fellow men graduate students. As an observer, it was difficult for me to distinguish which student was correct during the presentations; however, it was obvious in each case that the groups turned immediately to the men who offered their expertise after they spoke up, forgoing whatever knowledge the presenter brought to the table.

Self-Deprecating Comments

In contrast to their men peers' method of challenging others and thereby displaying their expertise, women in the research groups were much more likely to make self-deprecating comments and to seem uncomfortable when they were called upon in meetings to answer questions or act as an expert. For example, Tracy, during one of her group presentations, made several comments admitting her lack of expertise or skill (Williams Group Meeting 10.29.09). At one point during the presentation, when she was asked by one of the men graduate students in the group why she thought her yield in a reaction was so low, Tracy replied, "I blame myself, but I don't know…" Though she may have made a mistake while she was in the lab, Tracy's description of the error as something worthy of "blame," rather than a minor blunder that was easily resolved, made her seem insecure about her own abilities and knowledge about chemistry. Later in the same meeting, Tracy was asked a question by one of her peers, and she responded, "I haven't seen it, but I don't know everything. Ethan would know." In this case, not only did Tracy make a self-effacing comment when she noted that she "doesn't know everything," but she contrasted herself with one of the men graduate students, Ethan, who she believed knew the answer to the question, and thus possibly "does know everything" about chemistry. In both of these cases, Tracy's self-deprecating style differed greatly from the men graduate students I described earlier; rather than using methods of interaction that highlighted her expertise, she downplayed her knowledge and skill. When men graduate students and postdocs presented their work, they rarely presented their work in this way, but instead, were confident with their findings and responded to questions with ease and assertiveness.

Men and women in chemistry also seem to feel different levels of comfort when labeled an expert by their peers. During one group meeting, students suggested that the presenter could make a computer model, and one whole side of the room turned to Patrick and said that he should help make the model since he was the "computer guy" (Williams Group Meeting 7.10.09). Everyone laughed quietly and Patrick smiled, nodded, and laughed along. By simply nodding, Patrick indicated his acceptance of his peers' opinion that he was the expert in this group in computer programming and modeling and further solidified that opinion as well. In contrast, at a later group meeting, students were asked to work through a problem set to practice their computations (Williams Group Meeting 7.31.09). As they worked together, they asked each other for help when they reached difficult points in the problem set (which seemed to be difficult for all of them). At one point, Victoria turned to Stephanie and asked her for help with a particular problem, saying, "Stephanie, but you're good at these!" loudly enough for most of the group to hear. Stephanie responded apologetically, "Yeah, no, I know, I'm not…." It was clear that Victoria believed that Stephanie had some knowledge about the particular problem because of the topic that Stephanie focused on in her research, but Stephanie felt uncomfortable being thought of as "good at [this type of problem]."

Lynn was similarly unwillingly to act as an expert in another group meeting in the Williams group. During her presentation, Claire turned to Lynn, a postdoc, to ask her how long the half-life of a chemical was (Williams Group Meeting 7.17.09). Throughout Claire's presentation, Lynn had been quite engaged in the conversation, so it was clear that she worked in a similar field and Claire's question made sense in the context of Lynn's knowledge set. However, when Claire asked her this question, Lynn held up her

hands and said, “Don’t ask me for numbers!” In this situation, not only was Lynn uncomfortable being asked to represent the expert role on a topic that most of her peers expected her to fulfill given her knowledge on the topic, but her statement also highlighted her unwillingness to represent the role of expert in any quantitative area at all. This was especially striking given negative stereotypes about women and mathematical skill.

During group meetings, graduate students and postdocs often provide feedback and suggestions to their peers to help them with their projects. In these cases, they employed their own expertise to give these suggestions. However, women students and postdocs were much more likely than men students and postdocs to introduce their suggestions with a self-deprecating phrase of some kind. In this way, they made their knowledge and expertise seem much more suspect and untrustworthy. For example, Stephanie began a statement to the group by saying, “So I’m not very good at inorganic compounds, but….” (Williams Group Meeting 9.17.09). Similarly, Joan told James, “Synthesis is not my strong point, so I do not want to propose a total synthesis…” (Moore Group Meeting 10.14.09). In both of these cases, women students offered important information to the group or to specific peers, but by belittling their own qualifications in the preamble to their suggestion, they made their expertise and knowledge seem less useful and significant than their peers’.

Another common self-effacing communication style that was exhibited by women students was that they described their findings as things that they discovered by chance or coincidence, rather than because of their own skill or knowledge. Susan, for instance, told her group that one of her findings was “something [she] kind of stumbled upon”

(Moore Group Meeting 10.28.09). Rather than presenting her findings with pride and accomplishment, this style of presentation concealed the hard work, intelligence, and skill that went into the achievement. Isobel also described one of her findings as having been discovered "almost by accident" (West Practice Talk 10.28.09)." In response, her colleague, Rosie, advised her that she should avoid using a phrase like "almost by accident" because she felt that it "sounded like [Isobel felt] shameful" about it and that it sounded too passive overall. While Professor West pointed out in subsequent conversation that "some of the best discoveries [in science] have been accidents," when women graduate students like Susan and Isobel frame scientific innovations as coincidences they make themselves seem less agentic and less in control of their skill, talent, and knowledge in their field in comparison with the men they work alongside.

Men graduate students and postdocs did occasionally acknowledge their lack of expertise and knowledge to the group, but when they did so, they tended to use humor to temper the effect. For example, in Hasan's presentation of his work, one of his slides was titled "Lessons in Humility or Incompetence" and he introduced it by noting with a chuckle, "this is where I thought it would be easy" (Mitchell group observation, 4.22.10). By making light of the fact that he had had difficulty with his results, Hasan made it seem that he might not actually believe that he is incompetent, or at the very least, that he did not think that it was very important if he was. Similarly, Justin made many self-deprecating remarks during his presentation to the Williams group, yet he clearly used them as comic relief, pausing briefly for people to chuckle after each funny comment. He told the group, "So then [Professor Williams], demonstrating why she has the PhD and I do not, explained… (Williams group observation, 7.25.09)." In this case, Justin's

comment highlighted both his high regard for his advisor, as well as a joking humility about his own skill. Finally, Ray, a postdoc in the Moore lab, used a similar strategy during a brief presentation of his work. He explained that since previous literature about a reaction "generally describes a 90% yield of a fine white powder, [he's] expecting to get about 30% of some goo when he tries to replicate it" (Moore group observation, 1.15.10). Again, by choosing a humorous method of self-deprecation, Ray downplayed the importance he placed on expertise and knowledge. Rather than seeming particularly dejected or unhappy about the fact that he was unsure about his ability to reproduce others' results, Ray made a joke about it, thus making it seem like it was not a very big problem. Research on gender and humor has shown that men more commonly make jokes in mixed settings, so findings such as these are not surprising (Robinson and Smith-Lovin 2001). However, this research also demonstrates that while self-deprecating humor such as this may work to enhance high-status users' (such as men's) security and self-confidence, it may not be similarly effective for women.

Clothing

Both the men and women graduate students and postdocs in chemistry discussed the fact that they sometimes used their clothing to present themselves to others as knowledgeable during group meetings, practice job talks, and seminars. However, given their work in the lab, concerns about ruining dressy or nice clothing made this strategy less popular than it might have been otherwise. As one student remarked, everyone "looks the same under [their] lab coats." However, women students frequently mentioned that they would avoid wearing low-cut or "sexual" clothes for fear that they would be taken less seriously. Women who dress less casually and wear feminine, sexual

clothing are likely to get teased for breaking social norms, such as one woman who was called "Glamour Girl" by her peers because she wore high heels to the lab. Women's intelligence is also sometimes judged by their appearance, such as the fairly extreme case that Victoria described at some length when I asked her about how she chooses what to wear to work:

> But I also feel like I'm not gonna walk around necessarily with like a low-cut shirt on or tight clothes. …It was very interesting for me to have Adrienne in our lab, I guess, because she was one of the only people who dressed really sort of, not sexually, but… she would wear tight clothes or stuff that like accentuated [her body]. And I don't know if this has a correlation, but I feel like in the lab people thought that she wasn't as smart… And Ruchi called her out on [not knowing] her chemistry or that she didn't know what she was doing. … I wonder if her not being respected, I think that was it. A lot of people didn't really respect her, you know. Does that stem from that? …So I feel like when I come to work, I dress in a lot less sexualized clothing on purpose, consciously. And I don't know if that's also being in sort of a male-dominated field as well, … I want to be respected and looked at as an intellect as opposed to kind of being, …yeah.
>
> - #10, Victoria, Williams lab, white woman

Victoria's description of how she decided what to wear to work included more about communicating to others who she was *not* (sexually-provocative) then about who she was, a strategy that is not uncommon when determining how to present oneself to others (Freitas et al. 1997). This desire was heightened by her observations of how her labmates viewed and treated a previous woman postdoc.

In contrast to the gendered nature of the attire-related impression management I have just described, the remainder of concerns over clothing choice were raised by both men and women. The reasons that students and postdocs gave for dressing up during their presentations involved a desire to seem smarter and qualified in their field. For example, Blake explained his apparel choices during group meeting as follows:

> I'd probably wear a collared shirt or something a little bit nicer. But I don't get a whole lot nicer than like a button-up shirt and jeans.
> *Any reason for that?*
> Kinda going with the professional feel. So it kind of makes it seems like I deserve to be up there telling what I'm doing a little bit more.
>
> - #30, Blake, Mitchell lab, white man

For Blake, these clothes helped him feel like he had a right to stand in front of his students and speak with authority about chemistry because he thought they would see him as professional. Edward related a similar sentiment when he described his choices about what to wear when he presented in group meetings. He said,

> That's more of like a, not a subconscious thing 'cause I definitely think about it, but it's like a, [laughs] I have this thing where if I feel like I'm smarter, I'm gonna act like I'm smarter. So like for my [qualifying exam presentation], I wore a tie and like other people didn't, and I got made fun of a little bit. But it's like, if I feel like I'm projecting this image of an intelligent person, then I have that confidence that I feel like I'm gonna be smarter.
>
> - #25, Edward, Mitchell lab, white man

Like Blake, Edward felt that dressing up when he presented to his peers helped to make him feel more confident about his own knowledge and intellect. However, unlike Blake, Edward felt that wearing nice clothes made him feel smarter, thus his actual intelligence might be boosted, rather than Blake's belief that others would see him as smarter because of his clothing.

Other graduate students described similar reasons for dressing up for group meetings, and these were often related to the emotions that the clothing created for themselves. Zhi (#39), an Asian woman graduate student in the West lab said that she dressed up to present during group meetings because it just "made her feel better." For her, wearing nicer clothes made her feel more self-assured and more comfortable while she stood in front of her peers to present her work. Claire elaborated on this feeling:

> I do dress up a little bit more for group meeting. … Partly, just because in a sense it's still a performance. … Victoria just gave group meeting, and she was telling me "I'm just so nervous. I'm in my fourth year and I'm still nervous." Because everyone's gonna judge you. We all do it. At the end of every group meeting it's "was it a good group meeting? Have they gotten enough done since they last gave group meeting?" And so it is a judgment. And it's not like someone's gonna hold it against you but everyone is evaluating you in that moment, so.
> *So what do the clothes have to do with that?*
> I, yeah, what do they have to do with it? I guess just confidence. I think I usually feel more confident if I've taken that time to pick something, you know. I think it's purely vanity. [laughs] That's the way my brain works maybe.
>
> - #2, Claire, Williams lab, white woman

Victoria and Claire's relative seniority in the group has not alleviated their anxiety about presenting in front of their fellow labmates and advisor, mainly because, as Claire pointed out, these presentations were used not only as a method to provide help and support, but also as a method to judge each other's work ethic, intelligence, and skill. Like Blake and Zhi, Claire felt that dressing more nicely, i.e., choosing clothes without noticeable holes in them and avoiding tee shirts, hoodies, or sweatpants, might give her the confidence boost she needed to face a group of people she knew would be judging her the entire time she presented.

Authority in Teaching

Another important context in which men and women chemistry graduate students differed in their presentation of self was when they acted as teaching assistants (TAs). Given that the majority of graduate students in chemistry programs enter school directly after they graduate from their undergraduate universities, and the majority of students who are TAs teach in one of their first few semesters in graduate school, the age differences between TAs and undergraduate students is usually fairly negligible. As a

consequence, TAs frequently face concerns about how to take control of the classes they teach. Several TAs said that they had not thought about establishing authority prior to entering the classroom, but when asked about their strategies for maintaining classroom control, the strategy the TAs used, both consciously and unconsciously, were often influenced by their gender. While several men and women discussed the use of formal clothing to afford them greater respect and authority in the classroom, this was a less common strategy than it often is in other disciplines. A few women TAs used yelling, anger, or being "mean" to help students realize that they were in control. Others felt that the role of TA itself was enough to grant them the authority they needed. In contrast, several men graduate students felt that they were granted authority through their identities as (white) men – because of their size, deep voices, and "maleness."

Clothing

Similar to their strategies for gaining expertise, a common method used by both the men and women in my sample to gain authority in their classes was to dress "professionally," though many of the students I spoke with explained that their work in the laboratory made this choice impractical. Justin explained the reason for dressing up while teaching very clearly:

> I normally, at least for the first month, would wear a tie [when I taught]. After that, maybe just the button-up shirt or a nice polo…And it's a very visual line of demarcation. I am dressed nicely; you are dressed like college students. Let us clearly establish who's who here.
>
> - #9, Justin, Williams lab, white man

Justin felt that it was important to demonstrate to his students that he was the instructor in his classroom, which he accomplished visually through his clothing. Knowing that his students were likely to be dressed informally, he chose to dress more formally to

announce “who is who” in the classroom, presumably to let them know who had power and authority.

Similarly, Quan explained that early in the semester he wore nice clothing because he noticed that many of the professors seemed to dress nicely:

> If I'm teaching I will wear, I better wear a [nice, button-down] shirt. Like on the first day of class, I'm going to wear a shirt to be, to pretend to be important, professional. [laughs] But later I will change to t-shirts and stuff. …'cause [Professor Miller] or other instructors, they will dress up like that. So I had better follow, like at least not [look] too bad. So I'm trying to follow their example.
>
> - #22, Quan, Williams lab, Asian man

For Quan, the nice clothing he wore on the first few days of class acted as a type of professional “drag.” Since he recognized that his role was more like his professors’ than his students’, or at least he knew that he should be seen that way, he attempted to dress in such a way that he was perceived by his undergraduate students as similar to the faculty.

Isobel used a similar strategy early in the year, though she described the reasons that it changed as the semester went by:

> In the beginning I would dress up a little bit more. And then you get a few like nicer things destroyed, and then you're like “f” that….At first, I think it was like a professional slash like you're trying to say hey, I'm in charge and I have my shit together, like kind of request a little bit more respect maybe. … I think I've gotten to the point where I'm comfortable enough with most of the material that I present that it's not like, I don't feel like I need [clothes] as an additional crutch.
>
> - #12, Isobel, West lab, white woman

Isobel began the semester feeling that it might be useful to wear dressier clothes than her students both to exhibit her professionalism and to communicate to her students that she had the power in her classroom. However, given the realities of her lifestyle and the concerns that she (and many of her colleagues in chemistry) had about ruining their more sophisticated clothes, she quickly discarded the idea of dressing up to teach.

Mark chose to wear nice clothing to teach not to communicate his place in the classroom to his students, but to himself.

> [When I get dressed to teach I'm] maybe almost subconsciously thinking about like if you dress up at least a little bit that you somehow command some sort of respect. … I don't know about for you, but for me, sometimes, dressing up, gives you more self-confidence if you actually like feel put together that day rather than just throwing on your nearest pair of jeans and a t-shirt.
>
> - #5, Mark, Williams lab, white man

Like the graduate student presenters discussed earlier, Mark described the power of dressing to make himself feel smarter and more worthy of being listened to. For him, it was not so important that his clothes convey his authority to his students, but that his clothing made him feel that he was worthy of that authority, and thus, that he would be more effective as an authority figure.

Earlier, Isobel described the use of clothing as a "crutch" she used to make herself feel like an authority in the classroom. While men and women graduate students in my sample seemed equally likely to discuss using clothing as this sort of device, several other strategies they used to attain command of their undergraduate classes seemed much more connected to their gender.

Gendered Strategies

One of the clearest impression management strategies that the women in my study described was that of being "mean" to gain authority. For example, during an observation in the laboratory class she was supervising, Britney spoke warmly and kindly to all of her students. They worked well with one another and generally treated her with respect, and when I asked her whether she used any special methods to ensure this sort of respect, she explained that she "worked to establish authority during the first few weeks

by yelling at her students" (Classroom Observation 4.6.09). She felt that this method was an important one to lay out the ground rules and establish her standing among the students.

While several other women graduate students did not enter their teaching positions with the explicit strategy of being mean to gain control of their students and classrooms, they did discuss the fact that their style of emotional expression resulted in authority. Joan explained:

> [With] the students I've never had a problem with authority. … I think 'cause I'm mean [laughs] is why I've never had a student like try to even question my authority 'cause I'd shoot them down in a second, like "no".
> *So how are you mean?*
> I'm a stickler for the rules.
>
> - #11, Joan, Moore lab, white woman

Similarly, Rosie felt that she did not have an issue with authority in the classroom because her personality could be intimidating to students.

> [I'm] a hard ass from the beginning. I mean you come in, [and] it's all about tone. You just have to stand up on the first day of class and be like "I am in charge and these are the rules." Amazingly enough, that works. [laughs] …I don't think [establishing authority] was a problem for me because I can be very intimidating sometimes. I can be very like pointed. And if I'm pissed off about something, I will say I'm pissed off about this. And then they know I'm serious. So I usually don't have trouble with that kinda stuff because I will just use my frustration as a mechanism for gaining control.
>
> - #14, Rosie, West lab, white woman

Though research about emotions generally predicts that women are less likely to express anger than men are (Jansz 2000; Timmers, Fischer, and Manstead 2003), Rosie explained that she felt comfortable letting her students know when she feels irritated. Further, she capitalized on these feelings by allowing her students to see her anger, presumably so that they might fear her wrath. Men graduate students and postdocs, in contrast, did not cite

"meanness" strategies of this sort; at the most, they described approaches that involved being "more reserved and less friendly" at the beginning of the semester. While the women I observed might have seen their expressions of anger and "meanness" as a way to evoke more masculine styles of teaching, thus legitimating their scientific, classroom authority, these tactics might not pay off in the end. Given evidence that women professors are judged more harshly than men professors when they do not live up to feminine characteristics in the classroom, when they are "mean" rather than "warm and friendly" (Sprague and Massoni 2005), strategies such as Britney's, Joan's, and Rosie's could backfire if they continue to use them in permanent faculty positions that require tenure and promotion.[27]

Other than occasionally dressing more professionally to teach, many of the graduate students I spoke with explained that they did not have use any particular strategies to gain authority when they taught. For many of them, they felt that their authority emerged in large part from their personal or professional identities. However, men and women graduate students pinpointed different identities at work in this process: for the women, simply being a teacher, teaching assistant, or associated with the professor was enough to grant them authority; for the men, it was their masculinity, tall bodies, and deep voices.

Women graduate students were much more likely than men to identify aspects of their professional identity as contributing to their ability to gain authority in the classroom. For instance, Min said:

[27] Unfortunately, I did not have access to TAs' teaching evaluations, so I was unable to systematically compare men's and women's success in the classroom. There were no major gender differences in their qualitative accounts of their teaching success, however. Future studies of science graduate student teaching methods should explore this topic further.

> I think in most cases you will get authority automatically, even if you don't set up that on purpose, because they know you are going to grade their lab reports. They know, even if they don't respect you, they have to. [laughs]
>
> - #15, Min, West lab, Asian woman

Susan extended Min's explanation of how a "professorial" identity operated to increase authority. When asked if she was concerned about challenges to her authority in the classroom, she said:

> No. I mean, so I guess I worried about it before I started, but then once you're in that position, those students already respect you just because you're the teacher. And I mean it's not like high school….Everyone's choosing to be here. So they already think highly of you. And so as long as you maintain professionalism, then it's fine.
>
> #37, Susan, Moore lab, white woman

In Susan's view, students see teachers as fundamentally worthy of respect; thus, she believed that simply because of her position as their TA, her students granted her authority.

In contrast, though several of the men graduate students talked about how their identities impacted their authority in the classroom, they focused on personal identities rather than professional identities. Specifically, they talked about how their identity as men helped provide them with power while teaching. For instance, Blake told me that he did not have trouble with authority in the classroom, because he was "a big guy so [he] can kind of loom over most people, and it's pretty easy to establish authority, at least for [him], … [since] he doesn't have a problem being dominant" (#30, Mitchell lab, white man). In this instance, Blake believed that not only his identity but also his body size helped to compel his students to listen to him. By using the word "loom," Blake

emphasized the fact that it was not only his height, but also his strength and size that helped him to seem more assertive within the classroom.

While masculine bodies were important for creating authority in the classroom, masculine voices also helped. Ethan described this aspect of his identity as an important part of what helped to grant him authority:

> I sort of talk louder than everyone else, and I find that that works pretty well. And people sort of snap to attention when there's a deep, authoritative voice in the room, I've found.
>
> - #7, Ethan, Williams lab, white man

Similarly, Justin explained that he used to dress up to gain authority, but does not really do that much anymore. Instead:

> I never really had a problem with it. I mean part of it is when you're a white male with a deep voice, that's sort of an established authority trope. So I suspect if situations were different, there may have been other possibilities, but I got lucky.
>
> - #9, Justin, Williams lab, white man

In Justin's view, just being a white man with a deep voice granted him all of the authority he needed to teach his students; he recognized that if things were different, i.e., if he were a member of another identity group, he might need to work harder or use different strategies to ensure that his students listened to him. For Blake, Ethan, and Justin, gender and power is embodied in their height and in their voices. Bodies are often a source of power for men (Connell 1995), while they are often a source of anxiety for women (Young 2005), so my findings are not altogether surprising; however, they clearly demonstrate the fact that men's bodies act as a resource in these cases, while women's bodies do not. Though women must think about how to present themselves as powerful and authoritative in the classroom because they do not automatically get read in these ways, men's bodies may allow them to ignore these issues.

Conclusion

This study explored the topic of women in science from a unique angle, focusing on the dynamics of impression management and authority and expertise. This study examined the experiences of the day-to-day lives of men and women graduate students in chemistry, employing a reflexive, mixed methods, two-phase ethnographic approach. I found that both men and women graduate students and postdocs used impression management in their day-to-day interactions with students, peers, and faculty members. While there were some strategies that were used by both men and women (most notably, professional clothing choice), several others varied by gender.

My results showed that in group interactions, men are much more likely than women to use presentational styles that highlight their expertise and knowledge, while women are much more likely to downplay theirs. Using the common norms of asking questions in presentations and practice talks, many of the men graduate students and postdocs I observed emphasized their own understanding of a topic or a procedure through their inquiries, while women graduate students often put down their own knowledge as preamble when in similar situations. Further, when women acted as presenters, they were much more likely to use self-deprecating language to negate their own standing as an expert or to put down their finding as "just an accident." These results echo similar findings about gender communication styles described by Carli (1989). In contrast, when men graduate students or postdocs used self-deprecating language, they did so with humor, perhaps paradoxically reinforcing their own confidence in their skill by making a joke out of their failures (Robinson and Smith-Lovin 2001). Though these results can be read as blaming the victim (i.e., it is women's

fault that they are not seen as experts), it is important to note that these gender differences in interaction styles develop because of structural inequalities, which in turn affect the differential outcomes I have described here. These results also may provide important insights into another of the mechanisms through which women chemists-in-training are less likely to be seen as experts than are men (see chapter 2). Not only are women less likely to be seen as a "star" student, introduce new technology to the group, or to accept the label of "expert" when others place it upon them, but when they are in expert roles (i.e., when they present in front of their research groups), they are more likely to downplay their own knowledge and expertise.

One impression management strategy that was frequently described by both men and women chemists-in-training was the use of professional clothing to appear both more expert in group meetings and more authoritative while teaching. Since chemists often use harsh chemicals in the lab, many explained that they avoided "nice" clothing because it would simply be ruined, so "dressing-up" or wearing clothes that were more formal was a tactic that students and postdocs used to demonstrate that they deserved to be in front of the research group or class speaking about chemistry. For some, clothing acted as a way to communicate the distinction between themselves and the rest of the group or class, while for others, the clothing acted as a confidence boost. Indeed, given previous research suggesting that student misbehavior is less likely in courses taught by graduate student instructors who dress professionally, this strategy is likely to be an effective one (Roach 1997). On the other hand, some women students and postdocs faced concerns about suggestive clothing when choosing their attire, as well as possible consequences

that these types of clothes might have on others' evaluations of their knowledge and abilities.

Because professorial authority is still strongly linked with masculinity, at times, women graduate students used impression management strategies that aligned more with masculinity than with femininity in an attempt to succeed in a field in which unconscious bias is still the norm. This was evident in several women graduate students' choice to "act mean" in the classroom as a strategy to gain authority when they first began teaching. However, given research findings that demonstrate that women faculty members who do not live up to feminine standards of "being nice" are harshly judged by their students, this may have serious consequences for these women students, who may be much more likely to receive negative course evaluations and thus, might be impacted on the job market (Sprague and Massoni 2005). Further, impression management was more likely to be consciously undertaken by female graduate students. Whereas men graduate students felt that their masculinity or male bodies were enough to grant them authority, some (though not all) women graduate students felt that they needed to use other impression management strategies to demonstrate their authority to their undergraduates. This impression management can be understood as a form of unpaid "presentational labor" akin to the concept of emotional labor described by Hochschild (1983).

As these results reveal, not only are there differences in the ways that men and women engage in impression management techniques, but there are differences in the ways that these techniques function for individuals. For some, these strategies act as a way to present themselves to others: to communicate their identities as experts and

authorities. For others, impression management functions as a feedback mechanism: the strategy helps to reinforce the actor's belief about her own identity, and is therefore not simply a presentation to others. These differences have significant implications for gender, scientific expertise, and classroom authority, and thus, further research should be undertaken to explore this type of impression management.

Finally, it is of key importance to remember that the gender differences in interaction and impression management that I have described here primarily arise out of structural inequalities that persist in the workplace (and in other arenas). It is imperative that scholars and policy makers strive to fix the underlying structures that lead to these gender differences in interactions so that they will disappear and so that differential outcomes will as well.

References

Anderson, Kristin J., and Gabriel Smith. 2005. "Students' Preconceptions of Professors: Benefits and Barriers According to Ethnicity and Gender." *Hispanic Journal of Behavioral Sciences* 27(2):184-201.

Bachen, Christine M, Moira M McLoughlin, and Sara S. Garcia. 1999. "Assessing the Role of Gender in College Students' Evaluations of Faculty." *Communication Education* 48:193-210.

Basow, Susan A. 1995. "Student Evaluations of College Professors: When Gender Matters." *Journal of Educational Psychology* 87(4):656-665.

Becker, Howard S., and Anselm L. Strauss. 1956. "Careers, Personality, and Adult Socialization." *American Journal of Sociology* 62(3):253-263.

Beede, David, Tiffany Julian, and David Langdon. 2011. *Women in STEM : A Gender Gap to Innovation*. Washington, DC.

Bird, Sharon R. 2011. "Unsettling Universities' Incongruous, Gendered Bureaucratic Structures: A Case-study Approach." *Gender, Work & Organization* 18(2):202-230.

Brody, Leslie. 2000. "The Socialization of Gender Differences in Emotional Expression: Display Rules, Infant Temperament, and Differentiation." Pp. 24-47 in *Gender and Emotion: Social Psychological Perspectives*, edited by Agneta Fischer. Cambridge: Cambridge University Press.

Butler, Judith. 1990. *Gender Trouble: Feminism and the Subversion of Identity*. New York: Routledge.

Carli, Linda L. 2006. "Gender Issues in Workplace Groups: Effects of Gender and Communication Style on Social Influence." Pp. 69-83 in *Gender and Communication at Work*, edited by Mary Barrett and Marilyn J. Davidson. England: Ashgate Publishing Limited.

Carli, Linda L. 1989. "Gender Differences in Interaction Style and Influence." *Journal of Personality and Social Psychology* 56(4):565-576.

Chesler, Mark, and Alford A. Young Jr. 2007. "Faculty Members' Social Identities and Classroom Authority." *New Directions for Teaching and Learning* 111:11-19.

Citrin, Laura B., Tomi-Ann Roberts, and Barbara L Frederickson. 2004. "Objectification Theory and Emotions: A Feminist Psychological Perspective on Gendered Affect." Pp. 203-223 in *The Social Life of Emotions*, edited by Larissa Z. Tiedens and Colin W. Leach. New York: Cambridge University Press.

Clegg, Sue, Deborah Trayhurn, and Andrea Johnson. 2000. "Not Just For Men : A Case Study of the Teaching and Learning of Information Technology in Higher Education." *Higher Education* 40:123-145.

Conefrey, Theresa. 1997. "Gender, Culture and Authority in a University Life Sciences Laboratory." *Discourse & Society* 8(3):313-340.

Connell, R. W., and James W. Messerschmidt. 2005. "Hegemonic Masculinity: Rethinking the Concept." *Gender & Society* 19(6):829-859.

Connell, R.W. 1987. *Gender and Power: Society, the Person and Sexual Politics*. Stanford, California: Stanford University Press.

Connell, R.W. 1995. *Masculinities*. Berkeley: Blackwell Publishers.

Cooley, Charles Horton. 1902. *Human Nature and the Social Order*. New York: Charles Scribner's Sons.

Davies, Bronwyn, and Rom Harre. 1982. "Positioning: The Discursive Production of Selves." *Journal for the Theory of Social Behaviour* 20(1):43-63.

Davis, Fred. 1992. *Fashion, Culture, and Identity*. Chicago: University of Chicago Press.

Deutsch, Francine M. 2007. "Undoing Gender." *Gender & Society* 21(1):106-127.

Donaldson, Mike. 1993. "What is Hegemonic Masculinity?" *Theory and Society* 22(5):643-657.

Eagly, Alice H., Mona G. Makhijani, and Bruce G. Klonsky. 1992. "Gender and the evaluation of leaders: A meta-analysis." *Psychological Bulletin* 111(1):3-22.

Eagly, Alice H., and Steven J. Karau. 2002. "Role Congruity Theory of Prejudice Toward Female Leaders." *Psychological Review* 109(3):573-598.

Emerson, Robert M., Rachel I. Fretz, and Linda L. Shaw. 1995. *Writing Ethnographic Fieldnotes*. Chicago: University Of Chicago Press.

Etzkowitz, Harry, Carol Kemelgor, and Brian Uzzi. 2000. *Athena Unbound: The Advancement of Women in Science and Technology*. Cambridge, UK: Cambridge University Press.

Fernandez, Roberto M., and M. Lourdes Sosa. 2005. "Gendering the Job: Networks and Recruitment at a Call Center." *American Journal of Sociology* 111(3):859-904.

Finson, Kevin D. 2002. "Drawing a Scientist: What We Do and Do Not Know After Fifty Years of Drawings." *School Science and Mathematics* 102(7):335-345.

Fischer, Agneta H. 1993. “Sex Differences in Emotionality: Fact or Stereotype?” *Feminism & Psychology* 3(3):303-318.

Freitas, Anthony, Susan Kaiser, Joan Chandler, Carol Hall, Jung-Won Kim, and Tania Hammidi. 1997. “Appearance Management as Border Construction: Least Favorite Clothing, Group Distancing, and Identity Not!” *Sociological Inquiry* 67(3):323-335.

van Gennep, Arnold. 1909. *The Rites of Passage*. Chicago University Press.

Goffman, Erving. 1979. *Gender Advertisements*. Cambridge: Harvard University Press.

Goffman, Erving. 1959. *The Presentation of Self in Everyday Life*. New York: Double Day.

Haas, Jack, and William Shaffir. 1977. “The Professionalization of Medical Students: Developing Competence And A Cloak of Competence.” *Symbolic Interaction* 1:71-88.

Hill, Catherine, Christianne Corbett, and Andresse St. Rose. 2010. *Why So Few? Women in Science, Technology, Engineering, and Mathematics*. Washington, DC.

Hochschild, Arlie Russell. 1983. *Managed Heart: Commercialisation of Human Feeling*. Berkeley and Los Angeles: University of California Press.

Hunt, Scott A, and Robert D Benford. 1994. “Identity Talk in the Peace and Justice Movement.” *Journal of Contemporary Ethnography* 22(4):488-517.

Hunt, Scott A, and Kimberly A Miller. 1997. “The Discourse of Dress and Appearance: Identity Talk and a Rhetoric of Review.” *Symbolic Interaction* 20:69-82.

Ingersoll, Richard M., and David Perda. 2004. “The Status of Teaching as a Profession.” Pp. 106-118 in *Schools and Society*, edited by Jeanne H. Ballantine and Joan Z. Spade. Belmont, CA:: Wadsworth/Thompson Learning.

Jansz, Jeroen. 2000. “Masculine Identity and Restrictive Emotionality.” Pp. 166-186 in *Gender and Emotion: Social Psychological Perspectives2*, edited by Agneta H. Fischer. Cambridge: Cambridge University Press.

Karp, David A., Lynda Lytle Holmstrom, and Paul S. Gray. 1998. “Leaving Home for College: Expectations for Selective Reconstruction of Self.” *Symbolic Interaction* 21(3):253-276.

Keller, Evelyn Fox. 1985. *Reflections on Gender and Science*. Binghamton, NY: Yale University.

Kierstead, Diane, Patti D'Agostino, and Heidi Dill. 1988. "Sex Role Stereotyping of College Professors: Bias in Students' Ratings of Instructors." *Journal of Educational Psychology* 80(3):342-344.

Leary, Mark R. 1996. *Self-Presentation*. Madison: Westview Press.

Lincoln, Anne E. 2010. "The Shifting Supply of Men and Women to Occupations: Feminization in Veterinary Education." *Social Forces* 88(5):1969-1998.

Martin, Elaine. 1984. "Power and Authority in the Classroom: Sexist Stereotypes in Teaching Evaluations." *Signs* 9(3):482-492.

Mast, Marianne Schmid, and Judith A. Hall. 2004. "Who Is the Boss and Who Is Not? Accuracy of Judging Status." *Journal of Nonverbal Behavior* 28(3):145-165.

McHugh, Maureen C, and Jennifer Hambaugh. 2010. "She Said, He Said: Gender, Language, and Power." Pp. 379-410 in *Handbook of Gender Research in Psychology*, edited by Joan C. Chrisler and Donald R. McCreary. New York, NY: Springer New York.

Mead, George Herbert. 1934. *Mind, Self, and Society: From the Standpoint of a Social Behaviorist*. Chicago: University of Chicago Press.

Merton, Robert King. 1957. *The Student-Physician; Introductory Studies in the Sociology of Medical Education*. Cambridge: Harvard University Press.

Misra, Joya, Jennifer Lundquist, Elissa Dahlberg Holmes, and Stephanie Agiomavritis. 2011. "The Ivory Ceiling of Service Work." *Academe - Bulletin of the AAUP* 97(1):22-26.

NSF. 2009. "Survey of Graduate Students and Postdoctorates in Science and Engineering." Retrieved (http://www.nsf.gov/statistics/srvygradpostdoc/).

Owen-Smith, Jason. 2001. "Managing Laboratory Work through Skepticism: Processes of Evaluation and Control." *American Sociological Review* 66(3):427.

Pierce, Jennifer L. 1996. *Gender Trials: Emotional Lives in Contemporary Law Firms*. University of California Press.

Pratt, Michael G., and Anat Rafaeli. 1997. "Organizational Dress as a Symbol of Multilayered Social Identities." *The Academy of Management Journal* 40(4):862.

Rafaeli, Anat, Jane Dutton, Celia V. Harquail, and Stephanie Mackie-Lewis. 1997. "Navigating by Attire: The Use of Dress by Female Administrative Employees." *The Academy of Management Journal* 40(1):9.

Ridgeway, Cecilia L. 2001. "Gender, Status, and Leadership." *Journal of Social Issues* 57(4):637-655.

Ridgeway, Cecilia L. 1993. "Gender, Status, and the Social Psychology of Expectations." Pp. 175-198 in *Theory on Gender/Feminism on Theory*, edited by Paula England. New York: Aldine Press.

Ridgeway, Cecilia L., and Shelley J Correll. 2000. "Limiting Inequality through Interaction: The End(s) of Gender." *Contemporary Sociology* 29(1):110-120.

Roach, K. David. 1997. "Effects of Graduate Teaching Assistant Attire on Student Leaming, Misbehaviors, and Ratings of Instruction." *Communication Quarterly* 45(3):125-141.

Roach, Mary Ellen, and Joanne Bubolz Eicher. 1965. *Dress, Adornment and the Social Order*. New York: John Wiley & Sons, Inc.

Robinson, Dawn T., and Lynn Smith-Lovin. 2001. "Getting a Laugh: Gender, Status, and Humor in Task Discussions." *Social Forces* 80(1):123-158.

Rubinstein, Jonathan. 1973. *City Police*. New York: Farrar, Straus and Giroux.

Sandler, Bernice Resnick. 1991. "Women Faculty at Work in the Classroom, or Why it Still Hurts to be a Woman in Labor." *Communication Education* 40(1):6-15.

Shields, Stephanie A. 2000. "Thinking About Gender, Thinking About Theory: Gender and Emotional Experience." in *Gender and Emotion: Social Psychological Perspectives*, edited by Agneta Fischer. Cambridge: Cambridge University Press.

Sprague, Joey, and Kelley Massoni. 2005. "Student Evaluations and Gendered Expectations: What We Can't Count Can Hurt Us." *Sex Roles* 53(11-12):779-793.

Steinpreis, Rhea E., Katie A. Anders, and Dawn Ritzke. 1999. "The Impact of Gender on the Review of the Curricula Vitae of Job Applicants and Tenure Candidates: A National Empirical Study." 41(7/8):509-528.

Thomas-Hunt, Melissa C, and Katherine W Phillips. 2004. "When What You Know is Not Enough: Expertise and Gender Dynamics in Task Groups." *Personality & social psychology bulletin* 30(12):1585-98.

Tiedens, Larissa Z., Phoebe C. Ellsworth, and Batja Mesquita. 2000. "Sentimental Stereotypes: Emotional Expectations for High-and Low-Status Group Members." *Personality and Social Psychology Bulletin* 26(5):560-575.

Timmers, Monique, Agneta H. Fischer, and Antony S.R. Manstead. 2003. "Ability versus Vulnerability: Beliefs about Men's and Women's Emotional Behaviour." *Cognition and Emotion* 17(1):41-63.

Trudgill, Peter. 2001. *Sociolinguistics: An Introduction to Language and Society*. London: Penguin.

Turner, Victor Witter. 1969. *The Ritual Process: Structure and Anti-Structure*. New Brunswick, NJ: Aldine.

U.S. News and World Reports. 2010. "Best Chemistry Programs, Top Chemistry Schools, Best Graduate Programs." Retrieved (http://grad-schools.usnews.rankingsandreviews.com/best-graduate-schools/top-science-schools/chemistry-rankings).

Wenneras, Christine, and Agnes Wold. 1997. "Nepotism and Sexism in Peer-Review." *Nature* 387:341-343.

West, Candace, and Don H Zimmerman. 1987. "Doing Gender." *Gender & Society* 1(2):125-151.

Willis, Paul. 1977. *Learning to Labor: How Working Class Kids Get Working Class Jobs*. New York: Columbia University Press.

Winkler, Julie A. 2000. "Faculty Reappointment, Tenure, and Promotion: Barriers to Women." *Professional Geographer* 52(4):737-750.

Xie, Yu, and Kimberlee A. Shauman. 2003. *Women in Science: Career Processes and Outcomes*. Cambridge: Harvard University Press.

Young, Iris Marion. 2005. "Throwing Like a Girl: A Phenomenology of Feminine Body Comportment, Motility, and Spatiality." Pp. 27-45 in *Female Body Experience*. New York: Oxford University Press.

Chapter 5

Conclusion

The overall objective of this dissertation project was to examine gender, expertise, authority, and impression management in a scientific environment, in order to better understand some possible factors that influence women's underrepresentation in STEM disciplines. While previous studies investigating barriers to women's success in these fields have explored topics such as the chilly climate in science (Blickenstaff 2005), lack of role models (Etzkowitz, Kemelgor, and Uzzi 2000), and career-family balance (Savage and Fouad 1994), this dissertation provides insight into several possible mechanisms through which structural inequalities have led to gender differences in interaction that in turn may impact women's scientific and professional achievement. These topics are of particular importance given previous scholarship that has demonstrated the impact of negative assessments of women's authority in the classroom on student evaluations (Sprague and Massoni 2005), as well as research demonstrating the devaluation of women's scientific accomplishments and expertise in comparison with their men colleagues' (Wenneras and Wold 1997; Fox 2001). Taken together, the findings of these studies highlighted the need for further investigation into the day-to-day processes that produce several of the more subtle inequalities that women face in academic, scientific workplaces.

In this study, I focused specifically on the experiences of scientists-in-training (i.e., graduate students and postdocs) because of their particular position as individuals currently in the process of being professionalized into disciplinary norms. I also chose to investigate these topics in the field of chemistry due to its gender demographics: while it is currently still numerically male-dominated (in terms of faculty), the proportion of women graduate students in chemistry has increased dramatically and continues to show great improvements. This unique sample allowed for insights into a discipline that is currently shifting in its gender demographics, yet many of my findings are applicable to other research contexts.

Each of the three empirical chapters in this dissertation examined gender and interaction as it pertained to either scientific expertise or authority (or both). In the first empirical chapter, I investigate men and women graduate students' and postdocs' expectations of expertise, and discuss several outcomes of these expectations. I argue that overall, men are more likely than their women peers to be seen as experts in chemistry. This is due to a greater likelihood of being seen as highly knowledgeable or as "star" students, an increased likelihood of gaining particular knowledge of new machinery or instruments, and a greater willingness to volunteer knowledge or accept others' definitions of themselves as "experts" in group settings. As a result, men graduate students benefit from more practice with skills that will be directly applicable to their future careers: applying knowledge pertaining to their discipline to relevant questions and communicating this information to others clearly and comprehensibly.

In Chapter Three, I use theories of gender and gender performance to delve into the topic of masculinity and science more fully. I focus on the socialization process

experienced by graduate students and postdoctoral fellows, and compare these to the highly competitive, masculinized socialization described by Sallee (2011), Traweek (1988) and others. I contend that while the practices they describe are still at work in chemistry, they function differently for men and for women. The link between men, male bodies, science, and academia creates a context in which they do not need to work as hard to establish their claim to scientific authority. As a result, men are able to perform masculinity in varied and complex ways. Conversely, women, who do not embody masculinity and who are still relatively new to scientific contexts, feel more pressure to conform to strict norms of competition and hierarchy associated with traditional masculinity and science.

Finally, in the last chapter I discuss the impression management strategies that men and women chemists-in-training use to navigate scientific authority and expertise in the classroom, the laboratory, and during group meetings. My findings demonstrate that both men and women use impression management strategies, and while some (specifically, professional clothing choice) did not differ by gender, others did. Specifically, men are more likely than women to employ interactional styles that featured their expertise when they were in group situations, while women are more likely to underestimate or minimize theirs. In contrast, while teaching, women do occasionally use impression management styles that seem more aligned with masculinity than with femininity (e.g., acting "mean"), though this style of presentation also comes with its associated risks. Finally, men graduate students are more likely to feel that their bodies remove the need for impression management strategies in the classroom because simply being male or masculine grants them authority.

This dissertation contributes to current sociological literature in several ways. First, it provides important insights into the world of academic science through the lens of gender, authority, expertise, and impression management. My findings highlight the importance of how students judge their TAs' (or professors') authority, how an advisor (or peer) evaluates a graduate student's knowledge and expertise, and the many ways that individuals in these contexts use various strategies to affect these assumptions. As many decisions about faculty members' promotion and tenure are influenced by their students' and peers' evaluations of their abilities, any gendered bias in both these decisions and the behaviors that affect them are imperative to understand and document so that they may be taken into account. Graduate students influence others' evaluation of their authority and expertise through conscious and unconscious impression management, yet few comprehensive studies of impression management in the workplace have been conducted to date, and none to my knowledge have explored issues of authority and expertise or have focused on scientific contexts.

Additionally, very few ethnographic studies of scientists have focused on gender and gendered interactions; thus, this study provides valuable insight into the day-to-day experiences of women (and men) as they are socialized into a STEM discipline. Women's difficulty in STEM programs and careers has been an area of great concern to researchers and policy-makers alike, and thus increased knowledge about the barriers to their success will be useful for both training and personnel purposes. Finally, the findings of this study have implications for workplaces beyond academia and the natural sciences. The relationship between authority, expertise, competition, and impression management explored here is likely to apply to many other workplace contexts. The

effect of gender on this relationship is similarly likely to extend to other male-dominated workplaces and perhaps to male-dominated contexts in general, such as gyms or sporting events. Given our country's commitment to equality in wages for women; impression management and the unpaid labor that it entails is an extremely important topic of investigation.

My findings also suggest important implications for future research. This study used a case study approach to investigate the experiences of scientists-in-training in a particular discipline in a comprehensive and thorough manner. This approach allowed for an interesting comparison to research by other scholars who had explored different disciplines (such as Traweek, Sallee, and others), but given that these results focus on the experiences within chemistry, it is difficult to extrapolate to other fields and predict how other cases may or may not differ. Further, given that my findings do suggest that graduate socialization and training may be different for men and women in scientific disciplines with higher proportions of women, future studies should examine expertise, authority, and impression management in scientific disciplines which have larger proportions of women, such as biology or medicine. Further, additional studies exploring these topics outside of STEM disciplines, preferably in both numerically male-dominated non-STEM fields (such as economics or philosophy) and more gender-balanced ones (such as education and English), would help to further disentangle the effects of scientific norms versus the effects of tokenism and the underrepresentation of women.

This study focused specifically on the process of socialization and the graduate student experience because this time period in the scientist's academic career was seen as a particularly helpful vantage point through which they could identify and describe

academic norms. Literature on professionalization supports this view, yet laboratory and research group dynamics are difficult to describe without discussing the principal investigator's behaviors and thoughts and the influence these had on their groups. Unfortunately, I was unable to fully incorporate this type of data into the current study due to concerns regarding both anonymity and confidentiality. However, using different sampling techniques, further research into the processes I described might expand their emphasis to include the views of faculty members, as well.

Finally, given this study's findings regarding the relationship between gender and expertise, future research exploring gender differences in understandings and expressions of expertise conducted by both men and women researchers seem called for. Since there is evidence that the gender of interviewers can affect participants' responses regarding topics related to gender and sexuality (Catania et al. 1996; Huddy et al. 1997), research studies involving both men and women interviewers would be helpful to ensure that these affects are taken into account as much as possible.

References

Blickenstaff, Jacob Clark. 2005. "Women and Science Careers: Leaky Pipeline or Gender Filter?" *Gender and Education* 17(4):369-386.

Catania, Joseph A. Diane Binson, Jesse Canchola, Lance M. Pollack, Walter Hauck, and Thomas J. Coates. 1996. "Effects of Interviewer Gender, Interviewer Choice, and Item Wording on Responses to Questions Concerning Sexual Behavior." *Public Opinion Quarterly* 60:345-375.

Etzkowitz, Harry, Carol Kemelgor, and Brian Uzzi. 2000. *Athena Unbound: The Advancement of Women in Science and Technology*. Cambridge, UK: Cambridge University Press.

Fox, Mary Frank. 2001. "Women, Science, and Academia: Graduate Education and Careers." *Gender & Society* 15(5):654-666.

Huddy, Leonie, Joshua Billig, John Bracciodieta, Patrick J Moynihan, and Patricia Pugliani. 1997. "The Effect of Interviewer Gender on the Survey Response." *Political Behavior* 19(3):197-219.

Sallee, Margaret W. 2011. "Performing Masculinity: Considering Gender in Doctoral Student Socialization." *Journal of Higher Education* 82(2):187-216.

Savage, Claire T., and Nadya A. Fouad. 1994. "Traditionality of College Major and Attitudes Towards Work-Family Balance: Vocational Correlates." *Journal of Career Assessment* 2(2):163-178.

Sprague, Joey, and Kelley Massoni. 2005. "Student Evaluations and Gendered Expectations: What We Can't Count Can Hurt Us." *Sex Roles* 53(11-12):779-793.

Traweek, Sharon. 1988. *Beamtimes and Lifetimes: The World of High Energy Physicists*. Harvard University Press.

Wenneras, Christine, and Agnes Wold. 1997. "Nepotism and Sexism in Peer-Review." *Nature* 387:341-343