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Underneath it all: gender role identification and women chemists' career choices

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Abstract
This paper describes results from a study on the career choices of women earning doctorates in chemistry in the United States. Presented here are findings related to the participants' identification with traditional female gender roles and expectations for behavior in the male-dominated field of chemistry. Underlying a career decision-making model are the traditional gender roles women participants struggled with as they evaluated different careers in chemistry. Many of the participants envisioned being the primary caretakers for their future families and wanted careers that would accommodate this lifestyle. Findings of note include the freedom from traditional female gender roles exhibited by the lesbian participant, the views towards future familial responsibilities exhibited by both the participants in a relationship and those who were single, and the conflict between feminine personality traits and observed mannerisms of women faculty members. The challenge for research-focused chemistry departments in the United States lies in making departmental culture more supportive of families, more accommodating of the need for work-life balance, and more accepting of traditionally feminine mannerisms and behaviors.
Keywords: career choice, gender roles, graduate education, culture of science, chemistry

Introduction
Despite the growing number of women earning chemistry bachelor's degrees in the United States, there are steep drop-offs in the number of women earning doctorates in chemistry and moving on to academic careers at high research activity universities. The number of degree earners and faculty members has been documented extensively (Marasco, 2006; National Science Foundation, 2011; Raber, 2010), yet there is little qualitative understanding of the career decision-making process for American women earning doctorates in chemistry. What has been published has been based on the experiences of women who are established in their careers as professors (Bentley & Adamson, 2003; Packard, 2002; Rosser & Lane, 2002; Schiebinger, 1999; Sears, 2003).

The National Research Council recently published a report highlighting the need to more closely examine what influences women's career decision-making process during the transition from earning a doctorate in chemistry to starting employment as a chemistry professional. This report (2009) found that between 1999 and 2003, 32% of doctoral

chemistry graduates in the United States were women, yet women made up only 18% of the applicants for tenure-track academic research positions in chemistry. Women seem to be self-selecting out of these research-intensive careers in chemistry, opting instead to enter industrial, teaching, lab coordinator, or non-tenure track positions.

One of the most significant barriers facing women in academia is their role as primary caretakers for children and the elderly (Rosser & Lane, 2002). A career as a scientist has been based on the assumption that a man would have a wife who would be the homemaker. This freed the man to work long hours and devote most of his life to science (Rolison, 2003). This is no longer the case with the rise of the two-professional family and the professional woman. Unfortunately, this historical remnant poses a larger obstacle for women than men for a number of reasons (Workman & Bodner, 1996). While the scientists have changed, the expectations to put in long hours and to be single-mindedly devoted to a career have not. This makes it difficult to balance work and family. Compounding the problem is the fact that women academics tend to marry men academics, while the reverse does not hold true (Rosser & Lane, 2002). Although both have high-powered careers, the woman must make more sacrifices than the man because she is still considered the primary caregiver. Being a married man and having children is associated with gaining tenure faster and being a more productive scientist. For women, being married and having children hinders their career, especially if women have children prior to earning tenure (Bentley & Adamson, 2003; Long, 2001; Schiebinger, 1999).

It seems that the choice facing women graduating with doctorates in chemistry is an academic research career or a family, but not both, unless the family waits ten years. This perception is reflected by most of the women professors in chemistry departments. Young professors are typically unmarried and women are usually into their late thirties before having children. The role models for balancing a highly successful career with a family are few and far between (Sears, 2003). Additionally, most research-intensive institutions look for postdoctoral fellowships when hiring new faculty, postponing a family for one to two more years (Kulis, *et al.*, 2002). To a young woman, this often seems like a high price to pay for a career, making other options such as industry or teaching institutions seem much more appealing (Sears, 2003). Considering this, it is not shocking that few women are interested in applying for positions at research-intensive universities.

The findings presented here come from a larger study on the career decision-making processes of women in the United States earning doctorates in chemistry. This study, which generated data from graduate students, faculty at research-intensive universities, and faculty at teaching-intensive universities, led to the development of a career choice model (Grunert & Bodner, 2011a, 2011b). Of particular importance was the finding that the decision-making process for the participants was a complex, active process, rather than passively "leaking" from the pipeline. Underlying the many factors that the women in the study considered were their identification with traditional gender roles, the conflict between caretaking expectations and career expectations, and the mannerisms and behaviors they felt female research faculty exhibited. These findings are discussed here from the graduate students' perspectives.

Research Questions

The guiding research questions for this study were:

1. What factors do women earning chemistry doctorates in the United States consider when making career decisions?
2. What are female chemistry doctoral students' perceptions of different careers?
3. What motivates women's career choices in chemistry?

Methods and Methodology

Theoretical Framework

Standpoint feminism was selected as the theoretical framework for this study because the goal is to understand women as individuals and as a social category (Brooks, 2007; Harding, 2007). As female students within chemistry, the participants share a common set of experiences. Through the telling of their stories, we can generate an understanding of what it is like to be a woman in chemistry and how women in chemistry make career decisions. Using a feminist framework emphasizes participatory, collaborative, change-oriented, and empowering forms of inquiry (Reinharz, 1992). Participants actively constructed and re-shaped their opinions and knowledge through participation in this study, because the interview process forced them to examine their perceptions and beliefs. They constructed new meaning for themselves by talking with the researcher. By exploring their views of different careers and their experiences, they generated knowledge for and came to a better understanding of themselves.

Participants

Participants were recruited from two different large, research-focused Midwestern universities using email list-servs through the chemistry department and women's chemistry groups. All participants were one to two years away from completing their doctorate in chemistry. Four participants came from University of X, which had 9% women faculty in their chemistry department at the time this study was conducted. Six participants came from University of Z, which had 20% women faculty in their chemistry department at the time this study was conducted. From a national survey of high research activity chemistry departments, these universities represented the ends of the spectrum in terms of representation of women amongst tenured and tenure-track chemistry faculty (Marasco, 2006).

Seven of the ten participants were White, two were African-American, and one was Latina (Puerto Rican). As it is relevant to these findings, the participants are organized by relationship status below, using their pseudonyms. For the participants in a relationship, Eva and Rebecca were married for the duration of the study, Sarah was engaged at the start of the study and got married while the study was ongoing, Julie was in a same-sex committed relationship for the duration of the study, and Natalie started the study engaged but separated from her fiancée during the course of the study. Amanda was previously married, but had gotten divorced before this study started. With the exception of Natalie, all of the single participants were not in a relationship for the duration of the study.

Table 1. Summary of participants and relationship status.

Married with Children	In a Relationship	Single
Michelle	Sarah	Kara
	Eva	Imani
	Rebecca	Amanda (divorced)
	Julie (same-sex)	Keisha
	Natalie (beginning of study)	Natalie (end of study)

The study design and data collection methods were approved by the researcher's Institutional Review Board and complied with accepted protocols for human subject research. Participant consent was obtained from all participants, and they were provided with a copy of the consent form and contact information for the Institutional Review Board.

Data Collection

Three unique interviews were conducted with each of the participants. Depending on participant preferences, these interviews occurred in coffee shops, cafés, or a designated

interview room within a chemistry building. All interviews were audio recorded and later transcribed verbatim by the researcher. The participants reviewed their transcripts and were allowed to clarify statements or request that sections be omitted from analysis. None of the graduate student participants requested the omission of data.

Data Analysis

Constructivist grounded theory (Charmaz, 2003) guided the data analysis methods for this study. Following transcription of the interview data, the researcher used constructivist grounded theory methods, including coding, comparing themes, writing memos, additional participant recruitment, and multiple model iterations, to develop a model of career decision-making for women earning doctorates in chemistry. Constructivist grounded theory uses a reiterative, cyclical method of data analysis to generate theory. The researcher needs to gain a sense of and interpret the whole body of data, rather than parts and pieces. It seeks to organize and order the data to come to a conceptual representation that explains the phenomena under study. The final product is an analytic explanation and a testable theoretical model. It accounts for variation amongst participants and populations, and can be modified to fit emerging analyses and new data. In this study, the researcher built connections between existing literature and developed a model for understanding the career choices of women in chemistry.

Themes

The themes discussed below show how traditional gender roles factor into the participants' decision-making with regards to careers in chemistry. These gender roles affect their visions for their future lives with regards to having a family, as well as what qualities they would need to have to be successful in a research-focused chemistry department.

Wanting to have time to spend with family and children

One of the driving factors underlying the participants' career choices was the desire to have a personal life outside of their career. For the participants without children (single and in a relationship), there was a strong focus on finding a career that was family-friendly and would allow balance between a career and family/personal life. This was a personal value for these participants, and they viewed sacrificing family and personal time for their career as a cost or stress to self. This was most often described in terms of their interest in spending time with family and children, regardless of current relationship status. These women wanted a career and were willing to continue working hard to be successful, but not at the expense of time for themselves, their significant others, or their (future) children. These women identified with traditional female gender roles, where they would be the primary caretaker, with the exception of Julie, who is described later. Rebecca (married), Eva (married), and Michelle (married with children) described their roles in their families.

> Rebecca: ...I think that being a woman has affected my experience only in a really career- oriented fashion, because of the traditional roles that women play in society concerning family...I would say that looking for a career that has some flexibility that would accommodate other priorities like family is something that will be very important when I look into a career because that, for me, it really makes me think twice about choosing a career that is extremely time and work intensive.

> Eva: It's because everybody do it, so...if you don't do it, you're the outlier and you're wrong, because you have to work 24/7, and I tried to do it when I was single, but now that I'm married, I cannot do that. Otherwise I don't have time...with my husband...I was a late person, I could be in the lab until four or five in the morning, I don't care, I didn't have anybody waiting for me, but now I have to be at home by like 6, to make dinner and just to spend a few hours with my husband, so I have to come in earlier, and my body doesn't really get set that well, it's just...more constricted now, 'cause I used to just come in

> and be here, I didn't care, but now, and I have to clean more, you know, and try to keep things more organized, not like I didn't care so much before, but now I have to.
>
> Michelle: ...also, because I'm a woman, I do have...maternal mommy responsibilities, and it's not, I don't really feel like it's the same as a man. You know, I still have to come home and cook dinner...and I do have a very supportive husband, but I mean, at the end of the day, I still have to manage and do all the mommy stuff as well, and it's just...hard. I don't have a lot of role models to look at. I don't know anybody that does that...to be that kind of professor you have to really be super dedicated. The hours they work, especially when they're trying to get tenure. That process, you like have no life. And, I like my life. I like going home and watching TV with my husband and getting in the hot tub and having wine and I don't wanna give that up. That's, I value that! I don't wanna give that up. That's more important to me than being some great research professor, which somebody might say I don't have ambitions. It's not that I don't have ambitions, it's just that I have to be practical.

When describing their views of an academic career at a research-intensive university, the participants talked about the long hours they felt they would be expected to work. The common belief was that success at a research-focused school required 70 to 80 hour work weeks, complete commitment to scientific research, and delaying starting a family until after tenure. The following quotes from Kara (single), Imani (single), Natalie (engaged to single), and Eva (married) highlight this perception.

> Kara: ...the problem with academia is you can work as much as you want or as little as you want, you know, and I feel like...it's not like this is work time and this is home time...I watch my sister...she feels awful about leaving her kid at daycare. ...[it] seems like, you know, you look at some of the faculty and it takes some kind of traumatic events before they really start staying home. And 80 hours a week for the rest of my life? Just, I don't wanna do it. I know that wherever I work there will be weeks where you have to do that, you know, maybe for a month or maybe two at a time. But then there is also going to be times when you can do your forty hours and go home.
>
> Imani: I guess it would be the lifestyle [that's unappealing]. My advisor isn't the best example, but whenever they're in town, they're in the lab working. And I was initially surprised to learn that they had kids...but I guess that was done early on, but I guess, right now as a graduate student, I'm always in the lab, and I don't mind that right now, but later, I wouldn't want to do that.
>
> Natalie: I don't want to be at work 80 hours a week. Like I understand that there'll be grading to take home or you know, notes for the next day to look over, that sort of thing....but I'd like to remember what my husband looks like...I'd like to see my kids grow up, I'd like to be able to...take off a couple of weeks in the summer while they're on school break and go somewhere, see somebody, you know, that sort of thing. So that aspect of the whole teaching thing is also nice.
>
> Eva: ...I wouldn't like to deal with coming to work on weekends. Saturdays are okay, but definitely not Sundays...if I had a lab in academia, you know, I would have to become, I don't have a problem working from home, or if I were in a small college as a professor, I don't have a problem with that, I can prepare my classes and all that at home, but just having to come into the lab every time, that's what I don't [like]. I don't want to be like professors that spend the majority of their time in the lab then, with their family just at home.

Sarah talked about feeling like she would end up repeatedly delaying starting a family if she went into a research career. When weighing her options, she decided it was more important to her to have a family than sacrifice it for her career.

> It seems like it...takes so much out of your life to do that kind of research, that if you want to start talking about...having kids or having a family, juggling that on top of trying to get tenure and you know, trying to do really good science is, just seems, you know, impossible. Or it seems very, very hard, and...I don't want to be that person who keeps putting off having a family until the next thing...I'm getting married in October. And, you know, we're obviously not planning on having kids during graduate school, but….

Michelle, who is married with children, talked about wanting to have time with her family. She felt she would have to give up time with her husband if she were to pursue a career at a research-intensive university.

> I like spending time with my husband, you know, I value my family time. I value going home in the evening. I value sleeping in the same bed with my man at night...One of the things we promised ourselves was that we were gonna sleep in the same bed with one another every night, you know? It makes me feel secure and stable...I like that routine, it's a must have in my life. And I feel like...that would be compromised. …I value downtime. I value sitting on the couch with my husband in the evening, you know?

Eva is originally from Puerto Rico, and she contrasted the expectations at American research universities compared to those in Puerto Rico. She felt that the model of success in the United States placed too much focus on competition and devotion to career rather than being supportive of family life.

> I was even reading an article about power couples in research, that have published over three-, four-hundred papers, and been cited over 30,000 times by different people, and they are trying to give tips on how to have a balance between life and family, and their balance is like, one of them said, 'yes, we had three nannies and they would be taking care of the kids like 24/7 so that we can...do our own thing,' and they think that is great. And that...their time with their kids was like, 'yes, we'll go to the study room to work on the computers all together, so we're all together working and doing homework,' that's their family time. I don't see myself doing that, no. I wouldn't sacrifice that...[in Puerto Rico] I think there's more balance because, I guess there's not as much competition as there is here. And just in the culture in general it's more relaxed or something. People are not gonna look bad at you if you take a weekend off to go out with your family, as here, I feel embarrassed if I don't come on a weekend to the lab.

Keisha, who wanted to get married and have a family, discussed feeling like she was already too old to have children because of how long she has been in graduate school. She felt like she should just give up on starting a family and should focus on becoming successful in her career instead.

> I'm 31...we scientists, you read the literature, 35, you're supposed to conceive before 35. You know what I'm saying? ...I gave up on the clock, I just want a career now. So the relationship, the children...I've basically given up on that. I just want the career...if I could have anything out of this life, you know, at least give me the career. And all the other stuff, I can let it go. I'm cool with that, but I wanna have a name for myself.

These women evaluated the lifestyle they believed was necessary to be successful and earn tenure in a chemistry department at a research-intensive university and made career decisions based on these perceptions. They felt that these careers required working long hours, delaying having children, and sacrificing personal and family time for their careers. For most of these participants, this was too high a cost for them to consider an academic research career. Through the course of her interviews, Keisha came to the conclusion that she wouldn't be able to have the family she wanted, so she was free to pursue a research-focused career. Julie, described in the next section, also decided to pursue an academic career at a research-intensive university because she felt freed from traditional female gender roles.

Freedom from Gender Roles for Julie

Julie identified herself as the "breadwinner" in her lesbian relationship. She envisioned herself taking on the traditionally masculine gender role in her relationship and future family life. This self-identification freed her from many of the concerns exhibited by the women who identified with traditional female gender roles. Unlike the other participants, she was interested in pursuing an academic career in a research-focused chemistry department. Although she had the same views and perceptions regarding this career path as the other participants, she was not opposed to the lifestyle. She was not concerned about being the

primary caretaker for future children, but rather was concerned about having a stable job, being able to monetarily provide for her family, and making sure she could focus on being successful in her career.

> Family issues aren't an issue to me, I'm not ever going to be bearing children, or I hope not, I don't think so. So things like that have been less of a concern....I'm more worried about more traditional, I want the job stability, I want to support a family, I want to support a life, but...I've never really had to think, 'oh, when do I want to have my child?' So that makes me a little unusual, which is convenient.

Unlike the women participants identifying with traditional feminine gender roles, Julie was not worried about working long hours. She expected to work 80 hours a week in order to achieve her career goals at a research-intensive university. Her main concern regarding working so much was her partner's happiness and satisfaction, as shown in the quote below.

> ...it would certainly have to be somewhere that my partner's happy. ... But it's still, we're gonna have to go to a city or a place where personally she's going to be happy. And it's one of the reasons why we've loosely talked about the idea of me trying to aim back for [this area] because all of her family is here, and I feel like if I'm gonna have an academic career, I need a small support system but not a large social group. She is going to need a larger social group 'cause she's not going to work 80 hours a week, you know. Especially 'cause I'm going to be working 80 hours a week, she needs that group.

While the other participants were resistant to the culture and expectations of high-research chemistry departments due to the conflict with traditional female gender roles, Julie was not opposed to them. By identifying with traditional male gender roles, she did not share the other participants' concerns about having a family life and a successful career in a research-intensive university. This highlights the perception that the culture of research-focused chemistry departments does not support women trying to balance family and career, who identify with traditional female gender roles.

Needing to change personality to succeed as a chemistry researcher

In addition to believing that academic research careers are incompatible with having a family life, the participants felt that they would need to fundamentally change their personalities and mannerisms to be successful in those careers. When viewing female role models in the faculty, the participants saw negative characteristics. The participants' observations of women are shown in the quotations below. Natalie discusses not being able to find good role models and feeling that women had to make themselves more masculine to be successful.

> I know that there are women faculty here, but it's a very small percentage, so it's really hard to find almost a good role model in a way. And I've noticed that a lot of those female faculty...some of them have children, some of them don't, but a lot of them don't seem...womanly, in a way, like they seem like they're...really playing with the boys, and have kind of become one in a way. So I don't have a good female role model in that sense. It's kind of scary.

Julie talked about seeing women in chemistry demonstrate certain masculine mannerisms, and how she found herself also changing her personality as she has progressed through graduate school.

> ...since I was in undergrad, I've always seen that the women in chemistry tend to be more severe than the men in chemistry. And I've seen that happen to myself, but I don't know why. I don't know what caused that, if it's just something about me, if it's something about, 'I've chosen this, I've gotta make this work' attitude; without being a man as well, I really don't know how that works...I don't know about the guys in the department about why they're able to be different.

Natalie also discussed feeling she needed to change her personality and project herself in a less emotional way. She felt that she should have been more analytical in her interactions with

colleagues and wondered if that would have made her more successful in her personal interactions.

> I know that it is a male-centric environment...so you have the stereotype that women are emotionally driven. I fit that stereotype, I know that I do. …You know, or maybe if I could shut off the, 'well, I'm really excited about this' and just look at it from the factual, you know, let's analyze this like the chemists we are kind of thing...which is more of a male trait than a female, if again, you follow the stereotype. I wonder if it would be different.

Michelle talked about her experiences working in industry before entering graduate school and her observations of older women that she worked with. She felt that they had become hardened by trying to succeed in a male-dominated career. Michelle did not want to have to change who she was to succeed in a career and felt that working in industry or at a research-focused university would require her to be a different person.

> But I haven't really seen that many older women in academia either...I think I'd fundamentally change and I think I'd be unhappy with myself. I think I'd be a massively unhappy person. I tried to do it, when I worked in industry, and I hated myself and I hated what I was doing. And I hated feeling like I had to be that kind of person just to succeed in a job. And I was like, I don't want to live this way!...I can't leave grad school and go to a job like that. But there's a part of me that's afraid that any job is...going to have some of that to a degree, but I wanna try and avoid the ones where it's there a lot.

Interestingly, Michelle struggled with issues related to socioeconomic status as well. She felt that while she needed to become less sensitive and more of a fighter to succeed as a woman, she also wasn't polished enough to be successful. She felt that her casual, and sometimes vulgar, language and unfeminine behavior would also prevent her from being successful.

> I think some of it's 'cause I'm a woman, and I think some of it is because I am, of my low social standing in life. I come from...blue-collar, working class people. ...I think that's really what gets you funding, you know?...I think it boils down to who you know. And I just don't have confidence in people...I'm not going to put on airs to try and conform to their way. I'm not very PC. I'm kind of a little gruff and rough around the edges. I cuss and carry on and I'm, you know, I feel like that would be held against me.

These women struggled to reconcile their personalities with the professional image they felt they needed to project in their chemistry departments. These feelings of personal transformation in order to be successful were only discussed in reference to careers at research-intensive universities, with the exception of Michelle who also felt this applied to industry as well. They felt they would need to lose some of their femininity and acquire more masculine characteristics and mannerisms to adequately interact with peers and students in a professional setting.

Discussion

Many universities, and in particular chemistry departments, have recognized the importance of having diverse faculty members, including increasing the number of women. As shown with these findings, it is difficult to recruit women to high research activity chemistry departments when these potential women faculty members identify, at least partially, with traditional female gender roles. The fact that these women want fulfilling family lives in addition to their careers and want to retain their femininity and feminine qualities, but feel that is at odds with a chemistry research career, poses additional problems. The perceived culture of high research activity chemistry departments in the United States does not support femininity or the traditional female gender roles of primary caretaker and homemaker.

While many universities in the United States are implementing family-friendly programs such as maternity and paternity leave, spousal employment, tenure-clock stoppage options, and better childcare options, these efforts are rarely visible to graduate students. The women in

this study did not believe that research-focused chemistry departments were supportive of families. It was a commonly held assumption that women at a research university needed to wait until after earning tenure to have children. For the participants in this study, choosing to pursue a research-intensive chemistry career meant sacrificing their dreams of starting a family. This meant these women actively sought out careers that they believed were more family-friendly and accommodating of their desire to spend time with their spouse and children.

Also problematic was the observation that women in research-active chemistry departments were "hardened" and did not display feminine qualities. The women participants did not want to have to change to be successful in their career, but did not see women in their departments that embodied femininity. They wanted to retain their softness and emotionality, and to show they cared for their students and wanted to help them succeed. The participants felt that these qualities would be frowned upon and hinder their progress in a research-focused department. The solution seemed to be acting in a very business-like, cold manner, which was a fundamental personality change they were not interested in pursuing.

Addressing these issues of femininity and traditional female gender roles is a challenge for many chemistry departments in the United States. These departments have had trouble recruiting new female graduates to join their departments due to the perceived lack of support for women with families and the need to lose some of their feminine qualities. At the same time, it seems unlikely that the culture of these departments will radically change without women to push for it. It is a risky undertaking for new, untenured faculty members to challenge the conventions of departments by having children pre-tenure, utilizing maternity leave and tenure clock stoppage options, and choosing to spend nights and weekends with their families. Tenured faculty must advocate for and support new untenured faculty members so they feel supported and realize that they are not putting their chances for tenure at risk by pursuing a fulfilling family life.

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