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Doing Gender/Teaching Science: A Feminist Poststructural Analysis of Middle School Science Teachers' Identity Negotiations

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DOING GENDER / TEACHING SCIENCE:

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MIDDLE SCHOOL SCIENCE TEACHERS' IDENTITY NEGOTIATIONS

By

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ABSTRACT

This research joins the gender equity conversation within science education by providing a feminist poststructural analysis of teachers' *doing gender* and *teaching science*. Feminist poststructuralism is used in recognition of the oppressive nature of dualistic modes of thought, which often reduce reality into a limiting either/or fallacy and can be theoretically constraining as research within any particular field becomes more sophisticated. By uprooting the concept of gendered identity from the unproductive grip of essentialism, and conceptualizing it instead as a shifting 'work in progress,' feminist poststructuralism provides an invigorating theoretical framework from which to conduct inquiries. From a this perspective, the identity of a teacher, as any identity, is not a fixed entity, but rather an unfinished project, swarmed upon by a variety of competing discourses.

Situated in a rural middle school in the Florida panhandle, this research explores how numerous discourses compete to define what it means to be a female science teacher. More specifically, the aims of this research are to explore: a) how the participants negotiated successful gendered identities within science and b) how this taking up of subject positions crystallized into classroom practices which worked to reproduce and/or challenge commonsense notions of the heteropatriarchal gender dualism as well as the enmeshment of masculinity and science.

Findings illustrate a wide array of classroom pedagogical practices, ranging from anti-oppressive emancipatory constructions of both gender and science to more traditional objectivist constructions that validated the patriarchal status quo. Explicating teacher identity as effects of these pedagogical approaches proved insightful in unveiling

notions of resistance, frustration, enthusiasm, and agency as the teachers reflected on their practice.

INTRODUCTION

Within our everyday language, we often associate certain characteristics with either the female or male sex. For example, we stereotypically associate competitiveness with males and cooperativeness with females. In a heteropatriarchal society, such gendered associations exist inequitably in a hierarchical relationship. As these stereotypical constructions find their way into public education discourse, they affect how we address gender equity issues. When we advocate a female-friendly classroom environment, one that focuses on more cooperative learning for example, we are tightening the unproductive assumptions about a natural female essence. In her historical analysis of *The Science Education of American Girls*, Tolley (2003) aptly summarizes this point:

> It is important to recognize the ways that arguments based on oppositional gender differences, advanced in the name of increasing full equity for either sex, can effectively reproduce and reinforce older cultural stereotypes. Culturally developed images of what it means to be "male" and "female" are not fixed but are highly mutable. When feminists argue that science does not fit women because it promotes presumably masculine qualities of rationality, aggression, and competition, they reinforce the notion that such qualities do not belong to females, culturally developed or not. (p. 222)

I agree with Tolley's point that many efforts at more equitable teaching tend to maintain the supposed "naturalness" of female-ness and male-ness.

Rather than relying on the male/female sex dichotomy in order to create a more gender-equitable teaching and learning environment, we should recognize a continuum of

multiple socially-constructed genders (numerous masculinities and femininities) that are context-dependent, interactional, fluid (over time and space) and not innately anchored to one's sex category. This entails a fluid notion of identity in general, a position in accordance with poststructuralist theory. However, it is often the case that many interventions concerning gender equity in science education rely on the opposite: a taken-for-granted "natural" gender dualism and a fixed notion of identity.

> Gender tends to be seen in dualistic and oppositional terms with the result that there are just two gendered positions available – the masculine and the feminine – within which men's and women's experience can be located, thus limiting the opportunities for more complex and contradictory gendered positions to be noticed, let along explored. (Henwood & Miller, 2001, p. 238)

In contrast, keeping the subjects of "male" and "female" in play, and seeing identities as fragmented and in flux, injects a more nuanced notion of gender and opens up greater possibilities of change. I recognize that this alone is not a panacea, but is one step toward less oppressive education, in particular science teaching. I agree with Kumashiro (2001) who states, "My goal is not to name strategies that work (for all students, in all situations, against all oppression), but rather, to emphasize the partiality of any approach to challenging oppression, and the need to constantly rework these approaches" (p. 4).

My research aims to explore how science teaching and learning affects the existing gender structure: the continuous construction of an inequitable, heteropatriarchal male/female dualism. By simultaneously "doing gender" (West & Zimmerman, 1987) while teaching science, teachers are implicated in either sustaining or challenging the existing, inequitable gender structure. To view gender as something that is "done" rather than some essential attribute of an individual, is to place gender *within* the social realm where individuals accomplish their gender through agreed upon social norms and *outside* of the unproductive grip of biological essentialism. The gender structure we construct, a structure that is inherently laden with inequitable relations, directly impacts teachers' and students' identities and their relationships with classroom science. Barton (1998b) comments,

> Because of the situated nature of pedagogy, knowledge construction about science and self-within-science occur within and are shaped by the relational space of the social, historical, and political. It is from this perspective that questions of representation in science (what science is made to be) and identity in science (who we think we must be to engage in that science) become central. (p. 380)

The teacher is a key player in Barton's processes of *representation* and *identity* within science classrooms. The teacher holds a great responsibility in shaping a) how science is portrayed to the students and b) what type of person successfully engages in the scientific enterprise. This holds true for both teachers' and students' relationships to science. Therefore, through an understanding of gender as a discursively mediated, interactional *verb* rather than a naturally fixed, essentializing *noun*, this research investigates how teachers' simultaneously *do gender* as they *teach science* – how they continuously negotiate a successful gendered science identity. By exploring this issue with science teachers, it is my desire that alternative, less partial reform efforts can be constructed to better address the gender equity issue in both science education and society as a whole. I agree wholeheartedly with Davies and Banks' (1992) who view

> the current gender order as problematic and locate the problem in its dualistic and hierarchical nature. Until such time as the current order has broken down, children (and adults) need to understand precisely how the current order is held in place and how their identity is organized in terms of it, if they are to resist it (p. 3-4).

Rather than my research simply suggesting alternative ways to balance the male/female see-saw within the scientific community, this work points to ways that science teaching itself can be used to challenge patriarchy and hegemonic masculinity within our society as a whole. It is also important to recognize that the two created gender categories of male and female are not symmetric. "Masculinity is not equal and opposite to femininity; it attracts a higher status" (Hughes, 2000, p. 435). Therefore, see-saw balancing is a highly oversimplified resolution.

However, the theoretical framework of my research is in conflict with the everyday understandings of gender. Society in general frames gender as being either male or female. This dualism is seldom questioned and plays an extremely important role in our daily interactions with others. "We perceive the world from a gendered subject position and we re-create the sexist world by re-creating the male/female dualism in the things we say and do" (Davies, 2000a, p. 40). However, gender *is* a social construction. It is something that we have created – a fabrication with very negative consequences for many individuals (i.e., as a consequence of heteropatriarchy). Therefore, we have to deal with what we have created. We can make it better or even get rid of it all together (Lorber, 2000). In order to start along this path, I feel that it is important to look at how our daily practices work to either strengthen or weaken this very thing called gender. This study will look at how teaching science does just that. How do science teachers, both explicitly and implicitly, engage in this process? Due to the androcentric and patriarchal history of science and the taken-for-granted connections between biology and gender, science classrooms are unique settings for such an exploration. Research within the science education discipline that relies on sex-differences or humanist notions of a stable identity can at times provide useful remedies to the current state of gender inequity. However, these band-aids do not address the gender structure itself and can often even work to reinforce its perceived naturalness. It is my belief that by exploring how teachers themselves negotiate their gendered science subjectivities, our thinking can evolve beyond this reliance inequitable gender dualism we have created.

CHAPTER 1

RELEVANT LITERATURE

This chapter will provide a summary of how gender has been conceptualized in the social sciences as well as how I am framing gender for the purposes of this study. In addition, I will provide a review of how the issue of gender equity has been addressed within the discipline of science education. I will conclude with how my dissertation research will join in this reform conversation and contribute to the drive for achieving equity.

Conceptualizing Gender

In order to study the issue of gender within science education, it is important that I define what I mean by "gender" itself. It is a complex notion that is conceptualized differently by a wide range of disciplines and political perspectives. The theoretical framework for my dissertation draws on both *materialist* and *discursive* accounts of gender, both of which operate under the umbrella of social constructionism. I will describe each of these accounts separately and then explain how a more powerful conceptualization of gender emerges when both are employed. Due to the fact that gender is "the workhorse concept of feminist theory and research" (Olesen, 2000, p. 228), I will also incorporate feminist thought. However, before doing so, I think it is important to briefly discuss other contrasting accounts of gender that do not fall under the social constructionist umbrella (e.g., biological determinism, sex role theory, and sociobiology).

Doctrines of Natural Difference

Early approaches to studying gender focused around, what Connell (1987) refers to as, "the doctrine of natural difference" (p. 67). Overall, these essentialist views of

gender rely on there being two fixed biological sexes: male and female. The gender that then arises (whether explained in biological or sociological terms) depends on the natural existence of these two categories; thus, gender becomes a linear progression from sex.

A biological essentialist view of gender perceives being male or female (behaving masculine or feminine) as biologically determined. As Risman (1998) explains, this "is the assumption that the basic differences in orientation and personality between men and women are rooted in biology and nature" (p. 2). This stance posits that males and females are *naturally* different and have innate qualities that distinguish one from the other. In essence, biology determines gender (i.e., biological determinism). Under this stance, the two gender categories are fixed, natural, and unavailable for reconsideration. As I will discuss later, I disagree wholeheartedly with this stance and see science education as a unique vehicle for such reconsideration.

The creation of a theoretical distinction between sex and gender allowed researchers to critique, and move beyond, biological essentialism. Viewing gender as the social manifestation of a biological sex was a pivotal conceptualization.

> The notion of gender was invented or adapted from its grammatical usage to hold in place a conception of historically specific sociocultural forms of being women and men. The distinction between sex and gender performs ruthless but invaluable surgery that has opened the way to gains in knowledge and theory that would have been unthinkable earlier. (Smith, 2002, ix – x)

An early approach to studying gender that capitalized on this distinction, thus moving away from strict biological essentialism, was sex role theory.

Sex role theory recognizes the influence of society on gendered identity. The underlying idea behind sex role theory "is that being a man or a woman means enacting a general role definitive of one's sex" (Connell, 1987, p. 48). This process involves an individual being socialized into one of two roles: "thus feminine character is produced by socialization into the female role, masculine character by socialization into the male role" (Connell, 1987, p. 49). Thus, the focus is on socialization experiences of *individuals* into gendered selves; a series of events to which the individual is rather passively subjected.

Connell describes sex role theory as using an "*additive* conception of society and nature" (p. 73). As opposed to a strictly essentialist view in which nature *determines* gender, sex role theory sees society as *adding* to what nature has already provided, "tracing out the ways society improves on nature's handiwork in shaping little girls and little boys" (p. 73). While sex role socialization is a valid aspect of our understanding of gender and its dualistic structure, it does not provide a complete picture. The theory does not allow for more than one form of masculinity and one form of femininity, thus reducing the spectrum of gender to a false and absolute dichotomy. Not all women are equally feminine nor are all men equally masculine, not to mention differences across cultures or throughout time. "The sex-role literature has also been accused of simplifying reality by promoting binary distinctions based on 'feminine' and 'masculine' roles and not considering the actual behavioral practices of women and men in everyday life" (Stromquist, 1998, p. 3). In addition, this theory fails to account for compliance and/or resistance to specific gender roles (Alsop, Fitzsimons, & Lennon, 2002). Notions of power and agency, concepts that prove pivotal in my theoretical framework, find little or no place within sex role conceptualization.

Biological essentialists would argue that women are naturally feminine, and men naturally masculine, because of their biology. However,

> essences do not have to be biological essences….Social essentialists would accept that all women, for example, share characteristics as a consequence of adopting the same social role, being placed within the same kind of social structures or being subject to the same symbolic order. (Alsop et al., 2002, p. 65)

Therefore, essentialists are not confined to the realm of biology. Viewing any particular mechanism, society or biology, as simply filling in what nature started is a form of essentialism that works to separate the gender continuum into two homogeneous blocks of male and female.

While it is rare to find scientists who attempt to explain gendered behavior *exclusively* with biological differences, there are numerous studies that do draw strong correlations. Many in the field of sociobiology explain sexual differences by using

evolutionary evidence of natural selection. These assertions "to ground social behavior in a genetic determinism, are reinforced by animal studies showing that male/female differences are found in non-human societies in ways that supposedly parallel those found in human ones" (Alsop et al., 2002, p. 21).

Neuroendocrinology is a particular field where sociobiology often lays claim to explanations between the sexes. A recent (2001) issue of *American Sociological Review* was the site of a heated debate about sociobiology (Firebaugh, 2001; Kennelly, Merz, & Lorber, 2001; Miller & Costello, 2001; Risman, 2001; Udry, 2001) and provides an excellent example of the complexities involved in studying gendered behavior. An article by Udry (2000) sparked the debate by comparing fetal hormone exposure to subsequent adult gendered behavior. "Udry investigates whether the level of testosterone in … pregnant mothers' blood organized their female fetuses' brains in ways that created 'predispositions' for certain types of gendered behaviors as adults" (Kennelly, Merz, & Lorber, 2001, p. 599). While Udry does not discredit the effects of social forces in determining gendered behavior, he evokes a strong causality between biology and gender. Udry (2001) summarizes the response generated by his study:

> No part of my paper pleased the critics. They call me a biological determinist. My critics found fault with my using an animal model as the basis of my predictions. They found fault with the concept of the dependent variable, gendered behavior, and with how I measured it. They found fault with the hormone theory, and fault with the measure of parental gender socialization. They also found fault with the [*American Sociological Review*] for publishing the manuscript at all. Above all, they were unhappy with the political and policy implications they and I drew from the research. (p. 612)

Miller and Costello (2001) compare Udry's work to that of Durkheim who was "an adherent of craniometrics, [and] claimed that functional differentiation between men and women was revealed in differentiation in skull capacity – and hence intelligence" (p. 592). They add that any attempt to classify a specific version of femininity (or masculinity) as "natural and universal" (p. 593) is a major fault of biological

determinists, lacking a historical or cultural perspective (e.g., Udry's equating femininity with the use of make-up, passivity in social interactions, and an affiliation with family and children). "His dichotomous conceptualization of gender cannot account for its interactive and developmental aspects, its cultural and temporal contexts, and its reflection of institutional pressure and conventionalized assumptions" (Kennelly Merz, & Lorber, 2001, p. 600). The distinction of what females 'typically' do illustrates the cultural subjectivity of his work. His understanding of gender consequently is reminiscent of sex-role theory in which gender is solely an attribute of individuals (i.e., a predisposition rather than a social relationship). "Udry consistently confuses sex role theory with more recent approaches to gender construction in interaction and the institutionalization of gender itself" (Risman, 2001, p. 606). While Udry's critics seem to shy away from altogether discrediting any biological theories concerning sex difference, they strongly call for an integrated approach that places strong authority on sociological explanations. "Gendered behavior and its variations are the results of genetic and hormonal input, long-term evolutionary adaptations, lifetime experiences, and involvement in ongoing social situations" (Kennelly Merz, & Lorber, 2001, p. 599).

Once gender is conceptually removed from the sole grip of biology, it can be viewed as being socially constructed. This also opens up the possibility for locating gender within social interactions rather than within the core of an individual.

> In common-sense understanding gender is a property of individual people. When biological determinism is abandoned, gender is still usually seen in terms of socially produced individual character. It is a considerable leap to think of gender as being also a property of collectivities, institutions and historical processes. (Connell, 1987, p. 139)

The social construction of gender can take many forms, depending on the discipline and methodology involved in its study. However, social constructionists all understand gender as being something separate from the everyday comprehension of biological sex. There is also an added emphasis on the collective, interactional nature as opposed to individualistic accounts that focus on gendered personalities.

The Social Construction of Gender

"That gender is not fixed in advance of social interaction, but is constructed in interaction, is an important theme in the modern sociology of gender" (Connell, 1995, p. 35). Under this perspective, one's practices construct one's masculinity or femininity, rather than the other way around. I agree with this social constructionist standpoint when it comes to my understanding of gender. To view gender otherwise, to rely on essentialism or some form of biological determinism, is to severely restrict the possibilities for social change. Social constructionism is a broad theory that gives us a lens into how a society has created certain regulatory conceptualizations and understandings, such as gender. Again, recognizing that gender is something that we have created gives us the agency to edit our creation.

Alsop, Fitzsimons, and Lennon (2002) remark that social constructionist views of gender can be generally categorized in two ways: those that use materialist accounts and those that use discursive accounts. Both frameworks influenced my theoretical perspective and I separately discuss each below, relying predominately on the work of Sandra Harding and Judith Butler as respective examples of each.

Materialist Accounts of Gender

Materialist feminism examines "structural and material features and patterns to understand what it is to be gendered" (Alsop et al., 2002, p. 8). Drawing on Marxist ideology and notions of patriarchy, materialist feminists explore sociological issues from women's *positions* within society. It is women's common experiences, in opposition to those of men, within a shared social location that pushes this strand of thought.

> Materialists see gender differences as rooted in social relations which give rise to social practices that produce and reproduce gender inequalities. People are made into social men and women by the particular positions which they are allocated in the social order. To understand what it is to be a man or woman in a given society is to grasp the social relations involved. There is a material reality to gender categories which, though socially constructed, constrains and forms people. (Alsop et al., 2002, p. 68)

One powerful theoretical framework that utilizes women's particular positions within the social order is feminist standpoint theory.

Patricia Hill Collins (1998), Sandra Harding (1986, 1991, 1997), Nancy Hartsock (1983, 1997) and Dorothy Smith (1987) are key representatives of feminist standpoint theory where issues of gender intermingle with power, social relations, knowledge, and epistemology. Recognizing the situated nature of knowledge, feminist standpoint theory posits that an individual's location within the social structure affects her/his process of meaning making. Olesen (2000) accurately summarizes the work of these individuals:

> The concept of essentialized, universalized woman disappeared in the lens of standpoint thinking to reappear as a situated woman with experiences and knowledge specific to her in the material division of labor and the racial stratification system. This carries with it the view that all knowledge claims are socially located and that some social locations, especially those at the bottom of social and economic hierarchies, are better than others as starting points for seeking knowledge not only about those particular women but others as well. (p. 222)

For me, the key to feminist standpoint theory is that it places value on the shoulders of those in marginalized locations. How to integrate this political positionality with some of the discursive aspects of poststructuralism is something that I will discuss later on.

To begin with, I interpret Collins (1998) and Smith (1987) as wanting to contribute to the overall *well of knowledge* that we as humans have access to. They argue that patriarchal power relations have historically dominated this *well*, shutting out women's (and other subordinated group's) contributions. Standpoint theory allows women (and other subordinated groups) to lay claim to their experiences (and the accompanying knowledge) and to add them to the common well. For Collins, the theory is "an interpretive framework dedicated to explicating how knowledge remains central to maintaining and changing unjust systems of power" (p. 37). Thus, feminist standpoint theory can interrogate *whose* lived experiences are being utilized as the foundations for meaning making and creating legitimate knowledge. For Smith (1987), a methodology

rooted in the daily experiences of women allows knowledge to be established from within their daily lives (something that she argues has been historically only occurring for males). "Taking women's standpoint and beginning in experience gives access to a knowledge of what is tacit, known in the doing, and often not yet discursively appropriated" (p. 378). Moving the *tacit* to the *explicit* is a political venture that feminist standpoint theory claims the ability to accomplish.

To further elaborate on the Marxist, materialist roots of feminist standpoint theory, I turn to the work of Nancy Hartsock (1983). She states, "Feminist Marxists and materialists feminists … have argued that the position of women is structurally different from that of men, and that the lived realities of women's lives are profoundly different from those of men" (p. 284). This framework draws from Marx's theoretical work on capitalist class structures and the relationship between those who control the material means of production and those who work for wages within it. Marx understood that a capitalist society created a dual system of material conditions based on one's location within the means of production (the ruling class and the ruled class - those that control the means of production and those that sell their personal labor to propel it). Thus, because material conditions shape our understanding of the world, two unique worldviews arose (e.g., that of the dominant group and that of the oppressed group).

Hartsock, using the sexual division of labor, maintains that this relationship between *material* life conditions and worldview holds true for gender just as it does for class. Those in dominant positions (controllers of means of production / males) have only the dominant theoretical framework from which to draw meaning and understanding. Those in subordinate positions (workers within the means of production / females) are also attuned to this framework because it is what shapes the larger social relations of society. Its omnipresent, dominant nature makes it immediately available and understandable. However, this second group also draws knowledge and meaning from their everyday, material conditions which are highly divergent from the ruling class. This perspective has the ability to shine light on oppressive conditions, alternative ways of

knowing, and may provide the insight into liberatory options. Thus, the notion that *material life shapes understanding* is relevant for both class and gender analysis. Hence, Hartsock (1983) proposes that

> like the lives of proletarians according to Marxian theory, women's lives make available a particular and privileged vantage point on male supremacy, a vantage point which can ground a powerful critique of the phallocratic institutions and ideology which constitute the capitalist form of patriarchy. (p. 284)

However, this vantage point is not something that women involuntarily attain. Hartsock (1983) makes it clear that this type of standpoint is not automatic (like a perspective or biased viewpoint), but is *achieved*.

> Because the ruling group controls the means of material as well as physical production, the production of ideals as well as goods, the standpoint of the oppressed represents an achievement both of science (analysis) and of political struggle on the basis of which this analysis can be conducted. (p. 288)

To achieve this standpoint is to become cognizant of the social relations of power, one's position within those relations, and how that inequitable hierarchy affects one's knowledge construction or meaning making processes. This achievement opens up the possibility for social change. Due to the fact that "the proletariat is the only class which has the possibility of creating a classless society" (Hartsock, 1983, p. 288), one can envisage that females are the only group to create a genderless society. I would add that other marginalized genders, those that do not align within hegemonic masculinity, also hold similar transformative power. However, because Hartsock seats the feminist standpoint within the sexual division of labor, much of which depends on the productive and reproductive traditional roles of women, her analysis retains a standpoint which is solidly female in sex.

Hartsock does not ignore the body in her analysis, drawing heavily on women's reproductive role (keeping in mind the *institution* of motherhood rather than the *individual* act). Bearing children is a biological option for some women, but they also have the social responsibility of raising children (who will enter the workforce).

Therefore, her dual role is both reproductive and productive (although not in the wage earning sense of production). Hartsock (1983) thus places women more in *sensuous* contact with the material world of everyday life.

> The activity of a woman in the home as well as the work she does for wages keeps her continually in contact with a world of qualities and change. Her immersion in the world of use – in concrete, many-qualitied, changing material processes – is more complete than his. And if life itself consists of sensuous activity, the vantage point available to women in the basis of their contribution to subsistence represents an intensification and deepening of the materialist world view and consciousness available to the producers of commodities in capitalism, an intensification of class consciousness. (p. 292)

This privileged vantage point can create a critical lens with gender emancipation as its ultimate goal. "The articulation of a feminist standpoint based on women's relational self-definition and activity exposes the world men have constructed and the self-understanding which manifests these relations as partial and perverse" (Hartsock, 1983, p. 303). The resulting epistemology has the ability to contribute in unique, less oppressive ways.

Sandra Harding is particularly important to my framework because of her role as a philosophical critic of science. She is a main contributor to the formation of feminist standpoint theory and to the exploration of how it contributes to a more sophisticated scientific process as well as an increasingly equitable society. She also provides a critique of the historically androcentric and patriarchal nature of science. It is this dual focus on gender and science that draws me to Harding's ideas.

An important aspect to Harding's critique is that she categorizes the natural sciences as "a subfield of the critical social sciences" (Harding, 1991, p. 15). She inverts the normal hierarchy that places natural sciences above, and as a model for, the social sciences. Traditionally, the flow of thought between these two categories has been one-sided: the transport of objective rationality and positivist methodologies from the 'harder' sciences to the 'softer' ones. Social scientists have long strived to emulate the scientific

method that grew out of Enlightenment philosophy. Harding argues that in order for a social critique of the natural sciences to be successful, the association between the natural and social sciences should be more of a give and take relationship. Although she does not completely deconstruct the divisions between the social and natural sciences, she makes the point that the social studies of the natural sciences should not be seen as inferior to more 'pure scientific' work. In fact, she argues that social scientists have a superior framework for which to study the natural sciences, something that the natural scientists are unable to consider because of their being too immersed within a Western, scientific mindset.

Harding's critique begins with an important distinction between feminist criticisms of *bad science* versus feminist criticisms of *science as usual*. *Bad science* is not as good as it could be due to the fact that it is derived from an incomplete workforce (i.e., not enough females). To be critical of bad science is to assume that by injecting more females into the existing system, the science will improve. "One could argue that presumably the quantitative change discussed above has qualitative results: adding to the number of good scientists in the workforce should have a positive effect on the growth of scientific knowledge" (Harding, 1991, p. 62). These feminists are supporters of the Archimedean situation of a value-free scientist who has shuffled off the negative influences of society in order to maximize objectivity. (It is important here to recognize that this traditional sense of objectivity is closely associated with a posture of *neutrality*, a connection that Harding finds problematic and an issue I explain below.) Although women are seen as an overlooked resource, this agenda sees nothing special about the perspective of the women themselves and promotes their being as objective and rational as successful scientific men. "The critics of 'bad science' are most active in supporting efforts to get more women into science - partly because these critics are most often to be found in the sciences" (Harding, 1991, p. 74). Those with successful status within the system have fewer incentives to critique its foundational assumptions. This approach is not critical about the nature of science itself, just the lack of females engaged in the process. Harding (1991) notes that with this approach, "nothing fundamental to how

description and explanation of the natural world are produced will be done differently" (p. 64). Seen in this light, adding women is really no different than simply adding people.

On the other hand, a feminist criticism of *science as usual* takes issue with the status quo of science itself. Rather than promoting an 'add women and stir' intervention, this form of criticism assumes that there is something unique and constructive that women, *as women*, can add to the inquiry process. However, Harding is quick to point out, "this is not because women have some inherent and universal ways of reasoning, attributable either to their different biology or to 'women's intuition'" (Harding, 1991, p. 68). She makes it extremely clear that the critique of science as usual does not support a biological determinist position or the promotion of an essential feminine essence. "Women scientists can find ways to use their experience as women, informed by feminist theorizing, to create a critical perspective on the dominant conceptual schemes and how they shape scientific research and practice" (Harding, 1991, p. 70). The possibility of a positive influence on science comes from their location within existing gendered relations of power, not from their mere biological categorization as females. The foundation for this perspective comes from the recognition that men and women's experiences are basically unique because of differing locations within social relations. It is this gap between men and women's experiences that creates the potential energy for contributions to be made - the opportunity for a unique feminist standpoint from which Harding feels is a better place to start scientific work. This produces a productive tension in my mind between valuing this very material standpoint positionality versus the dangers of essentializing the "female" category (and also in some ways the "male" category) as homogeneous blocks.

Drawing from a Marxist materialist perspective about daily life, Harding (1991), like Hartsock, asserts that "human activity, or 'material life,' not only structures but sets limits on human understanding: what we do shapes and constrains what we can know" (p. 120). Harding (1998) acknowledges the influence of Hegel's metaphor of the slave/master relationship on the development of standpoint theory. When viewed from

the daily activities of the master, the slave's life is very different than when viewed through the experience of the slave himself. The theories of class oppression, and the "standpoint of the proletariat" (Harding, 1998, p. 149) of Marx and Engels, arose from this metaphor.

In general, "a standpoint is an objective position in social relations as articulated through one or another theory or discourse" (Harding, 1998, p. 150). By exploring specific locations in the social relations, particularly marginalized ones where oppression is more influential, new problems surface that are worth investigating. The essence of this approach is a critical examination of the relationship between the production of knowledge and one's location within the relations of power. Once one recognizes that what is counted as valid knowledge is embedded within power relations, it is virtually impossible not to realize the consequence of standpoint studies.

The material life of women, according to Harding, has traditionally been ignored in the production of scientific knowledge. Knowledge has been produced, over the centuries, from the lives of men. She argues that we are consequently acquiring only part of the picture, and a distorted one at that. The material life of women is therefore an untapped resource not just because of its presence, but also because of its location within the relations of power.

> The distinctive features of women's situation in a gender-stratified society are being used as resources in the new feminist research. It is these distinctive resources which are not used by conventional researchers, that enable feminism to produce empirically more accurate descriptions and theoretically richer explanations than does conventional research. (Harding, 1991, p. 119)

Harding asserts that starting scientific research from the lives of women creates "empirically more accurate" and "less false" claims than those generated by the male-dominated elite status quo. Qualifying the degree to which scientific claims are true may, at first, seem radical to those enmeshed within the traditional mindset of scientism. However, Harding reminds us that science

> never gets us truth; it always promised something much better than truth claims… Scientific claims are supposed to be held not as true but, only provisionally, as "least false" until counterevidence or a new conceptual framework no longer provides them with the status of "less false" than those against which they have been tested. (Harding, 1997, p. 385)

The information we call scientific *truths* or *claims* is always tentative. It is this tentative nature of knowledge, built into the very fabric of the scientific enterprise, that allows for continual scientific advancement and progress (Lederman, 1992; McComas, 1998).

The following question arises when Harding proposes a privileged status to a feminist standpoint that draws from women's daily lives: "Why is the standpoint of women – or of feminism - less partial and distorted than the picture of nature and social relations that emerges from conventional research" (Harding, 1991, p. 121)? To answer this question, Harding provides several points of consideration about the differences between men's and women's lives.

To begin with, women's lives have historically been neglected as starting points for scientific work. Knowledge claims have been traditionally derived from the lives of white men. However, instead of using elite males as the reference points, "might our understanding of nature and social life be different if the people who discovered the laws of nature were the same ones who cleaned up after them" (Harding, 1991, p. 27)? To include others is to "provide a missing portion of the human lives that human knowledge is supposed to be both grounded in and about" (Harding, 1991, p. 122). The question then arises as to *which* women will become the focus of such investigations. Harding, in a multicultural stance, sees value and power in the diversity and difference in the category of women and makes it clear that there is not a certain 'ideal' woman who works best. "Standpoint theory is not arguing that there is some kind of essential, universally adequate model of the marginalized life from which research should start off" (Harding, 1998, p. 160). However, Harding does caution against focusing only on 'women worthies' - women who have found success within the existing, male-dominated scientific enterprise. Studies from the lives of these women "do not tell us what we need

to know in order to understand the experiences of the majority of women who try to make it into science or who may achieve less distinguished careers than these few" (Harding, 1991, p. 25). I agree with Harding's cautionary suggestion that if taken as representative of all women, studies of 'women worthies' would give us a distorted picture. However, it may be illuminating to see what these individuals had to change within themselves, or what type of gendered identities they were required to perform, in order to be successful in the field of science. Their experiences are still valid pieces of the landscape of women's experiences in science.

The feminist standpoint theories "focus on gender differences, on difference between women's and men's situations which give a scientific advantage to those who can make use of the differences" (Harding, 1991, p. 120). It is the discontinuity between dominant and marginal experiences that provides the drive for the theory. One example of this discontinuity is the notion of women being "strangers to the social order" and men being "natives" (Harding, 1991, p. 124). The stranger has the ability to see things that are almost impossible for the immersed natives to detect. "Knowledge is power, as the familiar saying goes; and it is from the extremities of knowledge-power networks that we can best perceive the limitations of how knowledge and power create and nourish each other at the centers" (Harding, 2000, p. 241). Harding finds value in Patricia Hill Collins' (1998) *outsiders within* concept to explain the unique position that women find themselves in when they engage in scientific work. With one foot in the everyday realm of daily life (a realm with which women are strongly associated) and one foot in the world of scientific activity (a world with which men are strongly associated), women as *outsiders within* have a special dual perspective. It may be important to recognize Sandra Harding herself as an *outsider within*, as a woman who is engaged in a social science critique of the natural sciences. This perspective allows the marginalized Other/woman/Harding/ to point the finger back at those who defined the playing field to begin with, to see what has traditionally been ignored.

"Standpoint theories argue that the social world in effect provides a kind of laboratory for 'experiments' that can enable one to observe and explain patterns in the

relations between social power and the production of knowledge claims" (Harding, 1997, p. 386). By talking about standpoint theories as "experiments" and arguing for increased use of objectivity, it is interesting to see how Harding's critique of science utilizes "laboratory" terminology and concepts. This is more than likely a consequence of her *outsider within* position that permits her to simultaneously appreciate and use the worldview of science, while at the same time judge its credibility.

Like Hartsock (1983), Harding sees importance in recognizing standpoint theory as an achievement, rather than something automatic. She makes it clear that insight via a *standpoint* is different from a *perspective*. Although both are derived from one's location within the social relations of power, a *perspective* can happen by simply "opening one's eyes" (Harding, 1991, p. 127). On the other hand, epistemology that arises from a feminist standpoint is achieved because of the *struggle*. "The need for struggle emphasizes the fact that a feminist standpoint is not something that anyone can have simply by claiming it" (Harding, 1991, p. 127).

Gender and Scientific Objectivity

One important aspect of Sandra Harding's philosophical critique of science is her stance on the traditional understanding of objectivity. Objectivity is considered important to science because of its function as a separator of scientific facts and findings from mere opinions and beliefs. However, Lincon and Guba (2000) point out that "objectivity is a chimera: a mythological creature that never existed, save in the imaginations of those who believe that knowing can be separated from the knower" (p. 181). It is this daydream of a neutral scientific stance that Harding takes to task.

She explains that to support *objectivism* is to strive for the recognition and bracketing of all social values away from the scientific inquiry process. The underlying assumption is that these social factors, if not removed, will place limits on claims of validity and generalizability. To solve this problem, the "scientific method has been constructed exactly to permit the identification and elimination of social values in the natural sciences" (Harding, 1991, p. 79). However, Harding finds fault in this simple plugging in of the scientific method to vanquish the social aspects of doing scientific

work. She claims that the entire scientific enterprise itself has historic ties to certain aspects of society and therefore to various associated values. "The sciences are part and parcel, woof and warp, of the social orders from which they emerge and which support them" (Harding, 1991, p. 37). To deny that "…modern science has been constructed by and within power relations in society, not apart from them" (Harding, 1991, p. 81) is to engage in "mysticism." More concretely stated, traditional objectivity is relegated to simply isolating the personal biases of a certain type of individual (usually elite white male scientists), rather than exploring the unarticulated presuppositions that are foundational to science itself. Harding comments that a without a stronger criterion of objectivity, "science can easily become complicitous with the principle that 'might makes right,' whether or not anyone intends this complicity. The ethics and rationality of science are intimately connected" (Harding, 1991, p. 97). Harding does not find fault within the concept of objectivity in general, rather she recognizes that the patriarchal discursive formation of objectivity has now limited its scientific potential. Her goal is to transform objectivity into a more sophisticated form where it can wield stronger influence over the scientific method.

She complicates the issue by claiming that existing objectivity is in fact *weak*, failing to do much of anything other than supporting existing hegemonic androcentrism. Harding considers this objectivity weak because the scientists involved are merely examining the values and ideas that exist within their dominant group. The goal of this process is intended to identify the influences of social values on scientific research. However, in reality, objectivity "has been operationalized to identify and eliminate only those social values and interests that differ among the researchers and critics who are regarded by the scientific community as competent to make such judgments" (Harding, 1991, p. 143). In essence, the elites of the scientific enterprise (Western, white males) are only identifying and eliminating the social values that reside within their view of the world.

> If the community of "qualified" researchers and critics systematically excludes, for example, all African Americans and women of all races, and if the larger

> culture is stratified by race and gender and lack powerful critiques of this stratification, it is not plausible to imagine that racist and sexist interests and values would be identified within a community of scientists composed entirely of people who benefit, intentionally or not, from institutional racism and sexism. (Harding, 1991, p. 143)

Weak objectivity is therefore easy and useful because of its selective "blindness." Since it is so ingrained into dominant forms of scientific research, it has become virtually painless to produce. "Thus objectivism operationalizes the notion of objectivity in much too narrow a way to permit the achievement of the value-free research that is supposed to be its outcome" (Harding, 1991, p. 144). Weak objectivity is limited in the range of questions it is willing to ask about the scientific enterprise and therefore is "too weak to be able to identify the kinds of culture-wide assumptions" (Harding, 1998, p. 129) that strongly influence the entire scientific enterprise.

In the end, weak objectivity allows those in dominant positions within the scientific enterprise to easily perpetuate "the ideal of the disinterested rational scientist" (p. 148) who is able to remove her/himself from the social world. Rather than objectivity confronting how the situatedness of scientific work affects knowledge production, objectivity confronts only the personal biases of individual scientists. "The issue is not that individual men (and women) hold false beliefs, but that the conceptual structures of disciplines, their institutions, and related social policies make less than maximally objective assumptions" (Harding, 1998, p. 135). Focusing strictly on the individual perpetuates the image of the odd alien-like scientific worker who is somehow separate from the normal human realm. This, in turn, "advances the self-interest of both social elites and, ironically, scientists who seek status and power" (Harding, 1991, p. 148). The myth of the Archimedean stance becomes an important one for those in power to sustain and Harding provides a perspective on how weak objectivity contributes to this myth.

To counter this weakness, Harding uses feminist standpoint theory to create the notion of *strong objectivity*. In essence, strong objectivity proposes to explore those social values and beliefs within scientific work that weak objectivity could not.

> Objectivity not only can but should be separated from its shameful and damaging history. Research is socially situated, and it can be more objectively conducted without aiming for or claiming to be value-free. The requirements for achieving strong objectivity permit one to abandon notions of perfect, mirrorlike representations of the world, the self as a defended fortress, and the 'truly scientific' as disinterested with regard to morals and politics, yet still apply rational standards to sorting less from more partial and distorted belief. (Harding, 1991, p. 159)

In order to access and explore these previously ignored social values, science must start somewhere other than from the lives of men. For Harding, the marginalized lives of women are great places from which to begin.

A critical step in the formation of strong objectivity is to understand that "maximizing objectivity is not identical to maximizing neutrality" (Harding, 1998, p. 129). The sciences have traditionally maintained an intimate relationship with the notion of neutrality and it has formed the basis of objectivity that was mentioned above: the removal of social values from a scientist's work. Harding argues that standpoint theory can be a way to sever the unproductive union of objectivity and neutrality: "to separate the goal of maximizing objectivity from the neutrality requirement in order to identify the knowledge-limiting values and interests that constitute projects in the first place" (Harding, 1998, p. 133). Because "what we do enables and limits what we can know" (Harding, 1998, p. 141), there is no reason to think that we can magically remove that influence and gain neutrality. However, what we do have the capacity to do is to search for strong objectivity through maximizing our recognition of as many social influences as possible on the scientific enterprise. Such an endeavor requires exploring multiple vantage points, not just the view from the top.

In summary, the materialist accounts of gender, such as standpoint theory, have removed gender from its biological roots and seated it within social relations. Gender is not an essential property of personality, but a structure that runs through the institutional, interactional, and individual spheres of life. Materialist feminism ties the social

construction of gender to the everyday material aspects of life, intertwines it with power, explicates its relationship to knowledge, and recognizes the liberatory politics of marginalized locations. When placed within the context of the science, materialist accounts of gender shed light on the enmeshment of masculinity with not only the actual doing of scientific work, but also the actual knowledge that emerges from such efforts.

Discursive Accounts of Gender

From the materialist perspective on gender that feminist standpoint provides, I turn to more discursive accounts of gender. Alsop, Fitzsimons, and Lennon (2002) remark that with this turn, researchers' "attention began to shift to an evaluation of the *meaning* of gender for individuals" (p. 79). The subjectivity entailed within the understanding of gender itself was left to be explored. Materialist feminists had unearthed the structural components, so the discursive approach was left to problematize the gender categories themselves. Gender was moving away from a 'thing' worthy of challenge to a 'process' worthy of deconstruction. Shifting and context-dependent comprehensions of gender, in which individuals did not wholly accept or conform to dominant ideologies, were made apparent.

Discursive analysis draws from both postmodern and poststructuralist thought. These two terms are often presented together as if they were interchangeable. Although, in other texts, they are treated as being completely different. Whereas they do have the ability to inform each other, postmodernism and poststructuralism stem from two different sources (modernism and structuralism, respectively), thus carrying with them certain presuppositions and theoretical baggage. I will describe the main aspects of poststructuralism through my subsequent sections on Michael Foucault and Judith Butler. First, however, I will briefly describe the aspects of postmodernism that directly relate to feminist research.

Consistent with its rejection of universal truths, postmodernism denies that there are set, preexisting terms such as 'man' or 'woman.' Rather, individuals from highly subjective positions, with continuously varying life experiences, constitute those concepts. Hence, "the meanings we give are never fixed and closed" (Alsop et al., 2002,

p. 81). Also, this perspective rejects "notions of a coherent unified self, capable of rational reflection and agency, in favour of a model of self which is fragmented, constantly in a process of formation, constituting itself out of its own self-understandings" (Alsop et al., 2002, p. 81). Gendering becomes a process full of subjectivities and inconsistencies, rather than a predetermined label. Thus, the materialist reliance on women's experiences is challenged by questioning the very notion of 'women' itself. Complicating subjectivities and keeping the notion of "woman" in play allows my study to rely less on the constructed dichotomy of homogeneous categories of male and female and to and more on nuanced and fluid accounts of masculinities and femininities. By postmodernism denying the existence of universal truths, there can be no universal woman and no universal set of women's experiences from which to generalize. Crotty (1998) provides a useful explanation of postmodernism's complexity:

> Postmodernism refuses all semblance of the totalizing and essentialist orientations of modernist systems of thought. Where modernism purports to base itself on generalized, indubitable truths about the way things really are, postmodernism abandons the entire epistemological basis for any such claims to truth. Instead of espousing clarity, certitude, wholeness and continuity, postmodernism commits itself to ambiguity, relativity, fragmentation, particularity and discontinuity. (p. 185)

Using this perspective to understand gender is a far cry from biological essentialism.

Discursive accounts of gender place "emphasis on the *meanings* which are attached to being male or female within society, emphasizing the role of language and of culture" (Alsop et al., 2000, p. 65). Foucault, an important contributor to postmodern thought, conceives of discourse in a broad manner.

> For Foucault discourses are anything which can carry meaning. Language, images, stories, scientific narratives and cultural products are all discourses. But discourses are also things we do. Social practices like segregating work, giving

> away the bride in marriage, and so on, also carry meaning. (Alsop et al., 2000, p. 81).

Thus, to give a discursive account of gender is to examine how individuals, within specific social settings, create and negotiate gender. To illustrate this discursive perspective, I will focus on the work of Judith Butler.

Drawing on the postmodern and poststructuralist work of Foucault and Derrida, Judith Butler (1999) claims that gender is a *performance*, continually changing, and not an inherent aspect of whom a person is. This places identities in a state of flux and challenges the belief that they are "persisting through time as the same, unified and internally coherent" (p. 22). Butler believes that "identities can come into being and dissolve depending on the concrete practices that constitute them" (p. 22). The relationship between identity and gender is clarified by her discussion of the *doer* and the *deed*.

> Gender is always a doing, though not a doing by a subject who might be said to preexist the deed….There is no gender identity behind the expressions of gender; that identity is performativity constituted by the very 'expressions' that are said to be its results. (Butler, 1999, p. 33)

Rather than being a linear *product* of a natural essence or "identity," the performance of gender instead works to *create* that identity of the actor. "There need not be a 'doer behind the deed,' but that the 'doer' is variably constructed in and through the deed" (p. 181). I take this to mean a certain fixed identity is not required to pre-exist behind certain gendered practices. If fact, it is only through a successful performance does one achieve the label of woman. For example, one does not have to be a woman to engage in "feminine" practices. However, one must successfully perform feminine practices to be securely positioned within the category of woman. This calls into question feminism's defining of subject. "A great deal of feminist theory and literature has nevertheless assumed that there is a 'doer' behind the deed" (p. 33). Butler would argue that if indeed gender is a performance that can be constantly adapted and modified, how could feminism claim to be about only women stakeholders? She takes issue with the notion

of solidarity and unity that seems important to feminism. "The insistence in advance on coalitional 'unity' as a goal assumes that solidarity, whatever its price, is a prerequisite for political action" (p. 20). Not only does this prerequisite represent a possible waste of time and resources, it may in fact be damaging.

> Does "unity" set up an exclusionary norm of solidarity at the level of identity that rules out the possibility of a set of actions which disrupt the very borders of identity concepts, or which seek to accomplish precisely that disruption as an explicitly political aim? (Butler, 1999, p. 21)

To cement feminist membership as being only for 'women,' is to limit the range of possibilities that can be used for social change. It assumes a specific *doer* behind the *deed*. However, what does this do to a materialist feminist standpoint theory that relies on such a membership for political action? This is a tension that I will explore later in negotiating a research agenda that attempts to draw on both accounts of gender.

As universal notions are challenged by postmodern cultural studies that explicate how gendered oppression changes from context to context, Butler (1999) argues that the same should hold true for the category of women: "My suggestion is that the presumed universality and unity of the subject of feminism is effectively undermined by the constraints of the representational discourse in which it functions" (p. 7). If this is not done, she believes that feminism then contributes to the existing system of binaries that limit the range of gendered expressions. "Is the breakdown of gender binaries… so monstrous, so frightening, that it must be held to be definitionally impossible and heuristically precluded from any effort to think gender" (Butler, 1999, p. viii)?

A more complete understanding of this relationship between gender and identity provides more ways to subvert the existing structure. "The reconceptualization of identity as an *effect*, that is, as produced or generated, opens up possibilities of 'agency' that are insidiously foreclosed by positions that take identity categories as foundational and fixed" (Butler, 1999, p. 187). Butler pushes feminism to better tackle the ways in which this performance can be used as a tool for change. Rather than shutting down possibilities, feminism should allow individuals a greater range of doing gender

differently. Moving beyond genders into sexualities, Butler (like Foucault) sees them as social constructions as well: "Gay is to straight *not* as copy is to original, but rather, as copy is to copy" (p. 41). Rather than seeing homosexuality as a constructed variant of a 'natural' heterosexuality, Butler sees both homosexuality and heterosexuality as social constructions. She views a greater diversity in the gender performance possibilities (as well as sexuality labels) as key to social change. Butler

> wishes to destabilize and denaturalize our binary gender categories. She rejects any view that gender differences have an origin in our biological or psychic natures, arguing instead that they are effects of contingent social practices. This opens up the possibility that they could be remade in different ways. (Alsop, Fitzsimons, and Lennon, 2002, p. 94)

While social constructionist accounts of gender have long since abandoned the notion that gender is biologically fixed, Butler goes one step further. She claims that biological sex too is a social construction.

> The goal of such destabilization is to make visible the performativity of gender, to render it evident that neither gender nor sex is a natural category – indeed, that the very idea of a 'natural' category is simply an effect of discourse. (Alsop et al., 2002, p. 105-106)

Because heterosexuality (a social obligatory norm) requires two sexes, that is how we categorize people: either male or female. A social construction (heterosexuality) thus provides the framework with which we currently understand biology (Alsop et al., 2002). Intersexed individuals or people who transition between sexes find little legitimacy within this constructed dualism. To further explain the social construction of sexualities and its relationship to how we understand gender, I turn to the work of Michel Foucault.

In his *History of Sexuality*, Foucault (1990/1976) deconstructs our taken-for-granted assumptions about sexuality. With an exceptionally anti-essentialist stance, he locates sexuality within a historical context and illustrates how, via an increase in the quantity and complexity of discourse about sex, that it is a social construction. He

implies therefore that there is a subjective nature to the way we currently bring into play sex and sexuality to define ourselves.

In order to convince us of this, Foucault (1990/1976) first challenges 'the repressive hypothesis' and illuminates how in fact the opposite has occurred: the flowering of a discourse about sex. According to Foucault, we are not in the process of finding liberation and freedom by our creative, newly found, sexual expression. Instead, we are simply continuing to add to a long line of "calling sex by its name" (p. 17).

Foucault (1990/1976) views the social construction of sexuality as a significant aspect to recognize. An example of this is his standpoint on homosexuality. He argues that as the discourse about sex increased and grew in complexity, the scientific community began to see homosexuality "less as a habitual sin than as a singular nature" (p. 43). Homosexuality "became a personage" and "the homosexual was now a species" (p. 43). Foucault relates how over time, science "concerned itself primarily with aberrations, perversions, exceptional oddities, pathological abatements, and morbid aggravations" (p. 53). This new focus for science constituted another unique form of discourse, illustrating how power relations among competing discourses creates change. As medical categorization of 'perversion' continued, and social stigmatization increased, gay and lesbian individuals (previously just individuals who engaged in same-sex practices) began to defend themselves. "Homosexuality began to speak in its own behalf, to demand that its legitimacy or 'naturality' be acknowledged, often in the same vocabulary, using the same categories by which it was medically disqualified" (p. 101). Being gay, having a gay identity, according to Foucault, resulted from the scientific community and the gay community using the same "discourse of power" (p. 101) for two different purposes. Through this matrix of increased discourse, acts of sodomy became a homosexual identity. "It was time for all these figures, scarcely noticed in the past, to step forward and speak, to make the difficult confession of what they were" (p. 39).

Another important theme for Foucault (1990/1976) is the notion of *power* and how it relates to the increased discourse about sex. Within the confines of commonsense, everyday language, we currently categorize power as usually a negative force, a push for

"limit and lack" (p. 83). Foucault refers to this as the *juridico-discursive* representation of power that creates a "law of prohibition" (p. 84) and is constantly punitive. Foucault argues that we should "cease to conceive of [power] in terms of law, prohibition, liberty, and sovereignty" (p. 90). Instead of the *juridico-discursive* model, he makes the point that power is "always local and unstable" rather than existing as large power-centers; it is productive as well as restrictive. "Power is not an institution, and not a structure; neither is it a certain strength we are endowed with; it is the name that one attributes to a complex strategical situation in a particular society" (p. 93). Foucault's power is more of a grassroots concept that works within everyday situations of discourse and social relations. "It is in discourse that power and knowledge are joined together" (p. 100). This is a major tenet of poststructural thought that drives much of its research applications. Foucault also argues that there can never be power without some form of accompanying resistance. However, just as power does not solely exist as an exterior, institutionalized presence, neither does resistance. Foucault describes a "multiplicity of points of resistance" (p. 95) that, like power, "ends by forming a dense web that passes through apparatuses and institutions, without being exactly localized in them" (p. 96).

Returning to Butler's theory of performativity, Foucault's notion of local, everyday power resurfaces. Rather than viewing power as a formidable, exterior, negative influence, she "shares with Foucault the view that power is not only prohibitive but also enabling" (Alsop et al., 2002, p. 100). While nonconformist gender performances can result in social punishment, they themselves are also powerful vehicles for social change. In order to explicate Butler's push for social change through performativity, the notion of *iterability* must be illustrated.

Alsop et al. (2002) note how structural accounts of meaning are seen as fixed. However, Butler draws on the poststructural work of Derrida to challenge this stability.

> Within post-structuralist accounts, however, such fixity of meaning is challenged. Central to this is the view that meaning has a temporal dimension. The meaning of a word is dependent on temporal history of usages. Whenever we use a term, according to Derrida, we are engaged in an act of citation. We are repeating a

> term, echoing its previous usages. This repeatability, termed *iterability*, does not always produce stability in meaning. For although we can repeat the term we do so in different contexts and circumstances and these affect the meaning which is to be derived from it, rendering it indeterminate and not always predictable. (Alsop et al., 2002, p. 103)

When performances of gender are conducted, they engage in this iterability by repeating and calling up previous notions of gender within certain situations. "In different contexts and times a repetition can take on a different meaning, undermining or subverting the dominant norms" (Alsop et al., 2002, p. 103). Iterability creates the freedom for change to occur and for the dominant gender dogma to be challenged. Performing gender, either traditionally or alternatively, takes on the possible power of transforming what "gender" means as it is repeated within different social situations.

Thus, such discursive accounts of gender place the focus of change on our constructed meanings about gender. However, one criticism of conceiving gender in this manner is that it de-emphasizes the role of material conditions. Connell (1998) articulates this position:

> Conceptions of gender that emphasize performance risk truncating the whole field. Gender is not only a system of signs and meanings; it involves the material labor of housework and machine minding, the accumulation of wealth, the materialities of violence and power, pregnancy and child rearing, and so on. Our models should not privilege the symbolic dimension of social practice over all others. (Connell, 1998, p. 475)

Connell's hesitation is very useful and points again in the direction of that productive tension that exists between highly discursive and more materialist accounts of gender. Thus, the study of gender requires a more holistic view that incorporates both the daily, discursive aspects of doing gender as well as the historically mediated material conditions that influence it. Why do we see our current conceptualizations of gender as natural? What forces, both within and external to, interpersonal interactions work to maintain or challenge this inequitable and dualistic understanding?

Doing Gender

West and Zimmerman's (1987) seminal conceptualization of "doing gender" is crucial to my understanding of gender as a social construction. It is one of the first pieces of research I read concerning the social construction of gender and it has remained highly influential to my thinking. Their notion of "doing gender" does not consider gender as an innate characteristic of an individual, but as something created during social interactions. "A person's gender is not simply an aspect of what one is, but, more fundamentally, it is something that one does, and does recurrently, in interaction with others" (p. 140). One can begin to draw associations with this understanding of gender and Butler's (1999) *doer/deed* concept that views gender as a performative effect. Importantly, this doing of gender is contextually dependent and draws influence from not only the individual, but also the institutional and interactional arenas.

> In one sense, of course, it is individuals who "do" gender. But it is a situated doing, carried out in the virtual or real presence of others who are presumed to be oriented to its production. Rather than as a property of individuals, we conceive of gender as an emergent feature of social situations: both as an outcome of and a rationale for various social arrangements and as a means of legitimating on of the most fundamental divisions of society. (West & Zimmerman, 1987, p. 126)

This combination of macro- and micro-levels of gendered analysis is one that I feel is highly effective. It places the seat of gender within everyday interactional contexts, while at the same time appreciating external influences such as societal norms.

To better understand this theory, I will explicate their very useful distinctions between sex, sex category, and gender. According to West and Zimmerman, one's *sex* is determined by an agreed upon set of biological criteria that categorizes an individual as either male or female. This is usually done at birth by visual recognition of genitalia or via chromosomal analysis. Here parallels can be drawn to Butler's notion that sex, in addition to gender, is socially constructed and influenced by discursive power relations. In addition to *sex*, membership in a *sex category* (either male or female) is achieved by displaying recognizable physical or behavioral cues on a moment-to-moment basis.

Finally, *gender* is something that is *done*, or *accomplished*, on an everyday basis and is context-dependent. "Gender…is the activity of managing situated conduct in light of normative conceptions of attitudes and activities appropriate for one's sex category" (West & Zimmerman, 1987, p. 127). For example, a physician recognizes a vagina at the time of birth and places that infant in the female *sex*. Afterward, others place this individual into the *sex category* of female by observing factors such as appearance and actions. These appearances and actions are ways in which this female *does gender* in her everyday life. She is held accountable for her doing gender (either as appropriate or inappropriate) with reference to her perceived sex category and the context to which this *doing* takes place. Her doing gender allows others to a) place her in one of two sex categories and b) place judgment on the appropriateness of her moment-to-moment practices. Unless this individual is undressed, her membership into the female sex is not available for public consideration; therefore, her sex category stands in proxy.

If this individual's doing gender is assessed as appropriate (doing gender which is contextually suitable for her sex category), then all involved are also implicated in reinforcing the naturalness of this female's behavior as feminine. Because of the patriarchal nature of our society, this reinforcement of female essence bolsters the existing inequity along gender lines. "If we do gender appropriately, we simultaneously sustain, reproduce, and render legitimate the institutional arrangements that are based on sex category" (West & Zimmerman, 1987, p. 146). Thus, three main assertions arise from this argument: 1) gender is done/accomplished within a social context, 2) individuals are held accountable for their doing gender, and 3) as individuals do gender, they reinforce the naturalness of existing gender inequalities within institutions.

Explicating this perspective of doing gender, West and Fenstermaker (1993) conceptualize gender as a *situated accomplishment*, implying "that we must locate [gender's] emergence in social situations, rather than within the individual or some ill-defined set of role expectations" (p. 157). They provide an example of how one simultaneously *does* gender while *doing* daily activities. Drawing on Hochschild's

(1983a, 1983b) research of airline flight attendants, West and Fenstermaker (1993) relate that

> women flight attendants served as airline "shock absorbers," placating and soothing mishandled passengers in ways that insulated the company from potential complaints. By contrast, men flight attendants were used as authority figures, charged with tasks such as managing "uncontrolled" passengers or settling differences between occupants of different seats. (p. 165)

Doing gender is thus interrelated to doing specific practices at work. West and Fenstermaker make the claim that because of gender's *interactional* and *omnirelevant* nature, people find it almost impossible to avoid rendering their "actions accountable in terms of normative conceptions of manly and womanly natures" (p. 170). However, they comment that although this accountability is unavoidable, collective social movements can indeed promote change and "by calling into question particular institutional practices based on sex category, promote alternatives to those practices" (p. 171). We will always *do* gender. Nevertheless, we can confront institutional norms that restrict this *doing* by challenging its seemingly inherent naturalness.

> What we have, then, is an essentially interactional and ultimately institutional undertaking. From this perspective, gender is much more than an attribute embodied within the individual, or vaguely defined set of role expectation. Here, gender becomes as theoretically central to understanding how situated human interaction contributes to the reproduction of social structure as is its practical importance to daily affairs… (Fenstermaker, West, & Zimmerman, 2002, p. 30).

The feedback relationship between practice and structure draws parallels to Butler's use of nonconformist gender performances within new contexts to promote social change.

Moloney and Fenstermaker (2002) provide a useful comparison of Butler's *gender as performance* and West and Zimmerman's (1987) *doing of gender* [including West and Fenstermaker's (1993) gender as a *situated accomplishment*]. While each of these camps has different theoretical orientations (Butler from poststructuralism and West

and Zimmerman from ethnomethodology and symbolic interactionism), there are several similarities.

> In Butler's theory, gender is discursively constituted; gender is 'performed' through discourse, broadly defined. In West and Fenstermaker, gender is interactionally produced; gender is "done" in interactions, broadly defined. While discursivity may not be synonymous with interaction, Butler uses a very broad model of discourse, while West and Fenstermaker have expanded our notions of interaction. (Moloney & Fenstermaker, 2002, p. 194)

Doing and *performing* gender are interactional aspects of daily life that take place in social situations with others. Neither Butler nor West and Zimmerman place sole responsibility on macro/social factors (e.g., sex role socialization) or micro/individualist factors (e.g., a pre-gendered self) to completely understand gender. However, they both recognize that gendered norms that are perpetuated on a cultural level (e.g., compulsory heterosexuality or normative understandings of feminine/masculine) work to regulate the ways we do/perform gender. Both formulations place an emphasis on accountability. While there are several similarities, I agree with Moloney and Fenstermaker's (2002) assertion that "the two frameworks should not be used interchangeably or treated as synonymous with one another" (p. 203). However, I feel that my understanding of West and Zimmerman's *doing/accomplishing gender* is enriched by the discursive contributions of Butler's *theory of performativity*.

Femininities and Masculinities

Connell (1987, 1995) explores gender beyond its dualistic conception as one form of masculinity vs. one form of femininity. "Often it is assumed that there is just one set of traits that characterizes men in general and thus defines masculinity. Likewise, there is one set of traits for women, which defines femininity" (1987, p. 167). This type of assumption is found in sex role research where differences between men and women are seen as natural and something that socialization builds upon to create masculine and feminine individuals. However, Connell (1987) remarks that such a conceptualization of gender is "plastic" and only "provides a gloss" (p. 170):

> It is clear that unitary conceptions of sexual character have a wide appeal and can give comfort to people of very different political persuasions. This is partly because having a unitary conception of feminine or masculine character does not in itself settle what the content of the two opposed characters might be. Speculation, assertion and inference from biology are the order of the day. (p. 168)

In order to avoid this "systematic confusion between 'sex difference' and 'masculinity/femininity' (p. 172), Connell discusses several types of genders which range from emphasized femininity to hegemonic masculinity. He notes that our use of the terms themselves (masculinity and femininity) indicates flux and complexity.

> If we spoke only of differences between men as a bloc and women as a bloc, we would not need the terms 'masculine' and 'feminine' at all. We would just speak of 'men's' and 'women's', or 'male' and 'female'. The terms 'masculine and feminine' point beyond categorical sex difference to the ways men differ among themselves, and women differ among themselves, in matters of gender. (Connell, 1995, p. 69)

This range of genders indicates a range of *practices*; ways of *doing gender* that extend beyond *performing* as either a male or a female. Thus, gender is a wide range of practices that are engaged in within different social contexts and different historical times.

In *Masculinities*, Connell (1995) describes numerous forms of masculinity: hegemonic, subordinated, complicit, and marginalized. To begin with, Connell (1995) defines *hegemonic masculinity* as "the configuration of gender practice which embodies the currently accepted answer to the problem of the legitimacy of patriarchy, which guarantees (or its taken to guarantee) the dominant position of men and the subordination of women" (p. 77). Realizing that not all men engage in this form of masculinity opens up the door to seeing patriarchy working not only between men and women, but also among men themselves. This is critical to his understanding of patriarchy as something among *all* individuals, not as just a static male/female tension. At the bottom of this

masculinity hierarchy, according to Connell, are homosexual masculinities. "Hence, from the point of view of hegemonic masculinity, gayness is easily assimilated to femininity. And hence – in the view of some gay theorists – the ferocity of homophobic attacks" (p. 78). This is an example of a *subordinated masculinity*. However, Connell quickly points out that other traits beyond gayness (such as nerdiness, weakness, or cowardice) are also subordinated, thus, "heterosexual men and boys too are expelled from the circle of legitimacy" (p. 79). Although not all men engage explicitly in hegemonic masculinity, many more do so by implicit actions. "Marriage, father-hood and community life often involve extensive compromises with women rather than naked domination or an uncontested display of authority" (p. 79-80). This *complicit masculinity* results in individuals indirectly tapping into, and benefiting from, the practices of hegemonic masculinity. Finally, *marginalized masculinities* incorporate race and class issues to the mix. "Marginalization is always relative to the *authorization* of the hegemonic masculinity of the dominant group" (p. 81). While these categories are defined as separate, I would assume that a gay, African-American, lower-class feminist male, for example, would embody a mix of these masculinities and engage in them within different social contexts. By recognizing such a variety of genders, research can move beyond male vs. female accounts toward a more holistic analysis.

Undoing Gender

Ultimately, I hold the elimination of gender *altogether* as a definitive goal. This stance is best articulated by Judith Lorber (2000) who calls for a "feminist degendering movement" (p. 80) that would do away with the ubiquitous arrangement of gender divisions on the whole. She argues that while feminism strives for equity among men and women, the gender division is consistently seen as natural and standard. "From a social constructionist structural gender perspective, it is the ubiquitous division of people into two unequally valued categories that undergrids the continually reappearing instances of gender inequality" (p. 80). Therefore, unless gender is done away with altogether, patriarchy will continue to reinvent itself to sustain inequity. "The legitimacy of the gendered social order can be subverted at the level of its underlying discourse – its

biological assumptions, its binarism and its socially constructed gender differences" (Lorber, 2000, p. 88). Risman (1998) remarks, "While gender is a social structure, it is a human invention and thus subject to reinvention and re-creation" (p. 156). What role can science education play in this reinvention, and eventual deconstruction, of gender? "As feminists, we need a gender perspective to make this structure visible. But we also need to think beyond gender to the possibilities of a non-gendered social order" (Lorber, 2000, p. 81).

Connell's (1995) and Risman's (1998) use of the term "gender vertigo" is appropriate here. While the ultimate decomposition of gender is the aim, the initial effect will be this feeling of "gender vertigo" that Risman describes as "the dizziness that we would feel without gendered selves and interactional expectation to give meaning to our lives" (p. 151). This will inevitably lead to power struggles and resistance, especially from those most benefiting from the existing gender structure. "Opposition is not just 'resistance', it brings new social arrangements into being (however partially)" (Connell, 1995, p. 229). We will also have to explore how these new social arrangements impact our current understandings of science teaching and learning.

Feminist and Poststructuralist Tensions

The previous sections have highlighted two varying accounts of gender: materialist (e.g., Harding's feminist standpoint theory) and discursive (e.g., Butler's theory of performativity). These two theoretical conceptualizations of gender pose two very different ideas about what it means to be a "woman" or a "man." Feminist standpoint theory (and much of feminism in general) requires some sort of coherent subject on which to base its *identity politics*. bell hooks (1994) remarks that "identity politics emerges out of the struggles of oppressed or exploited groups to have a standpoint on which to critique dominant structures, a position that gives purpose and meaning to struggle" (p. 88-89). Thus, there must be a somewhat, stable identity of "woman" (or any other oppressed group) from which to ground marginality and to point out a political strategy. This notion of gender is much more stable than it is within Butler's notion of performativity (or within queer or poststructuralist frameworks).

Butler, in noting that there need not be a *doer behind the deed*, places feminist identity politics under suspicion. Is a womanly identity something stable or something in flux? How can one recognize diversity among women (among all types of feminine gender) while still claiming a political standpoint? How does one recognize the material conditions of women, while at the same time, realize the gender fluidity and context/power dependency that highly discursive frames point out? Several theorists and researchers, some within the field of education, are pointing to feminist poststructuralism as a way to answer some of these questions. However, rather than a simple blending of these two theories about gender, feminist poststructuralism recognizes that the tension between the two camps can be turned into a productive force.

bell hooks (1994) offers a similar exploration of this apprehension that surrounds deconstructionist practices of the marginalized subject, with particular emphasis on race and gender. She discusses the fact that a critiquing of "'subjectivity, essence, and identity' can seem very threatening to marginalized groups, for whom it has been an active gesture of political resistance to name one's identity as part of a struggle to challenge domination" (p. 78).

My aim is to use materialist accounts of gender, such as standpoint theory, to validate the experiences of marginalized locations within the social structure. As Lorde (1984) eloquently put it, "The master's tools will never dismantle the master's house" (p. 112) so we must look elsewhere (e.g., to marginalized sources of knowledge) for the answers to the inequitable gender situation within science education. The epistemological tools found within marginalized locations (my own included) are imperative for this work. However, at the same time, I see this as merely an important starting point, a stepping-stone that must be used in order to push forward with political power. To go beyond standpoint theory and incorporate more discursive accounts of gender allows me to weaken the ties between gender and biological assumptions about sex, incorporate a wider range of gendered practices, and to focus on how the existing gender order is maintained/challenged within everyday interactions in particular contexts. I have found feminist poststructuralism to be the most insightful path to take when

placing this understanding of gender and identity within the context of teaching and learning.

Feminist Poststructuralism

In order to question the taken-for-granted ways in which we "word the world," (St. Pierre, 2000, p. 483) poststructuralist analysis relies, in part, on the tenets of competing discourses, non transparency of language, Foucaultian notions of power relations, and knowledge that is always partial and in flux (Ropers-Huilman, 1998). A poststructuralist lens can thus interrogate how taken-for-granted aspects of language work to fix certain meanings and legitimate certain knowledge.

Language. "Within poststructuralist theory, language is understood as the most powerful constitutive force shaping what we understand as possible and what we desire within those possibilities" (Davies, 2000b, p. 181). Poststructuralism's understanding of language comes from the work of structural linguist de Saussure (1959), as well as modifications of his theories by Derrida (1976). In essence, de Saussure's assertion is that words have no intrinsic meaning within themselves (i.e., they do not naturally correspond to some specific facet of reality). Instead, words acquire meaning from their relationships with other words. Weedon (1997) gives the example of how the word "whore" has no intrinsic meaning until it is understood in relation other words such as "virgin" or "mother" (p. 23). This notion of meaning through difference helps to shatter humanistic understanding of a transparent language that directly and naturally reflects reality. Drawing on the work of Bakhtin (1986), Britzman (1992) remarks that "language is always a negotiation because words are slippery and elusive; they bear the capacity to assert another intention, another meaning, another word" (p. 31).

St. Pierre (2000) explains how poststructuralism taps into the work of Derrida to develop de Saussure's understanding of language. In addition to removing any inherent connection between language and reality, Derrida's practices of *deconstruction* allows us to see that a word's meaning also shifts over time and place; it is highly context-dependent. Thus, "we can never know exactly what something means – we can never get to the bottom of things. Once this idea takes hold, neither language nor philosophy can

ever be the same" (St. Pierre, 2000, p. 481-482). Once we see how language is used to *create* reality, rather than to merely *reflect* it, we open up greater possibilities for change. When language becomes a unit of analysis, we can investigate the ways in which classroom language shapes not only how a discipline is represented, but also how it provides and limits ways for individuals to make sense of their lives. Language can thus be seen as "truly social and a site of political struggle" (Weedon, 1997, p. 23).

One important target of such deconstruction is binary categories, such as the everyday understanding of gender (i.e., the female/male dualism). Davies (2000a) comments that if we conceptualize "language as merely a tool for describing, then sex/gender can only be seen as a natural fact of human existence" (p. 43). However, a poststructural understanding of language gives us the ability to see how we all are active participants in either reproducing or challenging the linguistic scaffolding that in turn gives shape to this inequity. Therefore, a poststructural theoretical perspective on language is more than an analytical tool; it is an awareness of ethical responsibility. "Poststructuralism does not allow us to place the blame elsewhere, outside our own daily activities, but demands that we examine our own complicity in the maintenance of social injustice" (St. Pierre, 2000, p. 484). Science education is not exempt from such a responsibility. In fact, due to the entanglement of masculinity and science, as well as the degree to which the authoritative language and practices of science are often used to bolster commonsense notions of sex and gender, I would argue that the science classroom is a fundamental place for such a responsibility to be fleshed out.

Knowledge and Power. If we understand that our perception of reality is created from *within* language, rather than simply *reflected* by it, then we can begin to see the significance of Foucault's power/knowledge affiliation. Inequitable power relations influence what becomes legitimate knowledge by dictating what can be said and by whom. Weedon (1997) points out, for example, how the discourse of advertising creates a certain image of women and femininity that is positioned under "the male gaze" (p. 22). This can be contrasted to other discourses, such as Christianity, which may value virginity or motherhood. We do not possess fixed knowledge of what a "woman" is; the

definition of "normal" is context dependent and influenced by power relations among available discourses.

Those who benefit from being at the top of power relations are more apt to have their knowledge legitimated into the realm of common sense. '"Knowledge that is viewed as complete and true in a given social context varies over time, and those whose knowledge is most highly regarded in any such context are often defined as those with the greatest power" (Ropers-Huilman, 1998, p. 6). According to Foucault (1990), this power exists not as a monolithic *restrictive* force from above, but emerges from uneven associations, thus making it a *productive* force that is always "local and unstable" (p. 93). A deconstructive analysis of language, combined with an examination of power relations, gives us insight into the manner through which legitimate knowledge is constructed (and usually framed as commonsense or natural). "All categories of knowledge are historical and social constructions and connected to issues of power since knowledge has always been used both to communicate and to control" (Adams, 1997, p. 18). Knowledge then is at all times partial and political, rather than an aspect of any universal truth.

Discourse. For poststructuralism, the notion of *discourse* is a prevailing concept because "it is in discourse that power and knowledge are joined together" (Foucault, 1990, p. 100). Within previous sections concerning the discursive accounts of gender, I have used a broad definition from Foucault of discourse as anything than could carry meaning. While the majority of feminist poststructuralist notions of discourse have theoretical roots within Foucault, there are other ways of talking about discourse that may provide a richer understanding of this important tenet of the theory. I present here two that have been useful within my own grappling with poststructuralism. Discourse is:

- "socially and culturally produced patterns of language, which constitute power by constructing objects in particular ways" (Francis, 1999, p. 383)
- "a regulative body of ideas and knowledge that delimits the kind of questions that can be raised and governs the construction of meaning. As such, discourses are constitutive" (Hughes, 2000, p. 430)

Both of these understandings of discourse illustrate both the regulatory and productive functions of discourse. This is important in understanding the dual nature of being subjected to a discourse, as I explain later. One important aspect to add at this time is that discourses themselves are not static. They are constantly experiencing duplication and modification as individuals engage in their associated language and cultural practices.

Weedon's (1997) explanation of the functions of discourse within poststructuralism moves into an understanding of how discourses shape identity.

> Discursive fields consist of competing ways of giving meaning to the world and of organizing social institutions and processes. They offer the individual a range of modes of subjectivity. Within a discursive field, for instance that of the law or the family, not all discourses carry equal weight or power. Some will account for and justify the appropriateness of the status quo. Others will give rise to challenge the existing practices from within or will contest the very basis of current organization and the selective interests which it represents. Such discourses are likely to be marginal to existing practice and dismissed by the hegemonic system of meanings and practices as irrelevant or bad. (p. 34-35)

Weedon describes a process by which competing discourses vie for the manner in which a person makes sense of their experiences, thus the very way in which they define themselves. Thus, "to know anything is to know in terms of one or more discourse" (Davies, 2000a, p. 88). This knowing happens from particular location or *position* within a web of discourses.

Identity in Flux via Discursive Positioning. Within this first foray into doing research within poststructuralism, I see the most important theoretical underpinning being its break from traditional humanist notions of identity. Humanism relies on a very stable, coherent sense of identity – a rational self defined by transparent language and reliable experiences. "From early childhood we learn to see ourselves as unified, rational beings, able to perceive the truth of reality. We learn that, as a rational individual, we should be non-contradictory and in control of the meaning of our lives" (Weedon, 1997, p. 76).

Instead, poststructuralism challenges this "myth of the unitary person" (Davies, 1989) and its authority to hold onto inherent meanings of past experiences. From a poststructural perspective, an individual can be comprised of several "possible selves located in different story-lines. Like history, the person is disjointed until and unless located in a story. Since many stories can be told even of the same event, the we have many possible coherent selves" (Davies, 1989, p. 229). In order to pick a self, to settle down into a comfortable storyline, the individual must tap into a discourse that provides the language (and cultural practices) needed to construct an intelligible subjectivity. Pick another discourse and you become part of another storyline; the "I" becomes flexible. Davies (1998) remarks how this process, by and large, goes unnoticed: "Our subjectivities are experienced as if they were entirely our own because we take on the discursive practices and story-lines as if they were our own and make sense of them in terms of our own particular experiences" (p. 230). Therefore, breaking from humanism presents poststructuralism with an extremely effortful burden: to make explicit a way of knowing that is incredibly ingrained and taken for granted in our daily lives. St. Pierre (2000) comments that this is difficult because humanism is so very *natural* and *commonplace*:

> It is the air we breathe, the language we speak, the shape of the homes we live in, the relations we are able to have with others, the politics we practice, the map that locates us on the earth, the futures we can imagine, the limits of our pleasures. (p. 478).

In terms of conducting research in educational settings with poststructural frameworks, a break from humanism can also work to further separate researcher and researched. This was something that I had to be quite conscious of during my interactions with the participants, especially during member checking where we discussed the interpretations of findings.

Poststructuralism challenges the very ways in which we talk about our experiences and ourselves. The culturally specific resources made available at any one moment of interpretation will determine how an individual makes sense out of life and

self. Poststructuralism would argue that no longer am "I" the simple sum of a set of fixed experiences. Instead, "I" shift and change as I gain access to new sets of meanings. My identity is a constantly renegotiated effect, an ongoing process rather than a pre-determined essence. "The repudiation of a fixed self means that gender is not fixed, but that the self is positioned in gender discourse" (Francis, 1999, p. 383).

Davies (2000a) remarks that the "constitutive force of each discursive practice lies it its provision of subject positions" (p. 89). In other words, each discourse provides an array of normal, intelligible identities with which individuals can identify and take up. Francis (1999) gives the useful example of how two competing discourses can give very different accounts of what it means to be a woman. "A housewife, for example, could be positioned as fulfilling her natural role through traditionalist discourses of gender essentialism, or could be positioned as a victim of oppression in some types of feminist discourse" (p. 383). To take up a particular subject position is to become *subjected* to that discourse. Individuals are not "passively shaped by active others, rather they actively take up *as their own* the discourses through which they are shaped" (Davies and Banks, 1992, p. 3). This process of subjection is a two-edged sword. In once sense, it provides the individual with a productive means of making sense of the world. On the other hand, it limits and sets boundaries on this process, constructing other ways of knowing as marginal and out of reach. "The assumption by the individual of a particular form of subjectivity is at the expense of the qualities, structures of feeling and thought offered in competing forms of subjectivity and denied by the one that the individual assumes" (Weedon, 1997, p. 92).

Thus, from a poststructuralist perspective, identity is not a fixed entity, but rather a constantly unfinished project, swarmed upon by a variety of competing discourses (Britzman, 2000; Davies, 2000a; Evans, 2002; Jackson, 2004; Ropers-Huilman, 1998; St. Pierre, 2000; Weedon, 1997). If we understand identity to be constructed within discursively bound language, then we can interrogate how that language creates/limits the range of possible (gender) (science) identities. "We need to grasp the range of possible *normal* subject positions open to women, and the power and powerlessness invested in

them" (Weedon, 1997, p. 18). This is particularly poignant in to science education in light of Barton's (1998b) concerns about how we discursively construct both "normal" science and "normal" self-in-science. How this range of normal possibilities is legitimated within classroom science is part of my research agenda.

With multiple discourses being available at any one moment in time, each with certain legitimized meanings for maleness and femaleness, individual agency in choosing to become an author in any particular discourse becomes an important point of analysis. As Davies (1989) comments, "Choice-points between one discourse and another are critical moments in the development of each individual identity" (p. 238). For science teachers, these moments can open up (or restrict) a novel array of science subject positions. The *means* by which these moments of resistance emerged become just as valid as their liberatory *ends*. Tracing teachers' movements among available discourses makes explicit "how power circulates and surprises" and "how subjects spring from the discourses that incite them" (Britzman, 2000, p. 38). Thus, poststructuralism allows us to view the manner in which individuals are able to "resist those normalizing inscriptions and their material effect by moving from a discourse where only certain statements can be made to another where different statements are possible" (St. Pierre, 2000, p. 503). In contrast, such insight is drastically limited when the notion of (gender) (science) identity remains defined within humanism as a fixed and stable concept.

As stated before, traditional feminism requires a rather stable "woman" subject from which to conduct its political efforts. This is true within any version of identity politics, including race, sexual orientation, religion, etc. One needs a coherent and unified category in order to mark a place within power relations and stake one's marginality. Poststructuralism's notions of identity in flux challenges this by keeping the subject in play; what "woman" means shifts over time and place. "For poststructuralism, femininity and masculinity are constantly in process, and subjectivity, which most discourses seek to fix, is constantly subject to dispersal" (Weedon, 1997, p. 96). There is a clear distinction between feminism's reliance on the subject of "women" and poststructuralism's desire to keep identity in play. This tension is used as a productive

one within feminist poststructuralism, which validates the political base of identity politics (such as feminism), while challenging the dominant language practices and finding value in studying discursive positioning. I hope that my research is in concert with Weedon's (1997) striving to "hold on to feminism as a politics which much have tangible results, and to mobilize theory in order to develop strategies for change on behalf of feminist interests" (p. 11).

Feminist Poststructuralist Voices within Science Education. One important product of this dissertation work has been my joining the small, but growing conversation within the science education research community concerning the use of poststructuralism.

In order to better understand the positionality of three African American science teachers, Felicia Moore (2003) applied a feminist poststructural lens to investigate issues of power, knowledge, language, and difference. She examined how the participants gave meaning to their prior personal experiences, and how these various meanings influenced their teaching of science as well as their roles as adult learners within professional development. Her findings also drew interesting connections between the participants' reflections of their own science learning (as marginalized students/teachers) and their interests in representing novel science subject positions within their own classrooms.

Carol Brandt (2004) used poststructuralism to explore female Native American students' performances of science as they engaged in a scientific community of practice through majoring in biology. Her findings add to the conversation about the status of marginalized gendered identities in science education. In addition, she provides a unique critique of the model of biculturalism, which she argues greatly oversimplifies the complexities of her participants' engagements between Anglo and Native cultures.

William Letts (1997, 1999, 2001) applies feminist poststructuralism to his critique of the gendered nature of science and school science. He also injects a useful interrogation of heteronormativity into the anti-essentialist views of gender that already reside within poststructuralism. He brings this analysis into elementary science teaching as well as preservice teacher education.

Hughes (2000) looks at how the science-technology-society curriculum (STS) (and its associations with femaleness) are marginalized and devalued within dominant science education discourses. She has also studied how students' subjectivities traveled though available discourses to create a positive science identity within the discourse physical science (Hughes, 2001).

Feminism and Science Education

As a fellow science educator, Barton's (1998a) description of third wave feminism is one that resonates with my theoretical perspective. Before examining this position further, I will briefly relate her accounts of first and second wave feminism and their work with gender equity in science education.

Efforts at gender equity stemming from first wave feminist thought focus on increasing the numbers of females in science. This has been done by pointing out the disparities between male and female numbers in science (as well as disparities along class and ethic/race lines). With a deficit approach to equity, programs resulting from first wave feminism attempt to bring females and other marginalized groups 'up to speed' in order to increase participation in the sciences. "Liberal feminists studies have emphasized ways of bringing women and minorities 'into science' by focusing on achievement, attitudes and participation in science" (Barton, 1998a, p. 3). While such practices have "played a role in creating programs and opportunities to get more girls into science and to help them achieve there" (p. 3), "science itself, as a practice or a culture, was not critiqued or made problematic within the science or science education community" (p. 4). Therefore, Barton sees gender equity interventions that arose from first wave feminism as placing the burden of change on the marginalized group of people as opposed to the marginalizing discipline.

Second wave feminism shifts from placing the deficit on the marginalized individuals to critiquing science itself. With influences from feminist philosophers such as Sandra Harding (1986) and Evelyn Fox Keller (1985), this approach takes a critical stance toward "the nature and practice of science" and "ways of knowing in science" (Barton, 1998a, p. 4). A major assumption underlying these efforts is the view that the

traditional, positivistic tradition of science embodies norms and values that actively contribute to maintaining current inequities.

> Science is not a practice completely separated from other ways of knowing or doing. It is connected to, and influenced by, ways of knowing and doing that permeate every other aspect of life, from religion to survival, and that the knowledge produced within the science community is not value-free or independent. (Barton, 1998a, p. 4)

By utilizing a strong "social constructionist epistemological framework" (p. 5), second wave feminism embraces the political and cultural embeddedness of science as a way to illuminate existing inequities. "The discipline [of science] is imbued with European, middle-upper-class, and heterosexual values. It therefore presents a partial or distorted view of the world and represents an excluding knowledge" (Barton, 1998a, p. 6). Because science does not exist in a vacuum, the subjectivity of those who engage in science is highly relevant. Second wave feminism calls for including the voices of marginalized groups into scientific discourses. This has resulted in works such as Belenkey et al.'s (1997) *Women's Ways of Knowing* that describes how female voices and experiences are actively excluded from science and how science itself is devalued by this exclusion. "In short, second wave feminists suggest that the discipline of science demands that the perspectives and insights of women, minorities, and working-class students who have been kept from participating in the inner circle of science be included" (Barton, 1998a, p. 9).

Many of the equity interventions that emerged from first and second wave feminism could be described as 'female friendly' or espousing a 'women centered perspective.' Although a valuable resource for critiquing the heteropatriarchal nature of science, these perspectives have relied on perceived natural/essential different natures of males and females as a way to establish alternative science teaching practices. "Both of these waves are characterized by being separatist in nature, utilizing differences between genders as a way of creating inclusiveness and equality" (Barton, 1998a, p. 13). I would argue that "doing science" and "doing gender" in this manner perpetuates existing beliefs

about the naturalness of both males and females. By creating two homogeneous sex categories, and allocating certain ways of knowing to each group, these efforts enact a limited type of social change.

Within third wave feminism, Barton (1998a) illustrates a unique marriage between poststructural theory and feminist theory that resists a fall into relativism by maintaining a political vantage point. Her vision is not an antifoundational epistemology, but one that clearly recognizes positionality, subjectivity, and context. "Because feminism, unlike poststructuralism, has its roots in a political movement to change oppressive practices and beliefs, it moves beyond deconstruction into reconstruction and agency. This is important" (p. 15). The work of Foucault influences how "third wave feminism constantly questions how relationship and knowledge are situated within webs of knowledge and power" (p. 27). By not relying on *gender differences* (males versus females) to create equity interventions, third wave feminism can avoid essentializing the naturalness of males and females.

> This situatedness of science and science education – with their representations of the natural world and their set ways of regulating meaning – is central to understanding how the dynamics of power, privilege, and social desire structure the daily life of society. This demands a close examination of the connection between the production and use of scientific knowledge and authority. (p. 16)

Overall, I see this last perspective as having the ability to incorporate both materialist and discursive theories within a science education context.

Gender and Science Education

I will be discussing several studies in the field of science education that deal with the issue of gender equity. These specific studies were chosen because they illustrate a variety of methodological approaches, understandings of gender, and theoretical frameworks. I will provide a brief summary of each work as well as its underlying theoretical stances. Finally, I will summarize my findings from these works and discuss how these previous interventions and treatments can inform present efforts. However, I

will first relate Baker's (2002) historical analysis of the issue of gender equity in science education as a way to frame the subsequent studies.

Baker (2002) provides a useful historical look at the issue of gender equity within science education research by examining articles that have appeared in the *Journal of Research in Science Teaching* since the 1970s. Broadly speaking, gender first emerged in the literature in the 1970s in terms of the sex differences around cognitive capabilities.

> These studies were either psychological in orientation and used White male performance as the benchmark, or lacked explicit theoretical frameworks…They were conducted under what I call the "My Fair Lady" framework, or "Why can't a woman be more like a man?" When there were differences or correlates, the While male model was the right model. (p. 660)

Baker (2002) notes that by the 1980s, a less mechanistic concern for diverse populations, including women, had emerged. However, she notes that they were short on "the punch of a strong sociological or feminist perspective" (p. 660). With the late 1980s arrived a stronger advocacy for getting more female students involved in science, rather than simply explaining differences based on sex. However, "the psychological perspective still held sway, and no one was yet questioning whether the so-called problem of girls and science had less to do with the nature of girls and more to do with the nature of science" (p. 660). Baker relates how the research in the early 1990s changed this perspective by challenging the very nature of school science. Analyzing the curriculum and the classroom pedagogical practices represented a new way to inject more females into the existing system. 'Fixing school science' took precedent over 'fixing the girl science student.' The 1990s also heralded an emergence of feminist and emancipatory frameworks that began to illuminate the complexity of gender and its relationship to the nature of science. Rather than relying on the biological dichotomy of girls and boys, with its inherent reliance on essential natures, a more sophisticated conceptualization of gender took hold. Finally, Baker notes that attention toward a multiplicity of difference (gender, race, class, ethnicity, etc.) began to make connections between gender and other forms of social inequity.

Previous Gender Studies in Science Education

Although a very early study, Treagust (1980) provides an example of some of the previous work in science education that Baker (2002) describes in her historical account. Treagust used a series of Piagetian tasks to determine how gender ["the independent variable" (Treagust, 1980, p. 92)] impacted students' knowledge of infralogical spatial groupings. "It is anticipated that the development of infralogical groupings is prerequisite to a functional knowledge of certain aspects of mathematics, especially geometry, and to science subject areas dealing with spatial relations in chemistry, physics, geology, and astronomy" (p. 91). Sketching and justifying a perspective drawing of railroad tracks, moving from the foreground into the horizon, was one of the tasks asked of the participants. Another consisted of presenting the participants with a stick, rotated in various positions, and then asking them to describe its shape from various other perspectives. Using chi-squared analysis, he found a significant relationship between this ability and "gender" in four out of the six tasks.

Although Treagust employs the word 'gender' in the title of his study, he is actually investigating differences in sex category. It is not the socially situated accomplishment of "doing gender" (West & Zimmerman, 1987) that he is concerned with, but rather the consequences of the participants' assumed fixed biological sex category. The discussion of his findings flows from this unarticulated, yet important, presupposition. He begins his explanation by noting that comparable curricula for both sexes were found at the elementary level, but not at the secondary level (where courses such as technical drawing and home economics were more or less gender specific). However, because his study looks at students prior to this level of gendered curriculum specialization, he finds greater value in explaining his findings in terms of genetics:

> It is this investigator's contention that based on the consistency of the gender differences on the six tasks presented to adolescents and the lack of gender differences in elementary school subjects, a genetic epistemological explanation can better account for the data. (p. 95)

After implicating a biological explanation for the "apparently slower development in spatial conceptualization in females" (p. 95), Treagust goes on to recommend, "males and females should be taught in more similar ways in an attempt to reduce the differences in spatial abilities and ensure comparable opportunities between the sexes in higher education and employment" (p. 95). Treagust gives a genetic explanation for the female students' "deficit" and then promotes a gender-blind pedagogy to alleviate the disparity. He asserts an inevitable, biological cause for the girls' inabilities, and then suggests that we do the best we can and treat them just like the boys. By advocating such a gender-blind approach, Treagust fails to take a critical eye toward the androcentric nature of school science curricula, pedagogical practices, or other socially mediated factors that could better account for this marginalization of female students. This work can be characterized as somewhat biologically deterministic in thought and is representative of early research in the field of sex differences. It is also consistent with Baker's (2002) characterization of such early efforts being "conducted under what I call the "My Fair Lady" framework, or "Why can't a woman be more like a man?" When there were differences or correlates, the White male model was the right model" (p. 660). This research embodies no feminist thought and reflects its predating of more sophisticated sociological work on gender.

In a much more recent study, McGinnis and Pearsall (1998) reflected on a male instructor's experiences teaching an elementary science methods course which was comprised mainly of female students. "In this study, the gender difference between the male professor and his female elementary teacher candidates was of prime interest" (p. 919). The impetus for this research resulted from a realization McGinnis had while attending a science education conference:

> I looked around the room and saw hundreds of individuals responsible for the education of teachers of science. I felt welcomed and honored to be included in a group whose work I believe is important and meaningful. Suddenly, I had a thought: This group predominately consists of men, while my teaching experience on the collegiate level suggests that the prospective teachers in elementary

> methods courses are predominately female. Why is there this difference between my sex as a professor and the majority of my female teacher candidates? What implications does that have on my ability to promote inclusive, multicultural elementary science education? I resolved to study this using action research with my next elementary science methods class. (p. 929-930).

Visible differences in sex category provided the discrepant event for the researcher. Thus, it is important to recognize that while more sophisticated accounts of gender challenge everyday conceptualizations of what it means to be masculine or feminine (pointing toward a range of femininities and masculinities), it would be unwise to discredit sex-difference categorization as a useful starting point. It would interesting to consider how many other students of marginalized gender, beyond the heteronormative male/female homogenous blocs, have had similar experiences in science classrooms dominated by hegemonic masculinity.

During his attempts to address the issue of gender equity in science education within the context of a methods course, McGinnis and his female co-researcher, Pearsall, made observations about his students' reactions. With regard to students' resistance to change, they noted a difference between the instructor's and the students' perceptions of the gender equity issue. While it was a personally important and political issue for the instructor, the students were either indifferent to, or angered with, his efforts. On this, Rennie (1998) remarked that anger or aggression often results from gender treatments that isolate one group as disadvantaged and another group as advantaged.

> In the case of gender interventions, the spotlight usually falls on women and girls, and they do not enjoy the attention. It seems that by apparently isolating one group (such as females) in an intervention and pointing out aspects of disadvantage, there is an implication that the other group (in this case, males) is somehow to blame. Sometimes the unintended result in anger and aggression as the inference of blame is resisted, often by both sexes. (Rennie, 1998, p. 954-955)

In addition, it may be that while most students in methods courses acknowledge the issue of gender inequity, they see it as peripheral to their goals in the course and did not accept it as a personal challenge. The students would rather focus on their immediate goals of how to teach science and deal with students rather than on a social issue like gender equity.

Rennie (1998) skillfully adapts the work of Willis (1996) from the field of mathematics education to provide insight into the issue of gender equity in science education. The four standpoints, having similarities to Baker's (2002) overview, are: the deficit model, the nonsexist approach, the gender inclusive approach, and the socially critical perspective.

The first perspective, likened to a *deficit model*, places emphasis on adapting female students to the realm of science education without modifying the existing structure of classroom science. By focusing on remedial interventions, the assumption is that "some students, by virtue of their gender, are less well prepared than others to benefit from science education" (Rennie, 1998, p. 955-956). This "fix the girl" approach presumes that "there's something wrong with/missing from girls, so we need to compensate them for it" (p. 956).

The second perspective challenges pedagogical practices that favor males over females. The resolution from this *nonsexist approach* "is to consider students' background and experiences and provide the kinds of learning environment and assessment tasks which enable them to achieve their best" (p. 956). Identifying and removing explicit sexist classroom practices form the basis of this stance.

The third perspective takes a critical look at the nature of science as it is portrayed in the classroom. The assumption here is that the science curriculum has a historically masculine nature and must be altered to accommodate those students who occupy marginalized positions in society. This stance recognizes the relationship between how science is portrayed in the classroom and how we construct an image of who is capable of doing science. Thus, the tactical approach is to "rethink the nature of the students who do science (or who we wish to do science) and to structure the curriculum to accommodate

in a more inclusive way the interests, attitudes, social experiences, and values of all those students" (p. 956). When couched in terms of gender, this becomes a promotion of a *gender inclusive* approach to teaching science.

Finally, the *socially critical perspective* assumes that the science curriculum itself is "actively implicated in producing and reproducing gender inequality" (p. 956). The way science is taught not only disadvantages marginalized genders, but also participates in the maintenance of those very same marginalized positions.

> When science is viewed from this perspective, the problem of gender equity in science education can be interpreted in terms of the ways in which the science learner is constructed through the curriculum and how science is used both inside and outside of schools to position and privilege some people over others in ways which are gender based. (Rennie, 1998, p. 956)

There is an emancipatory aspect to this approach because the goal is "to challenge the hegemony of science (which means that participants must recognize the hegemony) and modify its use to serve students in a way which is more just in a social sense" (p. 956).

The goal of Rennie in explicating these four approaches is not to evaluate which is more appropriate, but to illustrate that there are multiple ways of approaching the issue of gender equity in science education. She emphasizes the importance of recognizing how these multiple perspectives have emerged in the history of science education and that not all science educators share a common conceptualization of the problem nor a common solution. Since I assume this about the teachers in my study, this holds certain import for how I look at their gendered practices.

It is interesting to note how McGinnis and Pearsall (1998) use the terms "sex" and "gender" within their study.

> As coresearchers, we now recognize that "gender is what culture makes of sex" (Keller, 1986, p. 122) and that both the professor and his students have been cultured in a male-dominated system. However, the women in this study suggest that it is possible to be a male professor and yet display and accommodate characteristics that promote a friendly classroom climate for women. These

actions can alleviate the difference in gender between the male science education professor and his female teacher candidates.

To "display and accommodate characteristics that promote a friendly classroom climate for women" is a form of *doing gender*. While the researcher recognizes his membership in a particular sex category (as a man), he also recognizes the complexity in his gendered doing that goes beyond that categorization. To be a member of the male sex category does not directly equate to engaging in hegemonic masculinity. His "display" is a way of doing gender that challenges the existing structure by refusing to perpetuate the assumed naturalness of hegemonic male behavior. Carrying this further, I would add that this alternative "display" is also accommodating for many students, both male and female, who also exist within a range of femininities and masculinities. However, to stop at the recognition that this gendered behavior is good for only females fails to recognize the full multiplicity of gender.

The *Sisters in Science* (1999) program was a three-year intervention designed to increase "attitudes, perceptions, and achievement of fourth and fifth grade girls in science and mathematics" (Hammrich, Richardson, & Livingston, 2001, p. 1), with an additional emphasis on minority girls. The study involved elementary-aged female students, their parents, classroom teachers, and preservice teachers. The SIS program consisted of seven interconnected components: an in-school program, an after-school program, a summer program, Saturday academies, teacher training, intergenerational volunteers, and family education (Sisters in Science, 1999). A large focus of the program revolved around increasing teachers' knowledge about equitable, constructivist classroom practices. Teachers were encouraged to engage in reflexive thinking about their work and to play an active role in gender equity reform.

The study found an increase in teachers' awareness of both the issue of gender equity and of possible intervening classroom practices. However, there was a relationship between the teachers' comfort level with the scientific topic and their ability to engage in gender equitable teaching practices. "The teachers did express concern that when they are confronted with teaching a science topic that is new and unfamiliar they

tended to revert back to a more traditional teaching approach" (Hammrich, Richardson, & Livingston, 2001, p. 36). This led the researchers to advocate more of a sustained program of professional development rather than a brief intervention. Such a finding questions that effectiveness of professional development programs that simultaneously introduce novel science concepts and gender equity issues.

It is interesting that teachers remarked how "not all lessons make a connection to gender sensitivity but they are still learning and trying new approaches" (Hammrich et al., 2001, p. 37). I interpret this to mean that teachers viewed their science classroom practices as either being gendered or not. Instead of exploring the intimate, interconnected nature of gender and science, equitable practices were defined as only those that explicitly increased female student participation. The less obvious, implicit relationship between the nature of science, as represented via classroom instruction, and existing gender relations was not explored.

Constructivism and its relationship to promoting female appropriate teaching formed the theoretical basis for the SIS program: "constructivism, an epistemological perspective of knowledge acquisition, serves as the foundation for many of the noted suggestions regarding female-friendly science education" (Hammrich et al., 2001, p. 4). The researchers tapped into constructivist theory as a way to position science instruction within the personal experiences and prior understandings of the students, in this case female students. The goal then becomes the promotion of a "female-friendly brand of instruction" (p. 8) that draws on "gender-related, learning style differences" (p. 7). Gender is again reduced to something masculine versus something feminine – one type of boy and one type of girl. "The rationale being, when girls are allowed to work in a manner that is intrinsic to their learning style (e.g., with the manipulation of materials) learning will occur" (p. 8-9). The very term "intrinsic" implies something natural or essential to either sex.

The emphasis on "female-friendly" and "female appropriate" teaching and learning has roots in liberal feminism. By promoting strictly "female-specific intervention programs" (p. 7) the complexities of gender are not fully explored; in fact,

they are greatly reduced. The underlying assumption here is that *all* females express the same form of femininity and that *all* would benefit from the same type of "female appropriate teaching strategies" (p. 4). I would argue that such pedagogical approaches work to sustain existing gender inequalities by promoting the naturalness of what we consider male and female. However, such approaches could have value in challenging current conceptions about the nature of classroom science and how science is represented by classroom activities. In this program, inequitable classroom practices (like calling on boys more than girls), while clearly useful, fall short of challenging the heteropatriarchal nature of science or the existing inequitable gender structure.

Bailey, Scantlebury, and Johnson (1999) discuss the use of a quantitative observational tool used to create discrepant events for student teachers with respect to the issue of gender equity in science classrooms. Measuring student/teacher interactions as well as pedagogical practices, the tool was part of a collaborative effort between university researchers, participating teachers, and student teachers. "The objective was to align the methods course and student teaching experience with gender equity as a major theme" (p. 163). Rather than gender equity residing as merely an abstract concept in the methods course, the study places the issue within a concrete classroom setting.

The researchers point to the lack of congruency between science teachers' previous experiences as science learners and the goals set forth by national science education reform efforts. "How can science educators prepare preservice teachers to teach science given that these preservice teachers' experience with science are unlikely to reflect the current goals of science education reform" (p. 159-160)? Traditional, non-constructivist, non-inquiry environments of university science courses do not provide gender-equitable models for preservice teachers.

Bailey et al. (1999) point out that preservice teachers' initial conceptions of "good teaching" often revolve around having good classroom management. This impacts the students' receptivity to issues of gender equity that may be viewed as peripheral. The researchers concluded:

> Although the collaboration between university and teacher researchers seems to have resulted in more equitable classroom interactions for some student teachers, the team continues to be concerned because the student teachers implemented a limited range of teaching strategies. They relied on "lecture/discussion" as their primary teaching activity as evidenced by content analysis of their lesson plans. There is also still a disparity between teacher-centered and student-centered discussion. (p. 169)

The researchers lamented that the student teachers created "a competitive, rather than cooperative, classroom atmosphere…Therefore, the teaching style used most frequently by the student teachers favors boys" (p. 169). By explaining sex-differences in this manner, the researchers frame the student teachers' understanding of the issue as what is best for "boys" vs. what is best for "girls." This creates an image of homogeneous group of girls (or boys) that share common learning style preferences. Framing certain types of learning styles or pedagogical practices as favoring certain *types* of masculinity or femininity seem more appropriate and less likely to succumb to creating an essential nature of all females or males.

This type of intervention seems to be an effective way for beginning teachers to problematize the issue of gender inequity in science education. Due to the fact that these individuals have elected to become science teachers, they more than likely have had positive experiences within the discipline of science. Therefore, this type of discrepant event has the capability of shifting their frame of thought toward those who may be more marginalized by science or by science teaching practices. Of course, there are chances for this type of study to go further in probing the teachers for the reasons behind some of their actions. For example, many of the strategies implemented after inequitable teaching practices surfaced seemed to be impersonal, i.e. using a seating chart or "shuffled notecards with student names to ensure random interaction" (Bailey et al., 1999, p. 168). While this may relieve an imbalance within teacher/student interactions, gender equity goes much deeper than simply question/answer periods. There are many other factors that affect the gendered culture of a science classroom.

Jones and Wheatley (1990) conducted a quantitative study of student-teacher interactions within high school science classrooms, with the purpose being

> to examine gender differences in classroom interactions between science teachers and students in an effort to understand why women are underrepresented in high school physics and calculus classes, college technical majors, and careers in physical science and engineering. (p. 861)

They appropriately comment that a "cursory examination of [SAT and GRE] score differences may lead to the conclusion that males have more innate ability than females and thus score higher on standardized tests" (p. 862). Stopping at this level of analysis would contribute to furthering biological deterministic explanations. However, Jones and Wheatley point out that gender differences are more complicated and require a deeper scrutiny, including investigating course background, prior life experiences, and socialization. "Girls are often socialized into … characteristics such as dependence, nurturance, and passivity" (p. 862) which may be in conflict with the characteristics traditionally associated with scientific work. The role of the science teachers is critical to Jones and Wheatley's framework: "If teachers treat students differently in science classes, this differential treatment may affect the decisions the student makes about their future coursework and careers" (p. 863). Therefore, measuring the nature and frequency of teacher-student interactions becomes important.

The researchers found that there were disparities in all types of interactions measured, with statistically significant differences in terms of teacher praise, students' calling out, procedural questions, and behavioral warnings. In addition, there was a notable relationship between questioning students and the sex of the teacher, with male teachers asking "significantly more direct questions of students than female teachers" (Jones & Wheatley, 1990, p. 866). Their discussion of findings does not point to one cause of this disparity, but points to the complexity of the issue. However, they suggest that teacher expectations, norms about classroom management, students' prior experiences, and stereotypes about science may all play a role. While the causality of the inequity is not nailed down, the study clearly demonstrates a need for reform:

> The results of this study, showing that male students received more of every type of classroom interaction, suggest that teachers need to institute methodological changes in their classroom. Teachers need to be sensitized to gender equity issues and taught how to collect data on their own interaction behaviors. (p. 873)

The quantifiable nature of such work is accessible to teachers in the form of classroom action research and has the ability to problematize the issue of gender equity through creating an easily observable discrepant event.

Mason and Kahle (1988) designed an experimental study to determine the effects of a one-day science teacher workshop intended to foster a *gender-free* learning environment. The basis for this research was "focused on the need to remove obstacles, perceived and actual, to girls and women attaining full and fair participation in educational programs in science" (p. 26). The teacher intervention program consisted of distributing curricular materials, providing hands-on experiences, and promoting discussion in order to "sensitize the experimental-group teachers to the need for changing their classroom environment" (p. 31). The role of science classroom teacher is emphasized in this study as being critical to students' perceptions and attitudes toward the field of science. While not completely ignoring external factors, such as societal socialization or students' previous encounters with science, the particular aim of this study was to measure what effects teachers could generate by altering their classroom environment.

> The student brings to the already complex environment of the classroom so much in terms of prior experiences and preconceived notions that it is difficult to functionally differentiate between social influence and personal choice. However, the teacher has been shown to be an influencing factor in affecting student attitudes. The Teacher Intervention Program implemented by this study sought to encourage teachers to provide a stimulating, gender-free learning environment for their students. (p. 35-26)

By comparing scores of student science attitude tests between the experimental and control groups, the researchers concluded that the teacher intervention program had a

significantly positive effect for all students, both male and female. Sensitizing teachers to the issue of gender equity and more equitable classroom practices affected the attitudes of *all* students.

The researchers point out, "Women should be recognized as being as capable as men, and they should be encouraged to enter and remain in science and science-related professions" (p. 37). While this study encourages teachers to equally value and encourage both male and female students in the science classroom through more equitable pedagogical and curricular approaches, its theoretical framework continues to rely on the naturalness of a binary gender system (which itself relies on the naturalness of a binary sex categorization). How would this study have differed had a multiplicity of genders (dislodged from their connections with biological sex) been the target of analysis? While it is necessary, in terms of political positionality, to recognize the historical patriarchy that surrounds much of science and science teaching, the essentialness/naturalness of male and female gender is maintained.

Baker and Leary (1995) used a feminist lens to describe female students' beliefs and feelings about science and science education. In order to avoid the inadequacies of what they considered to be gender-biased paper and pencil quantitative surveys, Baker and Leary used semistructured interviews to gather data. Drawing on, among others, the work of Gilligan (1982) and Belenky et al. (1986), Baker and Leary understood gender to be highly influential on how a person makes meaning and decisions. Rather than focusing on the influences of school or society, which Baker and Leary describe as lacking "explanatory power" (p. 5) when it comes to elucidating the lower numbers of females in science, the researchers turned their attention to the personal voices of the female students themselves. They focused on "women's decision-making processes in the context of the psychology of women" (p. 3). Their findings paint a generally positive picture of female students' beliefs and feelings: female students enjoy science, find it useful, and do not see their gender as an impediment to attaining a career in science. They also found ways in which the "female" ways of knowing were not included or validated within the science classroom (e.g., the need for affective relationships). Rather

than seeing science education as a way to promote equitable social change, Baker and Leary promote a more female friendly way to teach and learn science. Science teaching, in their eyes, has the responsibility to make up for what society has allocated to female students rather than taking strides to challenge the structure itself.

The use of a psychological model conceptualizes gender as an individual attribute. Baker and Leary (1995) use the marriage between female identity and female ways of knowing. Women thus have unique "expectations of multiple life roles, self-identity, and ways of interacting with people, objects, and experiences in the world" (p. 4). The researchers are concerned more with the aftermath of a static gender structure rather than how gender is maintained or challenged on a moment-to-moment interactional level. I see this in contrast to the theoretical framework used by West and Zimmerman (1987) who assert that gender is more of a social process. "A person's gender is not simply an aspect of what one is, but, more fundamentally, it is something that one does, and does recurrently, in interaction with others" (p. 140). The fact that gender here is conceptualized as a "thing" rather than a social process is an influential aspect of this theoretical framework.

In contrast, by examining autobiographical narratives, Letts (1999) investigates how three preservice elementary science teachers "construct their identities as both students of science and prospective teachers of science" (p. 2). His understandings of gender and identity are critical aspects of his theoretical framework that are worthy of attention. His work is representative of a theoretical shift from looking at gender as a *product* to gender as a *process*.

By perceiving identity as a social process in flux rather than simply a fixed individual attribute, Letts is able to position gender as being more than the social manifestation of a biological sex. He pushes for

> a more nuanced portrayal of gender – from a relatively dichotomous category that gets seamlessly juxtaposed on "biological sex," to a shifting construct informed by sex, ethnicity, sexual orientation, social class, "race," ablebodiedness, parental status, and a myriad of other identity categories. (p. 5)

Feminine gender (as a verb) is not the sole property of a female sex. The same is true for masculine gender. Other factors are involved and must be considered when studying gender. To add to this, Letts also finds importance of recognizing multiple versions of masculinities and femininities in our work on gender.

> I want to use these notions to disrupt what I see as the laziness around issues of men and masculinities and science. By this I mean the totalizing discourses that homogenized men and women in different ways, and place them all as central in positions of power, or as on the margins of powerless positions, respectively. Not only are such views over-simplistic, but they do an injustice to all who are marginalized and silenced by science as we know it because they present an inaccurate and incomplete picture. (p. 4-5)

I agree wholeheartedly with Letts' assertions and relate this to Connell's (1987) use of a collection of accomplishable genders (including *hegemonic masculinity* to *emphasized femininity*) and the fact that there need not be a male or female sex behind behaviors labeled as such. To create a universal male or a universal female subject is to limit our understanding of how people develop, enact, and modify their doing of gender (both within and outside of classroom science). If we only view those marginalized by science as "women" we fall victim to assuming a) that all women have the same gendered identity, one that is marginalized by science and b) that all men have the same gendered identity, one that is sustained by science. I agree that this static conceptualization is virtually useless.

Letts' findings indicate that these preservice teachers have a wide variety of interpreting pervious experiences as science learners and multiple ways of projecting those experiences onto their future teaching identities. His research revealed "what a gendered experience with school science means for these preservice teachers both in terms of opportunities granted and opportunities foreclosed" (p. 3). The historically masculine nature of science does not affect these individuals all in the same way. The overall picture painted from this work is one of intricacy. The students' "writings recognize the complex ways in which the constructs of schooling, gender and science

interact, hybridize, and experience synergy or attrition as they collide with one another" (p. 25). Letts successfully voids the messy pitfall described previously: using sex differences as a means of comparison inevitably strengthens their perceived naturalness and their ensuing effectiveness.

One of Letts' participant's reflections stood out to me as interestingly relevant. Kiki described her rather negative experiences dissecting a fetal pig in high school, and then created a counternarrative in which she flipped the conditions as she would have liked them to be. Letts rightly pointed out that her counternarrative relayed a 'personal deficit model' that placed much of the blame on her own lack of abilities. Letts writes,

> I confess that I am saddened that instead of formulating a stronger case to object to the class dissection, Kiki seems [in my eyes] to have acquiesced, looking for a deficit in herself to explain her lack of engagement rather than a deficit in the pedagogical and curricular practice. (p. 19)

He continues,

> I am concerned if students' first reaction when they are not engaged with something at school is to look inward for blame. Even though Kiki doesn't seem to have any trouble identifying her teachers as the source for lack of engagement, I think that what she may ultimately be referencing is a personal deficit model. (p. 20).

Further exploration of this type of belief and how to move toward a more critical examination of the curriculum would be useful in subsequent research.

Brickhouse, Lowery, and Shultz (2000) draw on Lave's (1992) *situated learning* to study four middle-school female African-American science students. This theory of learning creates a context-dependent relationship between individual identity and the subject learned.

> To understand learning in science, we need to know much more than whether students have learned the proper explanation for how plants make their food or why there are seasons. We need to know how students are engaging in science and how this is related to who they think they are (what communities of practice

> they participate in), e.g., a good student, a basketball player, a gossip, and who they want to be (what communities of practice they aspire to), e.g., a teacher, a mother, a gemologist, an obstetrician. As students transform their identities, the requisite knowledge and skills for being a part of the new communities are learned. Thus, if students are to learn science, they must develop identities compatible with scientific identities. (Brickhouse et al., 2000, p. 443)

By establishing this link between identity and success in science, the importance of how science is represented to students gains credence. When a teacher teaches science, she is advocating a representation of *science* and a representation of *scientists*: a community of practice. The gendered nature of this endeavor affects who feels eligible for participation.

The situated nature of experience/learning points to the fact that not all sciences are the same. Brickhouse et al. (2000) make this important distinction between science and school science.

> For the most part, students are not engaging in science, they are engaging school science. School science often does not allow for varieties of approaches and directions. Furthermore, science classes are places where students are engaged in a large variety of activities that may appear to have little to do with science. These activities may, however, be crucial in understanding how students are constructing identities relative to school science. (p. 445)

It is this wide range of activities and interactions that are often ignored within our efforts to gain equity in science classrooms. By focusing only on the nature of science or pedagogical practices, we limit the ways in which we can understand how the science classroom affects, and is affected by, the individuals in the classroom.

Like Letts (1999), Brickhouse, Lowery, and Shultz (2000) argue against a uniform conceptualization of boys and girls. General beliefs about the issue of gender equity "has created a stereotype of girls and boys that fits no one in particular and presents a homogeneous image of both girls and boys as science learners" (p. 442). It therefore fails to acknowledge the existing range of masculinities and femininities. The

dichotomy of "boy science student" and "girl science student," while perhaps conceptually easier to research, limits the applicability of any findings. As I have mentioned before, working with this limited version of gender also works to maintain existing inequitable gender relations by emphasizing the *naturalness* of male and female behavior. Brickhouse et al. (2000) make an important conclusion by declaring, "When teaching girls science and trying to explain why it is they are or are not doing well in science, we need to know more than that they are girls. We need to know what kinds of girls they are" (p. 457). The same holistic notion is also appropriate when considering boys as well.

Barton (1998b), in her research on teaching science to urban homeless children, uses a critical feminist perspective to represent science in terms of the lived experiences of the children. She questions how the "situated nature of pedagogy" affects "representation in science (what science is made to be) and identity in science (who we think we must be to engage in that science)" (p. 380). If science is represented as something that white, middle-class males engage in, then there is little correlation with the lives of urban homeless children. Therefore, Barton argues that science educators

> need to think about how children perceive themselves within and outside of science, and the choices they make because of those perceptions. We also need to think about how children perceive science and the kinds of interactions they believe they can have – or that they want to have – with that science. (Barton, 1998b, p. 382)

By "decentering science" (p. 289) and creating science activities from the actual lived experiences of the children themselves, Barton was able to find a less conflicting fit between the students' identities and the representation of science. Rather than the focus of change residing on the identities of the students, Barton found ways to alter the borders of science, making them more fuzzy and accessible to these particular students. Ball and Osborne (1998) praise Barton's efforts and comment that her study

> suggests that educating all students entails going beyond seeking ways to enable marginalized students to engage in present educational forms. Rather, [it]

> involves rethinking foundational assumptions about the nature of the disciplines, the purposes of education, and our roles as teachers. (p. 395)

The relationship between teacher practices, representations of science, student identities and power becomes salient in light of Barton's work.

> The production of knowledge, culture, and identity is a historically, socially, and politically situated process that is inherently subjective….Because of the situated nature of pedagogy, knowledge construction about science and self-within-science occur within and are shaped by the relational space of the social, historical, and political. It is from this perspective that questions of representation in science (what science is made to be) and identity in science (who we think we must be to engage in that science) become central. (p. 380).

Barton acknowledges, "As [children] learn science, they also learn a lot about who they are (and can be) and what science is (and can be)" (p. 382). She therefore strives to "validate the children's experiences by using their experiences as the starting point for … explorations" (p. 383). Barton recognizes that teachers play a pivotal role in "how pedagogical issues of representation and identity emerge in science class because of the role they play in helping children develop a reflexive relationship between science and school and the rest of their lives" (p. 391). When undertaking gender equity interventions in science education, Barton's framework becomes useful.

Male Teachers Doing Gender

I thought it would be interesting to briefly explore two pieces of research that explore the issue of men in education. While my particular focus is on gender in its totality (with standpoint roots in marginalized groups such as females), exploring the experiences of men in arenas traditionally conceived as feminine works to paint a more complete picture of gender and schooling. In addition, I feel that it speaks to my own positionality as a male educator engaged in feminist research.

The gendered nature of teaching, especially at the early childhood level, is made strikingly apparent by the research of Cooney and Bittner (2001). Data from focus groups consisting of male preservice teachers were used to explore male participants'

"experiences related to choosing a career in early childhood education" (p. 77). The impetus for this research came from Mark Bittner's realization that he was the only male at an early childhood professional development event. The researchers note, "As traditional gendered practices are questioned more and more within professional circles, the virtual absence of men [in early childhood education] is worth exploring" (p. 77).

One theme that emerged from the study is the conflict between social expectations of men as household breadwinners (i.e., heteronormative discourse about the traditional family) and the selection of a career that is perceived as being low-status and low paying. Some of the men "wanted to be the sole provider for the family and worried that the low salary would put their spouse and children in jeopardy" (p. 78). By considering the difference between providing material things for his family and his love for teaching, one of the men remarked, "I am gonna have to sacrifice what I like for what I love" (p. 79). I agree with the researchers that this is an interesting point. "While the societal bias against teaching as a high-status and high-paying career was disturbing to [the participants], the males in the focus group appeared to perpetuate societal bias against gender equity" (p. 79). These men are "doing gender" as they express their beliefs about being male teachers, and in doing so, reinforce existing gender inequities.

Another theme that arose from the study is the perception by male participants that college courses about early childhood education embodied a bias against males.

> The feeling of isolation within the college classroom and the school was shared, Matt stated that he felt "alone with no one to talk to" in his first teaching experience. He didn't feel comfortable sharing some of his teaching issues and successes with the female teachers in the primary unit. (p. 81)

Such experiences within the college setting combined with societal expectations about males and females with respect to children. "The stereotype that females/mommies are the nurturers and that males don't do this emerged as a barrier to recruiting males into the field" (p. 80). This study illuminates societal norms about gender and teaching and points to how male teachers tap into the array of available subject positions within the discourse of early childhood elementary education.

Roulston and Mills (2000) used interviews with two male music teachers (one from Australia and the other from Canada) to provide insight into male teachers' experiences within a field that has been traditionally viewed as feminine. Their analysis illuminates how these male teachers' pedagogical beliefs and practices work to maintain existing gender inequalities and the power of hegemonic forms of masculinity.

Certain aspects within the call for more male teachers in feminized disciplines, such as music education, parallel science education's call for more female participation. In particular, the lack of appropriate role models is questioned. However, as Roulston and Mills (2000) point out, this is a naïve solution to a complex issue.

> There is an ever increasing demand for there to be concerted attempts made to attract men to the teaching profession, and especially in those areas which have been deemed as `feminised'. This is clearly a simplistic analysis of the complex ways in which gender relations are constructed and reconstructed within the gender regimes of schools and the consequences of this in relation to student achievement. (p. 222)

By relying on superficial interventions, the complexity of gender relations is reduced to males vs. females and ignores the multiplicities of gender. Injecting males into the music curriculum will no more masculinize that field than will injecting females into science feminize it. Gender equity is not a seesaw that must be balanced. Roulston and Mills correlate such a balancing act with a form of patriarchal thinking.

> We argue that that the push towards more male teachers in schools is grounded in a men's mythopoetic or therapeutic politics and that this is a politics which reinforces dominant constructions of masculinity. We contend that calls for more male teachers are often simplistic. They neither take account of the ways in which gender relations are constructed through the curriculum and other school practices, nor do they pay any attention to the current gender order operating within the wider social context. (p. 223-224)

I would argue that analogous "mythopoetic or therapeutic politics" often drive similar efforts in science education where the gender inequity is perceived as problem of

numbers, a problem to be solved by the addition of more of one sex of teacher or role model.

By incorporating Connell's (1995) work on masculinities, Roulston and Mills draw connections between sexuality (in particular the policing of homosexuality) and gender relations within schooling. "Homophobia works on boys (and girls) to naturalise dominant gender performances and to create fears of being different. Boys who reject or challenge hegemonic forms of masculine behaviours are often seen as being inside traitors to masculinity" (p.226). Sexualities that deviate from the heterosexual norm pose a threat to dominant forms of masculinity, resulting in actions that work to reinforce masculinity to its heterosexual roots. Thus, the link between gender and sexuality becomes clearly evident. This same homophobic reaction, according to Roulston and Mills, works within teachers as well as students.

Tony, an Australian music teacher, sees his being a male (something *different* within music education) as an asset to his teaching. As a young, long-haired, rock musician, male, Tony draws a picture of himself as an outsider. Roulston and Mills note how this positionality, and the subsequent use of it as a pedagogical cornerstone, relates to gender within schooling.

> What did become visible as the year progressed was that Tony's utilisation of popular music as part of his teaching presented a challenge to the existing school culture. However, it is not the gendered aspects of the school culture which Tony is challenging. Tony's construction of himself here as a rebellious young teacher fits neatly with many popular images of the young male rebel who likes heavy metal bands. However, this form of rebelliousness does not necessarily problematise the existing gender order and indeed does much to hegemonise existing dominant masculine aggressive behaviours….Anti-authoritarianism does not necessarily equate with subversions of dominant gender paradigms. (p. 229)

This illustrates how daily practices of teachers can implicitly reinforce the existing gender structure. However, there are often more explicit and damaging ways that this can occur.

Andy, a Canadian music teacher, validates a specific form of masculinity within his classroom. He creates a "just one of the guys" relationship with the male students in order to improve their singing ability and creates a competitive atmosphere where the boys separately practice singing in order to surprise the girls. As Roulston and Mills note,

> This alignment, however, is not just about a teacher joining with his students to further their education. It is also an alignment of him and the boys against the girls. Here he is role modeling more than singing, he is modeling the hegemonic belief that boys can always do things better than girls (even feminised activities such as singing) when they put their minds to it. (p. 232)

Andy also demonstrates overtly homophobic attitudes and actions when it comes to portraying and supporting hegemonic masculinity. He relates his previous experiences at college where he often sang. During those events, he was frequently asked if he was gay. He reacted in a very assertive way to make his heterosexuality clear. He added:

> But their idea was you know like you're male singers so then you' re you're a bit *funny* you know so, that's a bit of sore point with me so I, I had an extra motivation to sort of get these kids *singing* and they were, and they, they could sing by the end of it. (p. 228)

Andy continued to stress the importance that his students (especially the males) not view singing as a homosexual activity. As Roulston and Mills (2000) point out:

> This is perhaps not surprising given that Andy has had to refute homophobic allegations because of his profession and that he is quite clearly tired of this, for example, '…you're male singers so then you're …a bit funny …that's a bit of [a] sore point with me'. Homophobia as a discourse does not only serve to police the behaviour of boys in schools, but also of male teachers. Indeed many of Andy's comments served to reinforce homophobic expression as legitimate, for instance, such as his rhetoric encouraging boys to sing: 'only prissies don't sing.' (p. 233)

By incorporating practices that sustain hegemonic masculinity and homophobia, both of these teachers' gendered interactions at work "reinscribe and reinforce dominant

constructions of masculinity, and existing gendered relations of power. Central to these interpretations by these men are attempts to distance themselves from femininity and `unmanliness'" (p. 234). The interactional gender practices of teachers' daily classroom experiences both sustain the existing structure and are continually constrained by it.

My Research Agenda

It is my desire that I join the conversation in science education concerning the issue of gender equity.

> The oppressors attempt to destroy in the oppressed their quality as "considerers" of the world. Since the oppressors cannot totally achieve this destruction, they must *mythicize* the world. In order to present for the consideration of the oppressed and subjugated, a world of deceit designed to increase their alienation and passivity, the oppressors develop a series of methods precluding any presentation of the world as a problem and showing it rather as a fixed entity, something given – something to which people, as mere spectators, must adapt. (Freire, 2003, p. 139)

I explicate science education's involvement in, as Freire above, presenting gender as a "fixed entity, something given – something to which people, as mere spectators, must adapt." I attempt do this by a critical ethnographic exploration of science teaching, focusing on the daily practices of three female middle school science teachers. This study utilizes feminist poststructural accounts of gender in order to facilitate my understanding of the intersections of gender and teachers' science teaching. In turn, this holds the possibility of contributing novel perspectives about the issue of gender equity from a uniquely feminist standpoint. In order to accomplish these goals, I have put forward the following research questions:

1. How do middle school science teachers negotiate successful gendered identities? In other words, how do the power relations among competing discourses (and subsequent subject positions) influence what positionalities are available to these teachers?

2. How do science teachers' language and classroom practices (i.e., "doing gender" and "doing science") work to reproduce and/or challenge the existing inequitable, dualistic gender structure and the enmeshment of science and hegemonic masculinity?

There is an underlying theoretical assumption that supports these two research questions: as we constantly "do gender" (acquire a gendered identity) we are simultaneously, and usually unconsciously, either maintaining or challenging the gender structure. We have to do one or the other. Thus, because of the ubiquitous nature of "doing gender," it is inevitable that science teachers' daily practices are involved in this process.

Materialist perspectives such as standpoint theory are commanding, political places from which work on gender equity can begin. Recognizing the powerful critiquing ability of marginalized positionalities, including my own, sets the stage for challenging patriarchy within the discipline of science as well as science teaching. Alternatively, starting from a political, marginalized location can examine the ways that "doing science" and "doing gender" are implicated in either maintaining or challenging the existing gender structure in ways that do not emphasize the taken for granted dualism nor the naturalness of male and female essences.

> On the level of discourse, we need to frame research questions and political issues so that they are not based on the standardized categories of 'men' vs 'women', and 'boys' vs 'girls' and on the taken-for-granted assumptions that their characteristics are uniform and universal, and thus somehow related to procreating and parenting. (Lorber, 2000, p. 88)

The Middle School Context

In previous sections, I have described the gendered nature of traditional, Western scientific discourse. I move now into a similar examination of middle school philosophy and structure. As with any other discourse, the language of middle level education facilitates certain masculinities and femininities, and encumbers others. Therefore, it works alongside science as a discourse that competes for defining, fixing, and naturalizing specific forms of femaleness and maleness within the context of formal

schooling. From a poststructuralist perspective, the professional identity of a teacher, as any identity, is not a fixed entity, but rather an unfinished project, swarmed upon by a variety of competing discourses. Therefore these teachers are constantly amending and shaping their own multiple subjectivities, sometimes moment-by-moment, by tapping into various conflicting discourses.

In understanding what it means to work in a middle school, it is important to begin with one aspect of the language that underpins the entire middle school philosophy: the term "early adolescent." Middle schools have developed out of a strong desire to create an educational environment that specifically catered to the unique needs of students in this particular developmental stage. Therefore, it is important to first recognize that the term "early adolescent" is itself a construct with its own history and associated language. First conceptualized in the late 19th century, adolescence signified a period of childhood that extended beyond puberty. Manning (1993) charts the emergence of this concept and notes, "In essence, America invented adolescence to provide for the time between childhood and adulthood, when a person was not a child yet did not have the authority to act or the right to be treated as an adult" (p. 5). This was first documented in Hall's (1904) work, *Adolescence*, which worked to better demarcate and define this phase of human development. Adams (1997) deconstructs the institutionalization of adolescence that occurred within Hall's work, noting that he characterized this time in life as *universal* and laden with *storm and stress*. Without a definition and understanding of this specific phase, there would be no need to differentiate middle level education as something worthy of a development. Thus, the language associated with middle school discourse works again to "word the world" (St. Pierre, p. 483).

Manning (2000) describes how today's middle schools emerged from what was once an educational system with just two levels: elementary and high school. "The eight-year elementary and four-year high school pattern dominated much of the nineteenth century" (p. 192). In the early part of the 1900's, the junior high concept originally emerged, in part, as a way to better track students into college-bound vs. technical-bound

programs. The middle school reform movements of the 1950s and 1960s pushed the development of an educational setting that was responsive to early adolescents' needs. While junior highs were an initial attempt to recognize the middle grades as a unique, transition period from elementary to high school, they failed to translate this philosophy into substantive structural, curricular or pedagogical changes. "In short, the junior high was tarred with the brush of overemphasis on teacher-centered, academic and disciplinary approaches" (Anfara & Waks, 2000, p. 47). The paradigm shift in philosophy resulted in new forms of school organization, curriculum, and pedagogy that were "designed specifically for young adolescents in light of their unique physical, psychosocial, and cognitive developmental characteristics (Manning, 2002, p. 225). Several important reform documents, including *This We Believe* (National Middle School Association, 1982, 1995), *Turning Points* (Carnegie Council on Adolescent Development, 1989), and *The Middle School We Need* (Association of Supervision and Curriculum Development, 1975), worked to crystallize the basic tenets of a developmentally responsive middle school philosophy, organization, curriculum, and pedagogy.

One unique aspect of middle school philosophy is the attention paid to the affective domain, highlighted by the creation of *advisory programs*. These programs are designed so that "one adult and a small group of students have an opportunity to interact on a scheduled basis in order to provide a caring environment for academic guidance and support, everyday administrative details, recognition, and activities to promote citizenship" (National Middle School Association, 1996). While these programs may vary widely in enactment, their philosophical intention is to provide a context in which teachers can address aspects of middle level education that fall outside of the traditional discipline boundaries. Along with interdisciplinary teaming, advisory programs can work to create *families within families* that facilitate each student's sense of belonging. Stevenson (1998) comments that such programs are "recognized as one of the most tangible evidences of the school's commitment to caring about and being responsive to kids' needs" (p. 303). With their focus on establishing personal caring relationships

between students and school faculty, advisory programs have become one of the main tenets of middle school discourse.

In examining the implementation of such programs, Anfara and Brown (2000) found that gender was an important factor. Comments from practicing teachers, both male and female, illustrated that because of a perceived innate caring essence, female teachers were assumed to be more capable of taking on these advisory roles. This assumption, in turn, resulted in female teachers predominating the programs and thus reinforcing the "feminization of teaching - the idea that women are more naturally suited to, and are the only ones who are capable of caring" (p. 30). [Pinar (1996, p. 368-369) observes that this stance, which builds upon an essentialist understanding of what it means to be female, is also reflected in Noddings' (1984) work on the pedagogy of caring and in *Women's Ways of Knowing* by Belenky et. al. (1986). Grumet's *Bitter Milk* (1988), on the other hand, transforms caring into more of an event/accomplishment, rather that seating it squarely within an essentialist argument.]

Advisories and other affective aspects of a developmentally responsive curriculum represent a strong force within middle schools. Alongside this force are the prevailing demands of subject area content, as traditionally defined by conventional discipline boundaries (e.g., mathematics, language arts, science, etc.). Anfara and Waks (2000) refer to this as the "dualism between developmental, student-centered vs. academic, subject-centered pedagogy" (p. 47). I would argue that while debates about progressive, child-centered, developmentally responsive curriculum and pedagogy abound throughout the educational literature as a whole, these topics are immediately reflected in the very concrete ways in which middle schools are structured and organized. In other words, I claim that middle schools explicitly embody these contradictions in ways that are less immediately tangible in other levels of schooling (e.g., science teaching at the early elementary or graduate levels). Describing reform efforts as a pendulum, Anfara and Waks (2000), note that, "the developmental vs. academic conflict in the middle schools" represents "conflicting values, each rising, then falling, and then rising again" (p. 47). In terms of poststructuralism, these are competing

discourses that strive to define what it means to be a science teacher and the nature of teaching itself.

Just as poststructural work can challenge the inequitable dualism that structures how we look at gender, the same can be done with respect to this cognitive/affective middles school dualism. Anfara and Waks (2000, 2001) tap into Dewey's notions of *knowledge in use* (as opposed to mere *knowledge possession for later use*) in order to interrogate the taken-for-granted dualism of "academic rigor" versus "developmental appropriateness" within middle school discourse. The distinctions between these two signifiers are strengthened through shifting policies and reform efforts that, over the course of decades, have pushed and pulled middle level education toward one of the two poles. However, arguing that middle school curriculum can be both academically rigorous and responsible to the needs of early adolescents, Afara and Waks challenge the dualism and highlight weak points in the ways in which it operates within middle school discourse. While these authors successfully illuminate how these two constructs are not mutually exclusive, the common sense knowledge about middle school philosophy, organization, and structure (as well as faculty/staff's ensuing daily practices) most often work in the other direction to fix their contradictory meanings. Although not specifically mentioning poststructural analysis, Anfara and Wak's theoretical framework sits comfortably alongside my work with gender and science teachers. Their rigor/developmental dualism can be related to cognitive/affective dualism that then also entails a gendered male/female distinction. "Given the importance of affectivity, connection, and relationship emphasized in much of the literature about women's learning, it is important to consider a feminist poststructuralist deconstruction of the "rational-affective" dichotomy" (Tisdell, 1998, p. 146-147). Thus, a poststructuralist analysis of what it means to be male and female for these middle school science teachers is paralleled by conversations about the philosophy of middle schools themselves.

The convergence of several competing discourses within middle level education, specifically middle level science teaching, creates a unique setting for illuminating the weak points within the existing, inequitable gender dualism: the current taken-for-granted

meanings of what it means to be female or male, feminine or masculine. The cognitive/affective tensions within middle school reform thus highlight teachers' encounters with the masculinized discipline of science and the feminized career of education.

It is also useful to take into consideration that middle school teachers are often involved in more than one subject area, either by participating in interdisciplinary team planning or by actually teaching a variety of individual disciplines. This variety can be a productive place to examine the gendered nature of different subjects, and the implications that has on how a teacher addresses equity issues in each class.

CHAPTER 2

METHODOLOGY AND METHODS

Critical Ethnography

This dissertation explores the enmeshment of hegemonic masculinity and science via an ethnographic analysis of science classroom culture, focusing primarily on the daily practices of science teachers (i.e., *doing* gender / *teaching* science). However, my alignment with feminism calls for a critical stance toward my fieldwork. Therefore, as I recognize existing gender inequities, I perceive the educational stetting as a place of conflict and possible social change. Thus, the field of *critical* ethnography proved most appropriate for directing my research agenda. According to Thomas (1993), critical ethnography moves beyond traditional culture studies as it

> deepens and sharpens ethical commitments by forcing us to develop and act upon value commitments in the context of political agendas. Critical ethnographers describe, analyze, and open to scrutiny otherwise hidden agendas, power centers, and assumptions that inhibit, repress, and constrain. Critical scholarship requires that commonsense assumptions be questioned. (p. 2-3)

Ethnography is essentially the study of culture. Rather than being simply descriptive, critical ethnography holds political potential. I would posit that *all* ethnographic work is political in one way or another; critical ethnography simply makes it explicit. Critical ethnography is "a methodology that strives to unmask hegemony and address oppressive forces" (Crotty, 1998, p. 12). The shift from traditional ethnography to critical ethnography, embodies a move toward not only uncovering oppressive cultural factors

but also jump-starting social change. Thomas' (1993) comment above that "commonsense assumptions" are questioned within critical ethnography is central with regard to my work with gender. It is precisely the commonsense, taken-for-granted, and naturalized understandings of gender that I challenge through my ethnographic work. While these commonsense notions of gender are implicated in oppression, their recognition as such within the science classroom setting is a place for positive social change.

Adkins and Gunzenhauser (1999) outline this emancipatory potential as an overarching concept of critical ethnography:

> The hope is that critical ethnographers may not only describe the lives of the oppressed but also uncover the structural and cultural factors causing oppression. The impetus for critical ethnography is social change, and mere description of oppressive conditions is inadequate for change, because merely to describe is to fail to question the status quo. (p. 61)

In terms of studying gender, my desire is not only to bring to light the oppressive nature of current gender relations within science education, but also to point out possible alternatives. I embrace the third point made below by Adkins and Gunzenhauser (1999) in their description of three presuppositions of critical ethnography: 1) All research, including critical ethnography, is value-laden and political; 2) critical social theory drives such work to not only describe oppressive conditions, but to strive for emancipatory action, and 3) critical ethnography embraces "knowledge *constr*uction, rather than simply knowledge *prod*uction" (p. 66). Via a reflexive relationship, both the researcher and the researched are collaborating in the production of knowledge.

Being merely collaborative in nature, however, is too broad a depiction of my intent. There are numerous aspects of the reflexive nature of critical ethnography that should be mentioned in order to distinguish it as an alternative method. Adkins and Gunzenhauser (1999) list these as "relationships between the researcher and the act of research; between theory and method; between macro- and micro-levels; among social theories; between the act of research and its transformative impact; and between the

researchers and the researched" (p. 67). The positionality of the researcher impacts how issues are problematized and which research agendas are deemed appropriate. The utilization of both micro- and macro-theories and methods makes critical ethnography unique in that it focuses on "over-arching structural forces that perpetuate domination and oppression and the particular, situated instances of reality though which they are mediated" (p. 67). By drawing on numerous social theories (e.g., feminism, critical theory, postmodernism, or poststructuralism), critical ethnography allows a "polylogue" (Adkins & Gunzenhauser, 1999, p. 68) to inform the research agenda and the analytical framework. Finally, the relationship between researcher and researched, as mentioned above, is crucial for knowledge claims to be a collaborative effort rather than simply reflecting researcher bias. "In the relationship between researchers and researched, knowledge construction is a process in which divergent perspectives are identified and explored" (Adkins & Gunzenhauser, 1999, p. 71). A similar account from the field of science education can be found in Barton's (2001) work with urban schools.

Participants and Setting

Finding value in feminist standpoint theory, I desired to begin the research within the lives of women. Therefore, it was important that all my participants be female. However, this selection criterion has not been based on a biological distinction of being female (i.e., biological essentialism), but on the fact that I looked for individuals who resided in more marginalized locations within the gender relations of power. However, this condition does point to my having to rely on the very gender dichotomy that I find to be problematic. Rather than a contradiction, I viewed this as an example of the productive tension between feminism and poststructuralism. The underpinning of this stance comes from the acknowledgement that men and women's experiences differ as a result of their contradictory locations within social relations. This gap between men and women's experiences thus creates the potential energy required for novel contributions to be made from marginalized positions.

The study is situated at Sandhill Middle School, located in a small, rural town on the Florida panhandle coast. The three female science teacher participants represented

each of the grade levels at the school: 6th, 7th, and 8th. Each is of European descent, in a heterosexual marriage, and a mother. The three participants in the study have varying degrees of experience and confidence with teaching science. The name of the school, as well as the names of the participants (Angie, Linda, and Marguerite) are all pseudonyms.

The organization of this particular middle school results in each teacher on a team being responsible for more than one subject. Therefore, some of the teachers are "newer" to teaching science than others, thus affecting their scientific self-efficacy and professional identity. This provides a unique opportunity to explore how both novice and highly experienced science teachers investigate the connections between gender and classroom science as well as how discipline-specific discourse functions within their construction of a gendered teaching identity. In addition, the classroom culture is affected by numerous subjects being taught in one room by one teacher at different times, thus disrupting the traditional labels of "the science classroom" or "the science teacher."

I gained entry into this particular school due to the fact that one of the participants is currently finishing her master's degree as a distance learner in the same department as myself. After talking with her concerning my research goals, she and I decided that there would be benefit in us coordinating her thesis work with my dissertation work. Her initial intention was to use an autoethnographic methodology to explore the process of being a subject of study and of co-constructing knowledge with an outside observer. However, she ultimately decided against focusing on her thesis at this time, due to other situations in her life. Through her, I met with other teachers at the school and was fortunate to find two other female science teachers who were interested in exploring the issue of gender.

Data Collection

Over the course of seven months, I spent an extensive amount of time at the school observing and interacting with these teachers. I was there a minimum of three days a week, spending at least one period in each of the three classrooms. In addition to these observations, I conducted numerous semi-structured interviews with each of the participants individually. These tape-recorded interviews were conducted after school in

their classrooms, usually lasting between one and two hours each. Informal conversations during class, between periods, and through emails also contributed to my data pool. The nature of the interviews also changed as the study progressed, with more emphasis on member-checking and collaborative meaning making about findings as time went on.

Data collection revolved around exploring the participants' understandings of gender, as well as their own shifting gendered scientific subjectivities. Overall, I looked for instances in which gender intersected with classroom science in ways that either sustained or challenged the existing gender structure. Davies (1989) comments "choice-points between one discourse and another are critical moments in the development of each individual identity" (p. 238). Recognizing these productive "choice-point" moments was an important guide in my data collection process and guided my inquiry as to which discourse the teachers tapped into to create successful gendered science-teaching identities. In other words, conceptualizing gender as a shifting effect of performance/doing, I looked for how science provided the language and cultural practices needed to negotiate membership into a particular sex category and/or science (teacher).

I made a concerted effort to review, reflect on and type up my fieldnotes on a daily basis. I was fortunate to find a nearby park a few miles from the school. I would drive there after meeting with the teachers, eat a late lunch, and then type up my fieldnotes on my laptop. This facilitated data management by allowing me to more promptly organize the fieldnotes into the NUD*IST software. In addition, this allowed me to focus my mental energy on *digesting* the fieldnotes one set at a time, rather than on *typing up* an accumulation of several days of notes.

My role in the classroom varied to some degree with each teacher. However, for the most part, in each class, I sat in the back corner of the room taking notes, interacting very little with the students. At the onset of the study, the teachers allowed me to introduce myself to the students, to explain why I was there and to answer any questions. With regard to *why* I was in their classroom, I explained to the students that I was not there to observe *them*, but their *teacher*. I did teach a lesson for each of the teachers, as a

means of helping out and showing my gratitude for letting me observe in their classrooms. It was usually on a topic that they were not particularly familiar with or that they were unsure of how to approach. Having been a middle school teacher myself before entering graduate school, I was very familiar with this age level of student and the science curricula. As accepted and comfortable as I was in their classrooms, I was aware that my "ethnographic marginality" was maintained since "the ethnographer remains a stranger as long as, and to the extent that, she retains a commitment to the exogenous project of studying or understanding the lives of others" (Emerson, Fretz, & Shaw, 1995, p. 36).

Carspecken's Methodology for Critical Ethnography

In the introduction to Phil Carspecken's (1996) *Critical Ethnography in Educational Research*, Michael Apple notes the importance of Carspecken's work: "It provides an exceptionally clear guide to the conceptual and methodological foundations of one of the most crucial forms of critical qualitative research" (p. xi). Carspecken's work provided a comprehensible technique to doing critical ethnographic research, especially in the field of education. While he recognizes the diversity within critical qualitative research orientations, he also illuminates the common threads:

> Those of us who openly call ourselves "criticalists" definitely share a value orientation. We are all concerned about social inequalities, and we direct our work toward positive social change. We also share a concern with social theory and some of the basic issues it has struggled with since the nineteenth century. These include the nature of social structure, power, culture, and human agency. We use our research, in fact, to refine social theory rather than merely to describe social life. (Carspecken, 1996, p. 3)

Since feminist research is openly political in nature, his description of the methodology and methods entailed in critical ethnography resonates with my research goals.

I used a version of Carspecken's (1996) five-stage methodology for critical qualitative research. I will briefly describe each stage below and some of the associated methods of data collection and analysis that are relevant to my work with gender in a

school science setting. However, Carspecken recommends not a strict adherence to this sequence, but "a loosely cyclical use of the stages" (p. 40).

Stage 1 – Compiling the Preliminary Record. Carspecken describes this first round of data collection as being monological because the researcher's voice is the only one present at this stage. It is through unobtrusive, intensive data collection that the researcher begins to formulate a comprehensive description of the site - developing a primary record. The nature of the observations recorded at this time can provide a "thick" account of the site.

During the first few visits, I collected an exhaustive amount of field notes and diagrams. Carspecken recommends the use of "low-inference vocabulary" (p. 47) at this stage in order to have as much data as possible as a source for further analysis. When data is collapsed too soon into coded categories or recorded with large amounts of normative reflection, it is reduced and reconstructed. I wanted that process of thematic reduction to occur explicitly during acts of data analysis as much as possible. This required me to be attentive not only to *what* I record during my primary observations, but also to *how* I record it. Obviously, paying attention to detail was important and the recording of body language and postures, verbatim speech when possible, as well as contextual information (e.g., times, incidental remarks, special events, etc.) was recognized as valid observations. Organization of field notes into separate categories of regular observations and "observer comments" was useful (Bogdan & Biklen, 1998). This process helped in later readings of the data to recognize the occurrence of "the researcher's feelings, reactions, hunches, initial interpretations, and working hypotheses" (Merriam, 1998, p. 106).

In addition to traditional field notes, I kept a personal journal to record my evolving participation with, and reaction to, the research process. While this journal of course also served as an additional source of data, its main purpose was to focus on my own learning and growth as an educational researcher/teacher educator. After reading the appendices of Jay MacLeod's (1995) *Ain't No Makin' It* and Annette Lareau's (2000) *Home Advantage*, I gained a great deal of insight into the more personal aspects of their

research. In addition to providing the reader with additional insights into the inquiry methods and the researcher's positionality, this type of writing also serves as a practical "how-to" (or "how-not-to") guide for other researchers.

Stage 2 – Preliminary reconstructive analysis. It is during this second stage that the researcher begins to analyze the primary record established within stage one.

> The analysis is reconstructive because it articulates those cultural themes and system factors that are not observable and that are usually unarticulated by the actors themselves… Reconstructive analysis always contains an element of uncertainty, or indeterminacy, but boundaries exist on the possibilities, boundaries that the researcher must discover and elucidate. (p. 42)

Carspecken categorizes this stage as the time when the researcher starts to "make speculations with respect to the meanings of interactions recorded in the primary record, to tease out normative and subjective references, and to articulate normative themes tacitly referenced in consistent ways" (p. 93). Coding and recognizing emergent themes also begin at this stage of the process and will continue for the duration of the study. It is expected that this information will impact successive observations and interactions with participants. "Reconstructive analysis is at heart a creative endeavor, akin to the creativity involved each time we understand other people in everyday life" (Carspecken, 1996, p. 94).

Part of this second stage, according to Carspecken, is the creation of a *meaning field*. This term refers to the range of *possible meanings* a researcher conceives of as being potential explanations for observed situations. Carspecken notes that the researcher and the researched both create meaning in the same way – through selecting from a range of possible meanings. "Meanings are always experienced as possibilities within a field of other possibilities" (p. 96). It is the role of the researcher, however, to articulate these possible meanings from the *tacit* realm to the *discursive* realm, keeping in mind that that these may or may not correlate with those of the participants. When the voice of the participants comes into play in stage three, these meaning fields can be explored with them. Until then, Carspecken suggests peer debriefing can be a way to bolster confidence

in the meaning fields constructed and to explore other possibilities. Because of the language of poststructural theory, and the degree to which it unhinges understandings of gender from everyday humanist thought, I found that communicating with peers about the overall themes of the research proved to be somewhat difficult. This did prompt me to be cognizant of the language of poststructuralist theory and how it could act as an obstacle during the later dialogical stages.

Stage 3 – Dialogical data generation. The monological nature of the previous stages gives way to a dialogical process among researcher and researched during this stage. "Stage three generates data with people rather than records information about them. It is crucial to critical qualitative research because, if used properly, it democratizes the research process" (p. 42). The information attained during this stage may sustain or challenge understandings created during the first two stages. Interviewing plays an important role here.

Interviewing participants is *not* a simple process of information gathering that occurs in some context-free situation, hermetically sealed off from the rest of the world. The subjectivities of *all* involved, the time and location of the interview, and the subject matter all influence the phenomenon. There is analytical importance in recognizing the impact of locating the interviewing process within a study that works with women to investigate gender issues in public education. The nature of critical ethnography does not afford the luxury of assuming a value-free, Archimedean standpoint from which to conduct research. Since the values and beliefs of both the participants and myself factored into the research, I had to maintain an open mind to what may surface.

Due to the fact that gender can be a private issue, I expected to run into personal, sensitive information. In addition, because of the intimate relationship between gender and sexuality, I strived not to assume heterosexuality nor assume that the participants' beliefs about marginalized populations will be the same as mine. I found that the extended time in the field and the established trust/rapport facilitated this process.

Fontana and Frey (2000) discuss the gendered nature of traditional interviewing methods and call for a feminist ethic to influence the practice. "In the typical interview

there exists a hierarchical relation, with the respondent being in the subordinate position" (p. 658). Thus, my positionality and that of my participants were not to be ignored nor taken for granted. The masculine model of traditional, structured, and seemingly objective interviewing should be questioned (Oakley, 1981). I recognized that both the interviewer and the interviewee are "doing gender" as they interact and co-create understandings.

Fontana and Frey (2000) mention three ethical considerations that are ubiquitous in interviewing techniques: "informed consent," "right to privacy," and "protection from harm" (p. 662). I obviously adhered to these guidelines. In addition, I was aware that issues of gender and sexuality (including the differences between myself and my participants) influenced the dynamics of the interviewing process.

Within this stage of dialogic data generation, subjective truth claims will emerge (Carspecken, 1996, p. 165) and several techniques may be utilized to strengthen such claims. Carspecken recommends using consistency checks of interview data where the researcher finds inconsistencies or discrepancies in what the participant said. The same applies to consistency within interviews and observed activity of the participants. (It is worth mentioning here that I find some degree of tension between Carspecken's and poststructuralism's views of inconsistencies/discrepancies within a participant's accounts – something that I comment on later in this chapter.) Working with normative/evaluative claims may result, as Carspecken warns, in emotional strain, especially when working with participants who may hold vastly different ideals than the researcher. "Researchers must be prepared to become hurt though their work; to allow their contact with others to threaten and perhaps alter their usual ways of conceiving of themselves" (p. 167).

Stage 4 – Describing system relations. During this stage, relationships are explored between the site being researched and other locations. Such a process entailed consideration of school and community culture. Participants' reactions to cultural products (e.g., media images, school documents, textbooks, etc.) are possible venues for making connections between sites. An example that Carspecken provides of this type of

analysis is Michael Apple's (1986) Teachers and Texts where schoolbooks are the commodity of study.

In terms of my study of gender, school artifacts (e.g., school website or hallway decorations about school dances), media images (e.g., local newspapers or television), as well as aspects of popular culture were all useful. Teachers' reactions to these commodities facilitated my establishing connections between the science classroom sites and other sites in society. Lateral comparisons between teachers also proved useful in that by talking about how they were different from other teachers (e.g., teaching style or room décor), the teachers were defining themselves and constructing a particular teacher identity.

Stage 5 – System relations as explanations of findings. The use of systems theories marks this fifth stage. While the previous stage can be termed a lateral comparison between sites, this final step analyzes findings from the primary site using more macro-sociological constructs.

> If successful, a critical researcher is able to suggest reasons for the experiences and cultural forms she reconstructed having to do with the class, race, gender, and political structures of society. Often it is this fifth stage that really gives one's study its force and makes it a constitution to real social change. (p. 43)

Adkins and Gunzenhauser (1999) remark that this attention to both the micro- and macro-lenses is a trait that has historically evolved within critical ethnography. They point to the seminal work of Willis as representative of this move:

> As the first critical ethnography, *Learning to Labor* (Willis, 1977/1981) emerged as a corrective to the limitations of critical social theory which was both pre-occupied with broad structural and historical patterns of domination and with macro-level empirical analysis of them. As a result, critical ethnography emerged to attend to the reflexive relationships between macro- and micro-level analysis and between theory and empirical observation. (Adkins & Gunzenhauser, 1999, p. 65)

Klein (1996), borrowing from the work of Gloria Anzaldúa (1987), remarks that critical ethnographers must develop "the eagle and serpent eyes" – "the macro and micro view of culture" (p. 8). This is the interplay of context and meaning, joining a larger overview of the sociocultural landscape in order to better understand the more localized occurrences. "Critical ethnographers are interested in studying the dialectical relationship between social systems and human actors, with particular concern for aiding actors in their resistance to dominance and oppression" (Klein, 1996, p. 9). For my study, gender as a social structure, patriarchy, and compulsory heterosexuality are examples of macro-level theory that were applicable. A systems analysis that draws from the daily language and cultural practices of the participants themselves maximizes the possibility of social change.

Quality Criteria

Lincon and Guba (2000) remark that there are traditionally two strands of thought concerning validity: those that stem from the positivist tradition requiring methodological rigor and those that stem from the postmodern perspective focusing on consensus and interpretation. In terms of this second camp, in which I locate my own data analysis, Lincon and Guba (2000) see much of the field of qualitative research asking, "Are we *interpretively rigorous*? Can our cocreated constructions be trusted to provide some purchase on some important human phenomenon" (p. 179)? These questions can be answered by exploring Carspecken's use of the hermeneutic process to explore validity claims. It is within this process that individuals can attain affirmation and dignity from the research process.

> Consensus to values and norms will occur most deeply when a single set of normative-evaluative claims wins the recognition of all parties involved, without influence or coercion, because each member "finds herself" as a valid human being through them. The ideas of what are good and right held by the group correspond to the ways each member seeks to make herself "right" and "good": make herself a valid human being in possession of dignity. (Carspecken, 1996, p. 143)

I used this notion of *finding oneself* as I spoke with the participants concerning the emerging themes as well as my final writing stages. It provided a way for us to negotiate valid representations in the way I wrote about who they were and their science teaching practices. This is akin to the conceptualization of agency as *authorship through discursive positioning* that I speak of in the discussion chapter.

Carspecken draws on the work of Habermas' *Theory of Communicative Action* (1981, 1987) and conceptualizes truth in terms of consensus.

> With truth, what should be concentrated upon is not whether they are true or false in the traditional sense but rather whether they meet certain validity conditions necessary to win consensus. Truth claims should be translated into validity claims when they are to be carefully examined. (Carspecken, 1996, p. 56)

The distinction between truth claims and validity claims is important to critical qualitative research. Rather than relying solely on the empirical nature of the argument, validity claims also take note of the cultural understandings of the semantic categories involved in the argument. Part of this process of interpretive consensus between the participants and myself took shape within the stages of *member-checking* process (Merriam, 1998), which evolved from verbal discussions about previous fieldnotes and conversations to the teachers actually reading drafts of the findings chapters.

In addition to the act of member-checking with the participants, I relied on the argument that *prolonged engagement* with the participants would increase the validity of my findings. While "friendship" was not a predetermined goal of the research process, I was never shy of allowing myself and the participants to come to know each other and to enjoy each other's company. This facilitated the natural growth of rapport and trust that I felt was vital to my exploring (in a critical way) the manner in which these three women dealt with issues of gender and teaching. In their discussion of "validity as an ethical relationship," (Lincon & Guba, 2000) remark that "the *way* in which we know is most assuredly tied up with both *what* we know and our *relationships with our research participants*" (p. 182).

Data analysis

Thomas (1993) describes the data interpretation phase of critical ethnography as resembling

> literary criticism in that we look for the ways that the symbols of culture create asymmetrical power relations, constraining ideology, beliefs, norms, and other forces that unequally distribute social rewards, keep some people disadvantaged to the advantage of others, and block fuller participation in or understanding of our social environs. (p. 43)

I allowed more open coding to create emergent themes that had an ongoing impact on my research in the field. This process of simultaneously collecting and analyzing data is recommended for qualitative research.

> At the onset of a qualitative study, the investigator knows what the problem is and has selected a sample to collect data in order to address the problem. But the research does not know what will be discovered, what or whom to concentrate on, or what the final analysis will be like. The final product is shaped by the data that are collected and the analysis that accompanies the entire process. (Merriam, 1998, p. 162)

I agree with this perspective and am aware that my agenda was shaped by the ongoing analysis of data. As stated within my description of Carspecken's model, data analysis unfolds throughout the study via the monological and dialogical processes.

Poststructuralist theory provided several categories that were useful during the initial data analysis stages. Ropers-Huilman (1998) highlights the main tenets of poststructuralism that are most useful for feminist thought: discourse, power, language, knowledge/meaning, and difference. These proved very useful as broad initial coding categories that organized my thoughts during the first rounds of data analysis. However, I was cognizant not to allow these categories to restrict the initial open coding process.

I used the NUD*IST data management software (Qualitative Solutions & Research, 1999) in organizing fieldnotes, observer comments, and interview transcripts. The software enabled me to continually develop, organize, and edit the codes used during

analysis. The "code reports" generated by the NUD*IST program were particularly useful in generating interview questions for subsequent visits to the school.

Reflections on my Researcher Positionality

Harding (1998) points out that men "can work to eliminate male supremacy, but no matter what they do, they will still be treated with the privilege (or suspicion!) accorded to men by students, sales people, coworkers, family members, and others" (p. 161). As much as I allow feminist thought and progressive concepts of gender to influence my personal worldview, I still must contend with having a male body that is perceived by others in a certain way. Despite the fact that I recognize and draw upon my own solidarity with feminist concerns of heteropatriarchy, I also must recognize that I am much more *physically* connected to masculinity and maleness. I am mindful of the fact that my doing of gender is flexible enough that I can rather easily "pass" within a range of maleness, but not within femaleness. My use of Connell's (1987, 1995) ideas about patriarchy working *within* genders, and not simply *between* genders, is one way to explicate my positionality as a male feminist. While I draw upon a wide array of both femininities and masculinities to negotiate a particular gendered self at any one moment in time, the physical and emotional experiences of continuously accomplishing "normal" female gender are not inscribed within my physical being. The female "sex category" is physically not *me*. Thus, my corporeal presence and the subjectivity that I create at any one moment are integral parts of the research, requiring me to be *reflexive* about how they affect this study; reflexivity being "the process of reflecting critically on the self as researcher" (Lincon & Guba, 2000). The implications of my male sex category/gender are not issues that I can ignore. While my being a feminist is a taken-for-granted notion in *my* mind, I have to recognize that existing power relations and patriarchic norms could influence the way that *others* will perceive my work and me.

I argue that being subjected by, and claiming authorship within, the discourse of homosexuality (i.e., being a gay man) constructs my positionality at the margins and opens up the possibility for less "partial and perverse" (Hartsock, 1983, p. 303) ways of knowing. In addition, Jones, Letts, Lewis, and Rodriguez-Munoz (1998) remark that

there is particular insight to be found within the peripheral viewpoints of graduate students who occupy marginalized locations, such as taking up a queer subjectivity. However, in good poststructuralist form, it is important that I recognize how that particular subjectivity ebbs and flows, fades in and out, of my work as an educational ethnographer. The above warning by Harding forces me to be critically aware of how I fit within existing sex/gender categorizations, ones that would normally be placed under scrutiny within a poststructuralist framework. In essence, this tension between *allegiance to categorization* and a desire to constantly *deconstruct and transcend that same categorization* functions in my life; therefore, it functions in this work. The "truth" that I tell about myself is as shifting and fractured and inconsistent as the findings I present in this work, each being shaped by the power(s) of both a marginalized subjectivity within the discourse of gender/sexuality as well as more centralized subjectivities within the discourses of race, ethnicity, ability, language, class, and nationality. Hopefully this allows me/the participants/the reader to better understand the embeddedness of myself (my selves) within the study as well as the ethics involved with the power/knowledge relationships that shape the presented findings.

I more than likely would not have chosen to write a dissertation about gender, much less use a feminist poststructuralist theoretical framework, had I identified as a heterosexual. Being gay problematizes the issues of equity, gender, and sexuality. Doing research within the context of critical theory allows me to validate my marginalized stance and use it as a beneficial vantage or standpoint. What it means to be a male (how to perform "normal" and "proper" maleness) shifts as I hail different discourses (such as Western Christianity, positivistic science, or theories of social justice).

> Power is embedded in discourses due to their ability to produce subjects and objects in certain ways: one might, for instance, be rendered powerless by gender discourse in one instance, while being positioned (or possibly positioning ourselves) as powerful via social class discourse in another. (Francis, 1999, p. 383)

However, here I am continually relying on binary ways of understanding what it means to be a gendered/sexual person: female/male and homosexual/heterosexual. Under the demands of poststructuralism, I must recognize the limitations of such a categorization and realize that I do not always "do" the same sexuality; my identities, like those of my participants, are discursively negotiated and "as discursive boundaries shift, so do our identities" (Britzman, 1992, p. 26). This dissertation emerges from my claiming the identity of "gay man" and I have been influenced by the work of other gay and lesbian ethnographic writing (Lewin, 1995; Newton, 2000; Rofes, 1999; Sears, 1991). However, the dissertation also simultaneously challenges the stability of the very categorizations of sexuality and gender. The voices of my multiple selves (teacher, activist, scientist, researcher, gay male, Southerner, etc.) spoke up at different times in the process of this fieldwork, thus enabling me to use the very act of research to construct who I am: "Writing – of all the texts, notes, presentations, and possibilities – is also a process of discovery: discovery of the subject (and sometimes of the problem itself) and discovery of the self" (Lincon & Guba, 2000, p. 185).

Just as Harding challenges me to interrogate my maleness, hooks (1994) asks me to do the same with my whiteness. I lament the fact that I have not been able to incorporate a more critical deconstructionist approach to being white, a racial categorization that I share with each of the participants in the study. There is an absence of non-white voices in this work, as well as an absence of a critical lens of what my race brings to the table. It is my hope that my future work will not only include a greater range of *intersectionality* (Collins, 1998) among marginalized locations (e.g., race, class, ability, language, etc.), but also a greater reflexive and deconstructive analysis of my own whiteness. In her discussion of who benefits from, or better yet who is less threatened by, the postmodern interrogation of the unified subject of identity politics, Patricia Hill Collins (2000) quotes Diana Fuss's (1989) *Essentially Speaking* to point a finger acutely in my direction:

> "Gay male theorists …have been quick to endorse the social constructionist hypothesis and to develop more detailed analysis of the historical construction of

> sexualities" (p. 98). Since we must assume that Fuss's gay males are Whites, this group need not engage in identity politics because social institutions as currently constructed protect their interests. (Collins, 2000, p. 64-65).

I appreciate this challenge and hope that I can continue to think about the extent that my whiteness provides a cushion or safety net for deconstructing categories of gender and sexuality.

Finally, I think it is important to acknowledge that simply aligning myself with feminist ideals, whether they be those of Harding or not, is to accept my position in the "countercultures of science" (Harding, 1991, p. 3). Although I have an undergraduate degree in biology, my graduate work in science education has moved me further away from positivist forms of research and toward more critical interpretivist forms. It is possible that I was initially attracted to science in high school in some measure by its "strangely alluring" (Letts, 2001, p. 262) ability to position me more within hegemonic heterosexual masculinity. I can use my current theoretical lens to *re-read/re-tell* how I have professionally moved from science, to teaching, to educational research. Alongside of this retelling, I can create parallels to my relationship with science that have moved from accepting, to neutral, to critical. Finally, I can elaborate on the story to include my "coming out of the closet" and claiming a gay identity but then moving toward an empowerment through the deconstructionist ideas of queer and poststructuralist theory. Within these thoughts, I am engaging in mental somersaults that are not always productive or understandable. Yet, I feel that this process is an important part of the story as it influences the way I conduct my research.

Writing Ethnographies via Poststructuralism

Britzman's (2000) chapter about the actual writing of poststructuralist ethnographies, in St. Pierre and Pillow's *Working the Ruins: Feminist Poststructural Theory and Methods in Education*, was very influential in helping me to digest the data and create the following chapters. Britzman begins by putting an assumption about ethnographies up on the chopping block: In its "mainstream and modernist version, ethnography depends upon the rationality and stability of writers and readers and upon

noncontradictory subjects who say what they mean and mean what they say" (p. 28). That is a little jarring since, in good poststructural form, it challenges the taken-for-granted ways in which I look at ethnographies in general (including the academic abilities I bring to the table which I consider appropriate for the task). Thus, poststructuralism not only provides a means through which data from the field are analyzed, it also bends back upon the ethnographic process itself. Since poststructuralism celebrates the contradictory and fluid nature of identity, as well as the power of discourse to provide language and shape experience, my work should fall under the same lens: who I am, what I did in the field, how I look at data, and the manner in which I report my findings. It is this last part, the writing up of findings, that Britzman takes to task in a very insightful manner.

> The ethnographic promise of a holistic account is betrayed by the slippage born from the partiality of language of what cannot be said precisely because of what is said, and of the impossible difference within what is said, what is intended, what is signified, what is repressed, what is taken, and what remains. (p. 28)

The very ways in which I construct the following chapters are representative of the discursively bound language that I use (or don't use). My "ethnographic authority" (p. 28) to go in and *get it right* is shaken. Going into this project, I worked under the common assumptions that with prolonged engagement, attention to issues of trust and power, and with an emphasis on co-creating meaning with the participants, I would better secure a more valid representation. While these practices are still critical, they are nevertheless only guaranteeing a partial view, however valid. "Representation is always in crisis" (p. 30); therefore, it can only help to also place my ethnographic writing (process and product) under the pressure of poststructuralism.

With her own ethnography of preservice teachers, Britzman allowed the multiple voices of any one participant to *argue* amongst themselves. These arguing voices from within the findings about any single participant can highlight the very contradictory and fluid identities that are important under poststructural research; ones that would be ironed

out under traditional ethnographic discourse which can work toward the creation of a stable self and a seamless set of findings.

> I tried to write against the discourses that bind the disagreements, the embarrassments, the unsaid, and the odd moments of uncertainty in contexts overburdened with certain imperatives. I tried to do this by provoking and contradicting multiple voices: the ethnographic voice that promises to narrate experience as it unfolds, the hesitant voices of participants who kept refashioning their identities and investments as they were lived and rearranged in language, and poststructural voices that challenged a unitary and coherent narrative about experience. (Britzman, 2000, p. 31)

I hope that within the subsequent chapters I can capture some of the same hesitancy and argument among the participants' multiple voices. Even if this is not done explicitly, it does work to free my thinking (and writing) from the need to work toward a fictitious coherence. "Poststructural theories of subjectivity capture the active process of taking up certain subject positions in an ongoing process of becoming – rather than merely being – in the world" (Jackson, 2004, p. 674). Thus, the chapters that follow attempt to illuminate *moments of thought and belief and identity in action*, rather than a serial list of evidence which accumulates en route for a single set of beliefs or practices or identity.

CHAPTER 3

ANGIE

Angie is in her mid-thirties and grew up in a nearby small city, quite similar to Sandhill. She has been teaching for nine years at both the middle and high school levels. Angie holds a master's degree in social studies education and a specialist's degree in exceptional education. This year, she is teaching three different sixth-grade subjects: life science, social studies, and math. It is only her second year teaching science. However, because she was on maternity leave for a good part of the previous year, she is encountering much of the science content for the first time. Having been predominately a social studies teacher in the past, science is a relatively new subject for her. Nevertheless, she is connected to the science education community through several friends who are science teachers as well as through her husband who is the program coordinator for a science professional development program for teachers. Angie is also a mother of two young girls.

"I'm just a teacher."

The first day I observed Angie teaching, I was struck by her choice of decoration and the overall appearance of her classroom. There was little or no physical evidence that this was a "science" classroom. The absence of the typical science classroom décor (e.g., skeleton, atomic models, science posters, microscopes, etc.) was noteworthy for two reasons: a) it reflected her decisions about how to decorate her personal teaching space and b) it revealed my own expectations of what a "science classroom" should look like It is with this observation of the physical classroom environment that I began our

first after-school conversation. Within moments, our language started to find connections between the physical space she occupies and her creation of a professional identity.

SCOTT: So when you walk into this room, do you think it looks like a science room? Do you think it looks like…

ANGIE: Oh, no! Oooohhh! [unpleasant, humorous sound]

SCOTT: Okay, no. Because if you go into Linda's classroom, it's a science classroom. [Linda is another participant in the study who teaches 7th grade science]

ANGIE: She's a science teacher. [laughing]. She's probably teaching them science.

SCOTT: So do you consider yourself a science teacher?

ANGIE: No.

SCOTT: What do you consider yourself?

ANGIE: I'm just a teacher. I'm a teacher. I don't say I'm a science teacher or ….

SCOTT: Why is that important to you? Or why do you say that?

ANGIE: I don't think I have the background knowledge to be a science teacher. Or a math teacher.

SCOTT: What do you have the background to be?

ANGIE: Social studies, reading, language arts.

SCOTT: So if you were teaching those, would you call yourself those kinds of teachers? Or would ….

ANGIE: No. I would still say I'm a teacher.

Angie defines herself as an educator in general ("I'm just a teacher. I'm a teacher."), rather than applying a specific discipline-term, with the word "just" signifying "simply" or "merely." Angie describes her deficit of science background knowledge as being detrimental to her abilities to teach science. Keeping in mind that positionality is always relational, Angie recognizes ways in which she is *not* Linda – someone who *is* a science teacher who *has* the requisite background knowledge and experiences in science as well as a correspondingly decorated science classroom.

Also during this interaction, Angie and I begin to construct ourselves to each other, taking up positions as science *outsider* and *insider*, respectively. My being a doctoral student in science education foregrounds, for us both, my interest in the topic of science. I have explained my interest in studying her as a science teacher, a positionality from which she immediately distances herself physically (room décor) and verbally ("I don't say I'm a science teacher"). It is from these starting points that we begin to take up positions within the familiar storylines of science insider/outsider (as well as researcher/researched). As Davies (2000a) remarks,

> Positions are identified in part by extracting the autobiographical aspects of a conversation in which it becomes possible to find out how each conversant conceives of themselves and of the other participants by seeing what position they take up and in what story, and how they are in turn positioned. (p. 91)

By Angie resisting the traditional identity of "science teacher," she positions herself as different, from me, from Linda, and from the title of science teacher. Pinned down within humanist thought, Angie's "belief" of her lack of science background would work to essentialize how we understand Angie – as someone who does not have the ability or self-efficacy to teach science. Rather, within poststructuralist thought, we see this as *identity in action*, words flowing from a specific moment in time, under the power of traditional scientific discourse, through which one of many Angie's voices speaks, placing her (temporarily) as a science outsider. However, I will show how the data reveals *other* voices – voices that argue with this particular moment and which renegotiate this positionality in light of other available discourses and subject positions. Rather than being conceptualized as irrational inconsistencies in a belief system, these inconsistencies are framed as engagements with multiple discourses - the very normal process of identity negotiation that is concealed when ironed out into an oppressive stability under humanist analysis.

The Periodic Table of Baby

Even as it is important to note what I did *not* see in her classroom that day (e.g., markers of what I thought a "science classroom" should be), it is just as important to

mention what I *did* see: a very personal space occupied by a feminist, a mother, and a teacher. Below is a section from my field notes:

> The first thing that I noticed when I came into the room was a huge (about four feet by four feet) color photograph of a baby. It was hung up high on the wall with two clown puppets on swings on either side. There were also scarves draped nearby, creating a rather festive, focal point of the room. There were also several bumper stickers and posters that had feminist slogans and/or images. Some of them read, "Oh evolve, " "I haven't been the same since that house fell on my sister," and "Wild women don't get the blues." There was also a small "Love your Body Day" poster on the chalkboard that mentioned a list of alternative ways for girls to spend their money: "For the price of ____" (e.g., breast enhancement) – "you could buy _____" (e.g., a year of college tuition). There was also a large pink poster with a female symbol on the storeroom door. Inside the symbol was the phrase, "Female history month."

There were also aspects that were not so surprising to see: American flags, math posters, classroom rules, a television, the teacher's desk area, and a few computers. In the teacher-desk corner were posters of cowboys saying, "Please do your homework." Her corner also had a radio, filing cabinets, and a hanging Asian purple lantern. There were a few small posters of impressionist paintings. Aside from a poster about the phases of the moon, there were no science writings/images, but several of language arts and math.

The huge baby picture on the wall is particularly illustrative of how Angie is simultaneously *doing gender* and [*not*] *doing science*. It turns out to be a picture of one of her two daughters. The photograph's *presence* works to signal how traditional discourse about the family (e.g., motherhood) influences her gendered identity. However, I find out, probably a month into my observations and conversations with Angie, that this giant baby picture is also remarkable because of what it *conceals*.

> ANGIE: You know, I even covered up the periodic table of elements. [Pointing to the giant baby photograph]
>
> SCOTT: Is that what's underneath there?

ANGIE: That's what's under there. [laughing] It was so ugly and horrible and I couldn't stand it.

She has superimposed an artifact/marker of motherhood (her child) on top of an artifact/marker of science (the periodic table) because it was "so ugly and horrible." This deliberate trumping of maternity over science (i.e., warmth over cold) is symbolically consistent with her being uncomfortable with her new position as science teacher. She is actively resisting taking up the traditional identity of science teacher. However, via the baby picture and conversations about her husband and family, Angie constructs a gendered identity within the heteronormative, commonsense notions of maleness and femaleness.

Teaching With Primary Colors

Angie sees her science content shortage as a deficit situation, thus positioning herself as an *outsider* who is less capable to teach science. By comparing herself with other science educators that she knows, myself included, Angie creates an artistic analogy to describe her science teaching (in)abilities:

ANGIE: You know, when I don't have the content, I feel like I'm painting with primary colors. Whereas [my husband] or you. You have a palette of colors to draw from. So you can create paintings and experiences that are maybe more vivid, more deep, reach more people in the classroom. Where I feel that I have primary colors only. And I really don't even know how to mix them. [laughing] I can't do my "yellow and blue make green" yet.

SCOTT: When you say primary colors, you mean of science?

ANGIE: Right. Primary colors of science content. …Maybe I can say [to the students], "[Science] is not as threatening." I wish though that I had a little more competency in it so that I could say,… "Well, this is this and let's go on to the next thing." Because a lot of times I'm thinking that I get bogged down with… "Well, I don't know. That's a really good question. I don't know that." And there's a lot of value in saying, "Well, let's try to figure it out." But if every other question is a let's-figure-it-out question, I feel like we get bogged down.

> Where…. other science teachers can answer even the smallest one and keep the conversation flowing and not make everything a we-have-to-figure-it-out question. [sigh] I'm… I don't know…. I think I would feel I was doing more of a service to my gender if I had more colors. [laughing] But, you know, I don't know. I want them to say, "Look! We can all do science!" But, I don't know. Lately I've been really…. Here lately, … I'm really starting to think, "Wow, Angie. How much… How, how much can we figure out together?" So, I don't know.

Angie is seriously troubled about her lack of science background and her frustration is apparent. She positions her husband and me within the typical science teacher narrative storyline and she justifies our positions by the traditional science teaching discourse that values concrete science experiences and a wealth of content knowledge. That same discourse provides Angie with the language to construct her own science teacher identity. Therefore, the dualism of science insider/outsider is reinforced as she constructs a science teacher professional identity for herself that is less traditional, less powerful, and less of an agentic insider. Poststructuralist thought allows us to call into question this insider/outsider dualism. Angie's use of either/or language to describe the qualifications of being a science teaching (i.e., having or not having science content knowledge) reproduces the dualism and limits the range of subject positions available to her within the discourse of science education.

This rather powerless subject position does not serve her personal interests and goals as a teacher. She wants to do "service to [her] gender" and therefore utilizes the discourse of feminism to reconfigure her science outsider position in a more positive light. Feminism gives her the additional "colors" she needs in order to be a productive science teacher and to "better serve [her] gender." She is able to find connections to feminist concerns about equity, voice, and challenging the scientific status quo.

> ANGIE: I said, "Well, you know, if I'm going to have to teach science, let me at least try to do it this way." Because I don't have the content, I don't have the background. I can't tell them why. But I can say, "You know, you do things all

> day long that are scientific. You do things all day long just like a scientist. You can think like a scientist. Don't be intimidated by it. Don't sell yourself short, saying that this is just for old, white men in lab coats. You know, you can do this. If this really just tickles your fancy, you can do this. You might not see yourself represented in the textbook, but don't let that deter you."

Her science teaching goals include conveying notions of "science" and "scientist" that are more accessible than those found within traditional science discourse. We can see how, in order to function efficaciously as a teacher, Angie taps into feminist discourse. It allows her to renegotiate a science teacher identity that is not in conflict with her feminist beliefs or what it means to be a woman.

> Power is embedded in discourses due to their ability to produce subjects and objects in certain ways: one might, for instance, be rendered powerless by gender discourse in one instance, while being positioned (or possibly positioning ourselves) as powerful via social class discourse in another. (Francis, 1999, p. 383)

Science and feminism are two discourses that are competing for Angie's subjectivity and for the manner in which she makes meaning out of her teaching. Power relations among the discourses influence the knowledge generated from such positions, determining what counts as legitimate knowledge in her classroom. The ability to "reach more people" through "deep" and "vivid" science teaching comes from the language and cultural practices of critical feminism, rather than from science.

Challenging and Changing Gender

Angie finds it useful to consider the fact that her middle school students are early adolescents who are becoming more aware of sexuality and gender. This surfaces as we discuss how being at a middle school in particular relates to her teaching.

> ANGIE: At the middle school is where I notice that [the students], they start caring about what other girls think, what other boys think. They start saying, "This is for me. This isn't for me. I can do this. I can't do this. I should do this. I shouldn't do this." …. All of a sudden they are saying, "Well, I can't…."

In terms of her students' classroom behaviors, Angie often celebrates less traditional expressions of masculinity and femininity: a boy bringing in and talking about flowers, encouraging a female student to play football or wrestle, a boy singing show-tunes, or a boy saying he wonders what it's like to be a girl. By Angie fostering an explicitly safe environment for alternative ways of doing gender, she is to some degree altering the immediate norms of gender accountability. What it means to be male and female are broader than normally defined out of her particular classroom. While it is not logical to think that Angie's efforts fully counteract the inequitable norms of gender relations in the outside world, we can think of Angie's classroom as a space where individuals could do gender in less traditional ways without as much pressure or fear of negative, social punishment.

> The gender identities and roles offered to children in the educational context are challenged by some parents and teachers. Yet common sense, the media and peer group pressure are just some of the social forces which work against the realization of non-sexist discourse in education. (Weedon, 1997, p. 96)

Spaces *are* created in her classroom through which resistance can emerge. The question remains whether such interventions are situated enough (or at all) within the context of learning science so that students' understandings of the gendered nature of science to be challenged in any way.

Angie at times used science classroom discussions about animals to explore the fluidity of sex in nature. One discussion revolved around hunters who had encountered female deer with antlers. Instead of framing these deer as outlandish anomalies, Angie ponders with the class what productive function they may serve in the deer population. Another discussion dealt with how individual fish can change sex when needed within the population. Again, this fluid sex situation was considered a normal, natural part of fish life. Being rural, coastal community, both hunting and fishing are activities and knowledge bases which many students are familiar with. Angie's examples in science class challenge the common-sense way the students understand gender. She taps into the discourse of science, with all of its implied authority, to broaden what it means to be male

and female. Her joining of feminist ideals and the discourse of science challenge the traditional assumption that two static sexes create two static genders.

A particular friend in Angie's life has greatly influenced this pedagogical stance. Angie speaks of this friend, who is a male to female transgendered individual, in very heartfelt ways.

> ANGIE: I had lived a very sheltered life up to that point. And, when she first saw me in the clubs, she took a mother-hen approach to me. She could tell I was very much out of my element. She would take me and she would talk about things, like, "You, you do your make-up this way and you do your hair this way. And you do your, um, you know, clothes this way." … And, you know, "These are the do's and the dont's." …. And I learned more about being a, a, a female, that a lot of heterosexual men would find attractive, from her.

Having sex and gender problematized in a very concrete, personal manner has given Angie a unique perspective. Unlike most individuals, who unquestionably learn gender performance in very unproblematized ways, Angie learned to do a specific type of gender in a rather formal manner. She received these explicit gender lessons from someone who embodied a fluid notion of gender and who constantly reminded Angie that gender was very much a situational achievement.

Angie creates an identity as a strong feminist through describing her clear intentions about how she challenges gender inequities in her classroom.

> ANGIE: I would like for [the students] to not have this, "This is what it must be to be female" and "This is what it means to be male." … And for the boys to say, "Okay, this female is like this and this and this and this. But, what is inside? What do they have to offer?" Be more broad. I would like the girls to do the same thing for the boys. …When they leave at the end of the year, I just want them to know that they don't have to settle for what they are being told.
>
> SCOTT: Okay. From?
>
> ANGIE: From anyone. From teachers, from parents, from the church, from a billboard, from a commercial, Brittney Spears, I don't care…. "Just you decide.

> If you want to wear a wig and that makes you feel what you are as a woman, then buy fifty. If you want to be Sinead O'Conner re-made, get out the razor blade. And it's all okay."

She clearly has interests in attempting to challenge the traditional notions of what it means to be female. This is not an idle goal, but something that pertains to herself as well: "I'm not held…. accountable for certain things because, you know, I have a uterus." Her approach makes explicit the personal and political nature of pedagogy.

An STS Orientation to Teaching Science

There are parallel political intentions between her pedagogical goals concerning both science ("Don't sell yourself short saying [science] is just for old, white men in lab coats") as well as gender ("They don't have to settle for what they are being told"). Her discursively constructed *science outsider* positionality finds resonance with her *insider feminist* one. Since science provides language and cultural practices that are intertwined with traditional notions of masculinity, Angie's resistance does not subject her to take up a masculine subjectivity. However, this resistance to the discursive positions of science is not ubiquitously consistent within her classroom practices. Depending on the science content and the pedagogical approach she uses, there are weak points within both the feminist and science discursive fields that act as visible *choice-points* (Davies, 1989) for Angie.

Due to inequitable power relations between the two discourses, especially in the context of a rural middle school, Angie must constantly negotiate a successful teacher subjectivity that allows her to find efficacy in her teaching as well as intelligibility in her gendered identity. As Ropers-Huilman comments, such feminist teachers'

> perceptions of their own identities, as well as their understandings of students' perceptions, sometimes resulted in these feminist teachers feeling "different" from the norm and "divided" as persons. As several teachers pointed out, though, many feminist teachers have developed the skill to act as chameleons in educational environments. Their multiple identities, in terms of cultural and political

> characteristics and beliefs, enabled them to relate to students in an educational sense while simultaneously retaining their feminist commitments. (p. 38)

These multiple identities allow Angie to reconfigure both science and gender within some of her classroom practices.

One way that Angie balances these gendered subjectivities is to access the science curriculum via a science-technology-society (STS) perspective. Due to the fact that she is confident in her abilities as a social studies educator (backed up by her formal training and several years of experience teaching that subject), she often explores the socio-cultural aspects of science with her students. She frequently engages her students in such conversations, using the STS worksheets that accompany her text as a jumping-off points. However, using STS, as Hughes (2000) points out, is not an a-political orientation to the science curriculum:

> Socioscientific material is not a neutral set of concepts that can be straightforwardly integrated into science education; it has the potential to upset the gender hierarchies that underpin the construction of science as masculine. Thus, the socioscience issue is linked to the debates on gender and science education where even the more progressive and aware teachers are faced with some complex dilemmas. (p. 433)

The explicitly political science teacher subject positions made available through the STS discourse allow Angie to work toward reconciling the contradictions between how gender is given meaning between science and feminism.

When I ask Angie how her thoughts about gender affects her science teaching, her response illustrates this influence of her social studies background.

> ANGIE: I don't know. It's difficult for me, having only taught science, this is my, well, really this is only my second year… And really, having gone on maternity leave the first year…. I don't really see how…. I don't see it in the same way that I remember it when I was teaching social studies.
>
> SCOTT: Tell me how you saw it more then.

ANGIE: Because I had culture and I had, um, the religion and dress and all that juicy stuff. … I bring in the culture like I did today [in science class] because that's what I like with the science.

"That juicy stuff" is absent from Angie's conceptualization of traditional science teaching that is characterized by the transmission of facts that are rather isolated from everyday social contexts. She sees her feminist positionality as a means to breath life into the curriculum and to avoid the emphasis on the objectivist scientific method, one that she characterizes as being too imbued with "exactness:"

ANGIE: Well, maybe because I'm an outsider… Yeah, maybe. …. Maybe because I'm outside of science, and I haven't….. When I see people that have their background in science, a lot of them seem hung up on….not a lot of them. Some of them seem hung up on exactness, I don't know if that's the word for it. Exactness….Like, "This is it! And we must control all our variables."

Being "exact" and "controlling all variables" (both of which are undeniably important aspects of certain scientific work) are attributes that Angie sees as contrasting to her gender teaching goals (e.g., being male and female are not fixed entities to be exactly controlled). Feminist discourse provides the political identity from which Angie can resist the exactness of science and instead create deep, vivid, colorful experiences for her students.

Angie easily discusses gender inequities within her social studies classes. She finds value in using history and culture to critique the current gender status quo. By tapping into feminism, she finds instances where she can carry this critique over into her science teaching as well. The resulting portrait of the nature of science that is often offered up in her class is predominated by science as a very human endeavor that produces a body of culturally situated, and tentative information. Thus, she recognizes that what science has to say about sex/gender is in flux and can be used for social change. This is most easily accomplished when Angie finds feminist access to the social issues of science.

Hughes (2000) investigated how STS curricula, and ensuing classroom practices, worked to marginalize and devalue socioscientific issues in relation to traditional abstract science content (e.g., being placed in a side-bar within the textbook or being taught only if time permits). She explains, "Socioscientific content is gendered through association with social concerns and epistemological uncertainty, and because gender is asymmetric, socioscience is devalued with respect to the masculinity of abstract science" (p. 426). Her findings point out that because of these gendered affiliations, the discursive marginalization of STS reproduces both the marginalization of femininity within science and the inequitable gender hierarchy itself. However, within Angie's classroom, STS does not take a marginal location. In fact, it is quite the opposite. This is due in part by her lack of confidence with the traditional abstract scientific knowledge as well as her feminist ideals. Angie places socioscientific issues at the forefront while simultaneously challenging both the gendered nature of science and the inequitable gender binary.

Hughes (2000) remarks that the more political nature of STS, and its gendered associations, places it in an antagonistic relationship with objective, rational, abstract, masculine nature of science that is traditionally supported through classroom science. She argues that some teachers may be wary of STS because it challenges their scientific epistemologies and their roles as transmitters of scientific knowledge. The opposite holds true for Angie, who finds ways to celebrate the embodied critical stances that an STS approach provides.

Emotional Work of Negotiating a Feminist Identity

In her work with gay and lesbian preservice teachers, Kate Evans (2002) fleshes out the "emotional work" that is often involved during the process of identity negotiation. This is especially true for teachers who simultaneously claim marginalized identities and work within the heteronormative school culture. For the teachers in her study, negotiating a queer identity required a substantial, continual emotional effort. This is especially true when one views identity as an ongoing process rather than a product, continually shaped by ever-changing contexts and discourses.

I extend this notion of emotional work to explore the efforts that individuals like Angie must exert in order to construct and maintain feminist positionalities within schools. While queer and feminist positionalities are in *no way* identical, they can both serve as markers of difference and marginalization. Angie explains how the feminist label has often been a source of strain:

> When [other teachers] hear I'm a feminist, they expect… I've always been teased, whenever I've expressed that to adults. I get more grief from the adults than from anyone else. It was really bad at [another school]. … There were two men that were just awful. Um. [exhale] You know, where they just sort of…. I see women acting just like me, expressing opinions just like me, but because I will claim the word "feminist" [pause]… For some reason, that's different. I'm different because I'm not… Because I accept the word. I'll say, "Okay, you can call me a feminist." It has been interesting to me. Because they have an expectation when I say I'm a feminist. They have an expectation that I'm not supposed to shave my legs, I'm not supposed to shave my arms, I'm not supposed to wear make-up, I'm not supposed to like sex with men, I'm not supposed to like men.

I recall Angie's speech as more measured, with several somber pauses, as she spoke to me about this topic. There is frustration in her words. She recognizes that because she "accepts" and "claims" the word "feminist," some people expect her to *do gender* in a certain manner. What is deemed appropriate for this particular type of femininity, one stereotypically associated with feminism, is assumed to be different. She is subjected to a different set of gendered norms; the system of accountability changes.

Angie's relating of this situation explicitly illustrates the fluid nature of gender and the way that it is constructed from a wide range of femininities and masculinities. Angie does not fit the stereotypical feminist femininity that she describes as being the perceptions of others: "I'm not supposed to shave my legs, I'm not supposed to shave my arms, I'm not supposed to wear make-up, I'm not supposed to like sex with men, I'm not supposed to like men." However, she recognizes that she does in fact do these things.

Thus, within the context of the conservative, heteronormative school climate, there often is a conflict between the manner in which she does gender and the feminist label she claims.

Her language, bound within historically mediated discourse about feminism, shapes who she is and constructs her reality. Angie is thus *subjected* by feminist discourse in both empowering and limiting aspects. It successfully provides a way for her to understand the world and to create a coherent positionality. On the other hand, it highlights her ways of doing gender (make-up, shaved legs, heterosexuality), marking her as "different." By comparing herself to other women (women who often hold very similar political beliefs but who do not accept/claim the "feminist" label), Angie demonstrates clearly the manner in which language is involved in the way we fluidly/contextually accomplish gender. What it means to be a woman is variable, something that is partly negotiated by the words that individuals select, which in turn, positions them as a certain types of women in a certain types of storylines. Angie's instance highlights a weak point in the language we have available to talk about gender. Our commonsense, everyday language gives us the duality of male versus female. However, Angie encounters conflict when her doing gender runs outside the boundaries of that fixed, dualistic terminology.

During our conversation about the conservative school environment, Angie's language again is used to mark difference. She uses the term "hidden radicalism" to describe the socio/political mood of the rural community and relates a recent incident with a particular teacher to illustrate her point. Her use of "invisible" and "hidden" indicates her understanding of the taken-for-granted nature of the community's more traditional gender discourse and how her stance, in opposition, is highlighted as different, if not deviant.

> I think that if the rural community seems conservative and all, all that they really are, are better at stifling… And the "they" is an invisible "they." The "they" is created by the community people. I don't even know if "they" exist. Of course, there are people out there that can act upon it and they do have power, like a

> school board member. … That radicalism, it is out there. Now, granted… there are people, there are a lot of people in this community who have very stereotypical, very traditional ideas of male and female. And religion. And they don't realize it. I don't think my co-workers realize, you know, when they are writing on the board in the teachers' lounge, you know, "What is the oldest book in the world?" And someone wrote, "the Bible." And I said, "Well, they're wrong." And I realized what I had said and I was like, "Oh!" … I was told I was going to hell at lunch that day.

Traditional, southern Christian discourse has a clear heteronormative message, working to fix a certain type of maleness and femaleness as natural and normal. On the surface this exchange was about religious conflict. However, as Angie makes clear, it also carries along with it a conflict about what it means to be a woman.

The incident in the teachers' lounge, had Angie not challenged it, would have been another unquestioned moment of citation/reiteration of conservative Christian discourse, and its underlying presuppositions about gender/sexuality. However, Angie is openly refusing this discourse, thus also refusing the ways in which that discourse defines what it means for her to be a female. Her decision is not a powerful one, or at least it conflicts with what is taken as normal, thus requiring her to justify or defend herself to her colleagues. This type of interaction is laden with emotion for Angie. Both Angie, and the Christian teacher, experienced a certain amount of "emotional work" (Evans, 2002) as they used language to define themselves to each other, and consequently to themselves. However, because of inequitable power relations among competing discourses (e.g., Southern evangelical Christianity and feminism), the two individuals do not experience the same level or intensity of emotional work. As Evans (2002) explains, because the identities of certain individuals (like Angie's Christian colleague), are assumed to be normal and natural, she and others like her

> are less likely to be put in situations in which they must engage in the emotional work of positing themselves in relationship to norms, or others' expectations. Such emotional work for those in privileged groups tends to occur not so much

> when their own identities are directly challenged or questioned, but when they are in interaction with someone perceived to be an other. The emotional work of negotiating one's sociohistorically imbued self is likely to be qualitatively different, while in some ways similar, for those who live in the sphere of the naturalized norms than for those who live as deviantly marked others. (p. 34)

Being one of the "deviantly marked others" does not completely define Angie as a teacher across time and space. However, these instances do indeed occur and have a dramatic impact on her construction of self, her understanding of her profession, and her practices within the science classroom.

Within the confines of common-sense language, Angie does gender "correctly" and "normally." Her successful performance of femininity results in those around her unquestionably placing her within the category of "woman." However, her drawing on the language of feminist discourse complicates the matter. Angie does not conform to her colleagues' everyday expectations of how a feminist *should* do gender. Hence, tapping into feminist discourse gives her the ability to be subversive in her doing of gender, challenging both the norms of gender relations in general as well as the meaning of feminist. The labels of "woman" and "feminist" are not roles that she takes on and off at will, but are places within her identity terrain that she visits at various times and for various reasons. By making the fluid nature of identity explicit and public, Angie's doing gender disrupts the taken-for-granted essentialist nature of what it means to be a woman or a man. However, this process is *effortful* and requires a substantial amount of *emotional work* in an already demanding workday.

Unfortunately, at least in the eyes of some colleagues, her association with this feminist discourse may challenge her progressive science classroom goals concerning gender. Weedon (1997) comments that in order to "maintain current levels of patriarchal power it is necessary to discredit or marginalize ways of giving meaning to experience which redefine hegemonic gender norms" (p. 76). In an *attack the messenger* manner, these antagonistic interactions with colleagues not only reaffirm her outsider status, but also marginalize the ways she approaches classroom gender equity. More commonplace

equity interventions, such as making sure that there are equal number of males and females represented in science textbooks, do not radically challenge patriarchal power relations. However, more progressive classroom practices concerning equity, that a feminist like Angie is assumed to be engaged in, do indeed conflict with a heteronormative patriarchal scientific discourse. Thus, the messenger is marginalized and her practices suppressed by "hegemonic gender norms" such as those found within the local community of the school.

"There's a fair and an unfair!"

Angie's access to feminist discourse has provided her with a specific lens to make meaning out of her past experiences. By "past experiences," I not only mean those narratives that comprise our personal histories, but also those more immediate happenings in science class the day before. These experiences mean nothing until they are given meaning through language (Weedon, 1997).

Angie is unique among the three participants in that she offered up a very detailed account of her encounters with feminism and feminist thought. While her minoring in women's studies in college obviously had an effect on this, it extends beyond academic jargon into finding intersections with very personal beliefs. Angie relates these feminist beliefs by talking about how they have evolved over time. She speaks of this evolution as periods of "transitions" that begin in early childhood.

> I remember growing up and, and being very pleased about the idea that I didn't have to work. … I was probably seven. And I thought, "Oh this is great. I don't have to work. That's what men do. I can stay home." And that made me very happy, the pressure was off.

Moving away from this acceptance of conservative female "roles," Angie describes how she began to resist traditional gender norms, finding it "liberating:"

> And then, I went to college and made the realization, "I do not have to have children. I don't even have to get married." And then, at that same moment sitting there on my couch, I said, "Oh but wait a minute. I don't have to be

> married to have children." …That was as liberating as finding out I didn't have to go to work. So, the pressure's off. "I don't need a man."

She then relates a time that she calls her "radical feminist period":

> It got real radical there for a little while. ….."Listen, I don't need you! Don't put your hands on me!"…. "Because that is subjecting me!"

Her room décor reflects and reproduces this radical feminist identity to some degree, in that it relies on celebrating a particular female essence, validating that which has traditionally been marginalized. Finally, she describes her thinking now as a more focused exploration of the gender binary itself.

> ANGIE: I think I've made this other transition during my specialist degree where I don't see [gender] so much attached to the male and female, these ways of thinking. …. I see it attached to a person. Like anyone can be there. …[Previously] I was still into, there's a right and a wrong. And there's a fair and there's an unfair! And everything should be equal…. We should have a level playing field. Every single thing should be equal. And I don't believe that now! You can't make everything equal!

Rather than working to balance the gender seesaw, she now places more priority in challenging the taken for granted meanings about what it means to be male *and* female: "Like anyone can be there." This is evident in her classroom practices. Instead of a gender-blind classroom, Angie desires a classroom culture where students' maleness or femaleness are not fixed-in-stone starting-points. However, this positionality stands atop a very political feminist platform which relies on a certain, rather fixed, meaning of woman-ness. This political base being used as a means for achieving greater equity and fluidity with regard to gender is similar to the tensions inherent within my own use of feminist poststructuralism as a theoretical framework. I have described how my observations in Angie's classroom provide insight into ways in which she accomplishes this goal, as well as incidents where language and practice work in the other direction, essentializing differences and natural essences.

Centering Lived Experiences

In her exploration of her own attempts at feminist science teaching, Barton (1998a) discusses the "political dimensions of positionality in science class through the act of centering lived experience in science class or, in other words, making lived experience as much of an issue in science class as the science itself" (p. 75). Barton capitalizes on the lived experiences of her students that arise during classroom conversations about science content.

> It is one thing to help students conceptually understand science from the standpoints of their own lives. It is quite another to help them use that personal knowledge to understand, then critique, a powerfully long-standing and excluding scientific discipline. This starting point is important in creating a critical scientific literacy for all students because it starts from the experiences of the students, and uses their knowledge to build a critical understanding of science as well as of their own experiences. (Barton, 1998a, p. 79)

Over the course of my fieldwork, I observed a similar pattern of Angie situating science content within her and the students' personal lives, a move that challenges the traditional authoritative, masculine status of science. Angie's science teaching was filled with countless anecdotes that illustrated how science and knowledge about the natural world influenced her personal life (e.g., being curious about how the iron in the well-water colored her hair, wondering why her grandfather called a pileated woodpecker a "Lord God," or trying to figure out which local mushrooms were safe to eat). For Angie's classroom, these are times when the validity of science stems not from its pre-determined authority/access to existing truth, but from within its relationship to lived experiences (i.e., science as a human endeavor). This seems to happen most often when she finds a way to access the science content via her feminist lens/language.

> ANGIE: Well, I try to show them how things are applicable to my life so maybe they can see how they apply to their lives. So that what they are learning can be applied that day or that week. And I sorta' get that from [university science instructors] too. They sort of helped me see the importance of "So why are we

> learning this?"…"What is the point?" "Why should we memorize the periodic table of elements?" "Why should we memorize anything?" "What is the point?" "How does this serve me?" So that… So the reason I talk about that is because it's easier for me to make that association with my own life than it is um… maybe something else.

However, her examples often go beyond the commonplace practice of using everyday aspects of students' lives to increase relevancy. Rather than using experience to *elaborate* on the science discussion, or to make a certain point about a science fact, teacher and student experiences become the *sources* of scientific knowledge. The selection of *whose* experiences are validated within science (which experiences find relevancy within science) can affect the way students access gendered subject positions within the discipline (Barton, 1998b). *What counts as science* and *who counts as a scientist* (i.e., the range of available self-in-science identities) are grappled with and stretched out within this classroom context.

However, what provides the potential for greater personal growth is that Angie is in the process of struggling with the effectiveness of this feminist pedagogical orientation to the science curriculum. She is concerned that by taking up the subject position of a feminist science outsider, she is unwittingly reinforcing existing gendered inequities.

> ANGIE: Oh, no I'm awful! I'm probably portraying that white, southern women [laughing] cannot do science! … That's exactly what I'm doing! [laughing] "She's lost as a deaf bat! Write off science for me! … I'm female. I'm from a small town. Scratch it off of my options!"

Angie's concern is reflected by Angela Calabrese Barton (1998a) in her book *Feminist Science Education*:

> In my science teaching-researching, I often worry that, because I teach my students to value their lived experiences as their science and to challenge traditional science from the standpoints of their lives, I am actively helping to keep a wall between science and people who are silenced in science. I wonder if the act of building new and more liberatory relationships in science is helping to

> perpetuate the "being in" and the "being out" of science, despite my efforts to blur these dichotomies. (p. 88)

The discourses of science and feminism constantly vie for Angie's subjectivity each day in the classroom. However, because of her realization and articulation of this tension, it becomes a productive one that promotes her being highly reflective about her classroom practices, both in terms of gender and science.

Science Classroom Feminist Narratives

Davies (2000a) discusses the power of feminist fiction in an individual's continual reconfiguration of gendered identity. Stories not only have the immediate power to transform subjectivity in the moment, but also the potential to challenge traditional ways that particular discourses shape the meanings of *femaleness* and *maleness*.

> We need stories that are elaborations of existing stories that mark their problematic nature. We need not only to see the problems in rational, didactic terms (though we need that, too) but to see freshly the images and metaphors and storylines we have become and to learn to read them against the grain. (Davies, 2000a, p. 85)

Although Davies' focus is primarily on actual fiction writing, I extend her ideas into the classroom where teachers, like Angie, often employ extemporaneous oral fiction as a pedagogical tool. During the course of my observations, I recorded countless instances where Angie would tell stories that related to the science content under discussion. At times, these stories were used as examples, finding reference points for students (i.e., connections with everyday life). At other times, they created novel spaces where she and her students could collaboratively play with, and make meaning out of, new science content.

"The Yanomami woman" story

During a unit on plants, Angie has the students read an STS worksheet about "medical treasures" from the plant world. As usual, students take turns reading out loud. They raise hands and are called on, typically reading one paragraph each. Everyone else

is silently reading along. Angie stays up front and periodically corrects students' pronunciations. She stops at one point and asks if students understand a particular sentence about medical companies who research plants. She explains how drug companies often use plants from different countries and remote locations to make new medicines. She points out the text's explanation that ethnobotanists often provide monetary compensation to local people for their knowledge about indigenous plants. To make a point about the ethics of this practice, Angie tells a story.

This particular action is marked as a story/performance, rather than simply another example or part of the discussion, by her slowing of speech, more eye contact with the class, walking more around the room, and placing the worksheet down, freeing up her hands for larger gesticulations. Each of these actions signals this event as unique and the students' attention is focused. She says to the class:

> I am a Yanomami shaman, a wise woman. I know all about plants. If someone has a sore throat, they come to me. Pfizer comes and talks to me. They ask me to stroll with them, to show them the plants that I pick and how I prepare them. Then Pfizer leaves and develops a medicine. It is put on shelves at WalMart and they get all the money. What do you think the Yanomami leaders would think if they were offered money?

She goes on to discusses how not all cultures may value money the same as we do in the West, commenting on the function of money in "materialist" America:

> The Yanomami might not be thrilled with money. We are still looking at it through our lens. We give them what *we* value not what *they* value.

She ends by noting that while people usually think of shamans as medicine *men*, some are women and that these "roles" are not true for "all places and times."

Angie creates a story that places a woman (herself) as the central protagonist. She becomes a resourceful woman whose knowledge of local flora and medicine grants her a position of authority within her community. Angie creates this feminist character in explicit juxtaposition to a Western, materialistic, male scientist. Thus, marginalized subject positions found within traditional science discourse are given power through this

narrative performance. The narrative becomes a place for stretching out the available gendered subject positions within scientific discourse. The notions of *science* and *scientist* are modified within her story.

How does this narrative maintain/challenge the male/female dualism that the current inequitable gender structure is based upon? Does her creation of a feminist science narrative disrupt anything? It is *not* a romantic narrative that forces the reader/listener to rethink humanist notions of identity or the effects of compulsory heterosexuality. However, it *is* an economic narrative, a scientific narrative, and a spiritual narrative; each having their own embedded gendered subjectivities to offer. "I am a Yanomami shaman, a wise woman." Again, there is the productive tension that arises from creating alternative images of science/scientist and playing with the science insider/outsider positions. Poststructuralist thought can understand these contradictions, conflicts and tensions as productive ones that can be used for critical reflection and growth.

Not only is this story useful in terms of what it conveys about science, but it also acts as a window into Angie's identity construction as a middle school science teacher and a feminist. As Davies (2000a) points out:

> Who we are, our subjectivity, is spoken into existence in every utterance, not just in the sense that others speak us into existence and impose unwanted structures on us, as much as early feminist writing presumed, but in each moment of speaking and being we each reinvent ourselves inside the male/female dualism, socially, psychically, and physically. (p. 85)

"I am a Yanomami shaman, a wise woman." By placing herself as both author and star of this narrative, Angie embodies the contradictions she talks about: a gendered and Westernized scientific enterprise. These contradictions are evident in her own conflicting adoption of both scientific and feminist discourses within her classroom.

As an observer, I was interested to watch as Angie shifted back and forth between scientific and feminist discourses, oftentimes, as above, within the same scientific topic. As mentioned before, these swings are often marked by changes in her movement and

voice. Her hesitant reading of the science textbook (often including glances in my direction with questions about pronunciation and content) becomes confident talking about more socio-scientific issues. However, these are more than simple "roles" that Angie unquestionably puts on and takes off when necessary. I agree with Davies (2000a) in her making the important distinction between the taking up of subject positions within discourse(s) and the common, everyday understanding of "roles."

> Role is something that is simply taken on and cast off, with a "backstage" person taking up and casting off a variety of roles. One also moves through multiple positionings in any one day or even in any one conversation. Positions are discursively and interactively constituted and so are open to shifts and changes as the discourse shifts or as one's positioning within or in relation to that discourse shifts. (p. 71)

As Angie becomes a speaking subject, she selects which discourse to tap into in order to fulfill her pedagogical goals. Feminist poststructuralism provides a means to understand how Angie's gendered subjectivity and pedagogical goals/orientations are continuously constructed and negotiated within various discourses.

Poststructuralist theory also allows us to understand Angie's narrative as part of her own means of successfully *doing gender*. Angie's membership in the category "woman" is reinforced by her taking up a subject position (a female Yanomami shaman) within the narrative that is alternative to traditional, scientific images. She is the "other" who is spiritually connected to her community and the land, and whose means of living and meaning-making are *not* rooted in familiar Western materialism. These characteristics can be seen as part of common-sense discourse about femaleness. While her brief narrative does create new images from *within* the male/female dualism, it does little to challenge the structure itself. Perhaps one cannot do both? What would it look like in such an instance? As Davies (2000a) comments, "the task of generating feminist storylines that have the power to disrupt and displace the old is extraordinarily complex" (p. 79). During the later stages of member-checking with Angie, she reacted very strongly to this point by Davies, being provoked and intrigued by the idea that her

progressive thoughts and practices concerning gender equity were often intelligible only within the confines of the gender binary itself. But as Jackson (2004) reminds us in her discussion of Judith Butler's *subversive repetition*, "it is when we are *within* the categories that we can be *against* them because the limits of a category are intelligible only *within* the rules governing that category, *within* the constituted effects of that category" (p. 682).

By hailing feminist discourse, Angie shifts the way in which she is subjected by science. Having little confidence in her content knowledge and being aware of the traditionally masculine nature of the scientific enterprise, she consciously draws on feminist images and knowledge to make meaning out of ethnobotany and pharmaceutical science. *Unconfident science teacher* into *confident feminist* drives a move in power relations for Angie and she is able to generate a novel storyline through which she can more passionately/personally/professionally teach. She is not totally replacing normalized ways of being a woman and a scientist with new versions, since "the new is always partially generated out of the old and thus partially contained by it…The repressive discourse cannot be ignored, therefore, as a generative force" (Davies, 2000b, p. 190). The dual products of this type of classroom narrative (i.e., the shift in her own subjectivity and an attempt to challenge the existing scientific discourse), allow us to focus both on Angie as a person as well as the discourses through which that person is defined.

> ANGIE: Maybe I can at least say, "Well, you know, I'm not a scientist. But, I'm a scientist in this way. You know, I'm not wearing the white lab-coat working for pharmaceutical company, but this is how it plays out in my life and this is the thing I think about and this is how it affects my life." So some of them… I may not be the science teacher that all of them need. But maybe I'm the science teacher that some of them need.

"The invention of farming" story

Angie is teaching a lesson on scientific classification, namely the mechanics of the current system of taxonomy based on the work of Carolus Linnaeus. One aspect of

the lesson is an STS worksheet reading about "Classification for Survival" that examines how classification schemes can be useful, and even imperative, for daily life. The worksheet provides the example of how some prehistoric, African cultures lived very close to the land. The worksheet contains the familiar descriptions of male "hunters" and female "gatherers." Angie quickly offers up an alternative storyline that challenges these gendered roles, ones that are often discussed in very common-sense terms and support the "naturalness" of traditional maleness and femaleness.

Angie begins by pointing out that, according to her, this topic of the gendered division of labor in prehistoric communities is one that anthropologists still debate today (i.e., the tentative nature of knowledge). She suggests an alternative telling in which the "gathering" was in fact probably the main means by which these people were sustained and that the "hunting" was a special event. This reworks the male/female power relations by re-centering the lives of the women in the narrative. She suggests that perhaps the females also set traps nearby their village, thus also participating in hunting. She says, "The line may have been blurred. The females may have hunted with traps and not spears." She repositions the females as active gatherers and hunters who did more than simply collect berries on the side while the main spectacle of aggressive large, wild game hunting was done by the men.

They continue reading until they get to a sentence about agriculture being "invented." Angie asks what this might mean. The text is making a point about how, until the invention of agriculture, prehistoric cultures in this area were more nomadic, following the animals that they hunted for food. Angie creates a scenario in which the females might have played a central role in this process. She explains that since the females were perhaps more stationary than the males, they might have observed how plants germinated from trash or storage places where seeds might have been thrown away. She concludes that the females "were the ones that noticed this" and could then have learned to gather closer to home, thus helping the community become less nomadic and more tied to the local land via farming. Within this feminist counternarrative she challenges the gendered norms within the context of science.

In contrast to these pedagogical practices that challenged the gendered nature of scientific practices and meanings, some of Angie's lessons incorporated gender in ways that worked to reproduce the taken-for-granted ways that gender is understood to function. For example, during one of the first lessons I observed, she was talking to the students about the process skills involved in collecting and analyzing scientific data. Angie asked the students to measure shoe sizes from "one female, one male, and one child," including at least one teacher from school. Each student's data was then tallied on the chalkboard. There were rich discussions about bias in data collection, quantity versus quality of data, as well as the possibilities of two groups of people coming to different conclusions using the same data set. However, the use of "male" and "female" categories worked to reinforce the notion that there are two fixed, natural categories of humans into which everyone could be grouped. Using sex categories as a means of data management works to reinforce the utility of the gender structure within the context of science.

A similar instance occurred when working with students on a worksheet about the parts of a flower. This discussion contained clear citations about the differences between "male" and "female" morphology, thus reproducing the biological categories. When Angie speaks to a female student who is confused about the worksheet, she says, "You and I are different people, but we have the same parts. They are called the same thing when we're at the doctor." She validates the botanical sex categories and extends them into human life, indicating an assumption that all females would have similar "parts." The naturalness and commonsense nature of the sex binary is reaffirmed, within the context of (heteronormative) reproduction. Angie and I discussed this teaching moment several times and were confronted by its numerous interpretations. She recalls that she was attempting to relate the labeling of the flower parts to the ability to name one's body parts while at a doctor – wanting the student to have the capacity to correctly discuss with a physician her anatomy.

In stark contrast, only a few days later, during a discussion about the classification system, Angie asks the students to think of ways in which the process of classification and categorization happens at school. One of the students mentioned that there were

separate male and female restrooms. Angie remarks on the uniqueness of this separation and that these arbitrary labels "tells us who can and can not walk through that door. It gives us two choices." Here she calls into question the taken for granted ways that we use the language of male and female categories to regulate our actions.

My last example from her teaching illustrates the pendulum of teaching gender again swinging toward critique. The class was reading a worksheet aloud about scientists studying African sleeping sickness. There was a drawing on the worksheet that showed an African, in traditional dress, working in the field with a microscope. One of the students asked Angie how the man in the picture would get a microscope. The student seemed to find this piece of scientific equipment out of place with this particular type of person (non-Western and non-white) in this type of setting (non-laboratory). Angie first addressed the fact that a microscope didn't have to be just used in a laboratory. She then questioned the student's assumption that the picture is of a male. Angie says that she first "looked for earrings," but then remembered, "some cultures don't always follow the same rules as we do." She added, "How people dress is different." Engaging students in this type of conversation pushes an understanding of gender beyond biological categories (fixed things) toward more cultural aspects like dress (fluid actions).

When science content is situated within a science-technology-society context, Angie more easily finds ways in which her feminist positionality can challenge the students' understandings of gender. However, when the science content is less obviously attached to a social setting (such as data collection/analysis or reproductive aspects of flowering plants), critiquing gender is less accessible.

"I am not here to hold their hand."

In terms of working specifically at the middle school level, Angie feels that her feminist pedagogy, and associated teaching goals about gender, might sit better with a high school context where she could tap into the life experiences of more mature students. In other words, the social studies pedagogical content knowledge that intertwines with her feminist teaching goals seems aligned more with high school

structure and more mature students. Having taught at both levels, we talk about her preferences.

SCOTT: And you like middle school the best?

ANGIE: No. I think I would like high school.

SCOTT: You seem at home here to me.

ANGIE: Nope.

SCOTT: Tell me why.

She talks about working in another middle school as a beginning teacher where attention to the affective domain was a "taxing" aspect of the job:

ANGIE: One thing that bothered me was…. It almost seemed like you had to address, acknowledge the emotional needs of the students. And I hated that.

SCOTT: Okay.

ANGIE: Because I said, "I am not here to hold their hand. I am not here to care about how their day went before or after I see them. That is not what I am here to do." And, then I went to [an alternative school for at risk students] and you drown in the emotional happenings. And I saw how those were connected with their learning. Uh… Because, high school, I think they're a little more mature and so you can discuss things that you can't necessarily discuss in middle school.

SCOTT: Okay. Issue wise?

ANGIE: Issue wise and they have more life experience. So they have more to draw on. And with middle school, uh, especially sixth graders, they're still such small children. They haven't had the life experience yet to draw on. …So, and I don't feel they're necessarily as opinionated as high schoolers and I would like them to be more opinionated. Um. So I think that's why I enjoyed high school.

I found this exchange fascinating in that she is resisting to some degree the affective aspect of middle level education that deals with "the emotional needs of the students." While she recognizes how the emotional aspects intersect with learning, especially at an alternative school, her feminist pedagogy interests predominate.

However, during my observations in her science class, I *constantly* saw Angie interacting with her students on a *very* emotional level every day. Her personal life intertwined with her teaching in countless ways and she demonstrated *very* caring reactions to students' personal lives. Thus, I was perceiving a discord between my observations of her in the classroom (a very caring, student-centered environment) and her discussions with me about her desire for a more academically rigorous teacher role (more teacher/subject-centered), one that she feels she would find at the high school level. I initially interpreted this preference for high school teaching as being mainly about looking for contexts in which a feminist teacher identity would requires less emotional work – a less "taxing" job. Due to the fact that teaching about feminism and gender is a political activity, efforts at integrating it into the current structure of formal education is an effortful exercise, and even more so with younger students at a middle school level.

As we began to negotiate an understanding about this issue, Angie mentioned that her preference for high school was articulated in terms of her feminist/gender/social studies educator lens. When it comes to teaching science, the middle school structure is actually beneficial and allows her to find productive interdisciplinary intersections between social studies and science. Therefore, she feels that her passion for social studies education would be best suited in a less affective-centered environment where the "taxing" work of addressing the emotional needs of students is less central. High school structure holds the allure of being a subject-specialized teacher of a certain discipline. In hindsight, my previously observed discord (between what I was hearing her say and what I was seeing her do) was more accurately a discord within my own researcher lens: I was hearing her talk as a social studies teacher and seeing her act as a science teacher. Thus her acceptance/resistance to the hand-holding teacher subjectivity within middle school discourse actually is dependent on whether she is talking about herself (creating a an identity) as an educator of social studies or science. These are voices coming from multiple teacher selves that do not exactly agree within each other, each speaking to issues of gender and pedagogy in unique ways. Angie's exploration of the social aspects

of the scientific enterprise (e.g., her use of STS worksheets and critical classroom discussions) is facilitated the philosophy and structure of middle level education where interdisciplinary approaches to the curriculum are encouraged.

Fighting Microscopes

As stated before, Angie very often used STS resources to connect with the science content. These instructional approaches usually took the form of very personal and insightful classroom discussions, with the students providing a great deal of input. It is important to note that these types of lessons were not the only ones that Angie employed. Her antagonistic relationship with the "science equipment," the actual *doing* of "classroom science" with activities or labs was *very* difficult for Angie to access. Her uncertainty about how to get microscopes to work, for example, resulted in her not being able to do a particular lab she had planned. Frustrated with this experience early in the year, she altered her lesson plans and avoided labs altogether, relying more on printed textbook and worksheet materials. Therefore, overall we can see two very distinct types of instructional strategies at work in Angie's classroom: STS/socioscientific classroom discussions and more traditional textbook based class-work.

During later conversations about my findings, Angie conveyed a very strong desire to create science experiences in the classroom that mirrored the way in which she felt "real science" happened. Our discussions about the differences between "real science" and "school science" illustrated that she held very sophisticated ideas about the manner in which science is actually conducted: a creative, human endeavor that relies on imagination and error as much as attention to procedure and objectivity, all leading to a body of tentative, yet durable, body of scientific knowledge. However, the traditional discourse of school science, especially in terms of laboratory equipment and procedures reduces this complexity into a more linear, right or wrong process. Therefore, Angie's very thoughtful practices at challenging gender (as well as its connections to science) flourished in contexts where she was not limited by her traditional images of "the science lab."

The Complexities of Doing Gender while Teaching Science

My work with Angie finds resonance with Ropers-Huilman's (1998) use of nomadic imagery to describe the notion of multiple identities.

> Like viewing a borderless map. Many of the landmarks have posted names; indeed, I have lived in places called *White* and *Woman*. Once a location, an identity, is a part of me, I cannot disown it. Yet it need not own me. Rather, I can visit, through careful listening and interaction, other locations whose characteristics and opportunities provide lessons and insights as well. While some people travel more frequently and enthusiastically than others, the process of traveling is endless. (p. 42-43)

Angie's multiple identities are in part a result of her having visited the locations of *Feminism* and *Science* and (middle school) *Teacher*. Her gendered subjectivity at any one moment is the site of these competing discourses about teaching, middle schools, feminism and science. Her daily practices in the science classroom are not reflections of a decided-upon, fixed identity. Rather, they are the very ways in which she negotiates these competing discourses – ways of constructing herself as a particular type of woman.

There were many ways in which Angie constructed her identity as a female, a mother, a wife, and a novice scientist through traditional commonsense discourses, thus reproducing the gendered status quo. Nevertheless, she also challenges gender norms in her classroom through very explicit and political conversations about what it means to be female and male. These conflicting positionalities are to be expected within a poststructural analysis that does not rely on a static, humanistic notion of identity.

The way Angie does gender in her classroom allows us to see beyond the confines of masculine/feminine. The insider/outsider categories are also too monolithic to fully explain how she moves between the two discourses of science and feminism. Angie does not remain an outsider, but has very efficacious moments where she taps into feminist discourse to become a very strong insider who can critique science from within.

CHAPTER 4

MARGUERITE

Marguerite is a native Floridian in her early fifties. She is new to the area, having moved to Sandhill County from central Florida only a year ago. She is married with three sons in their twenties. After completing a bachelor's degree in animal science, Marguerite worked on her family's cattle ranch for several years before entering the teaching profession. Prior to coming to Sandhill Middle, Marguerite taught science for fourteen years at three different high schools in Florida. She has taught environmental science, biology, Earth/space science, marine biology, oceanography, ecology, as well as integrated science. Therefore, working in Sandhill County is new both in terms of her being in a new city as well as in a middle school instead of a high school. Marguerite's husband is also a science teacher at a nearby middle school. Marguerite is a member of the eighth grade team at Sandhill Middle and teaches three classes of Earth/Space science, one class of math, and one class of world history. She is currently in a master's program in science education and has finished her coursework with only the thesis requirement left to complete.

"I don't recognize myself."

When I asked Marguerite if she considered herself a feminist, she was unsure and hesitant to respond. Her initial reaction was, "Yes." However, she quickly qualified her response in terms of her feeling rather uncomfortable with the academic discourse of feminism that she had encountered in her graduate coursework.

> MARGUERITE: Since I took one of the classes [for my master's degree]. And, you know, they were talking about feminism and I went into this…. I wrote this

response to a letter, to a writing or something. Coming at it totally from a wrong [laughing] approach. And I just felt, you know, like really stupid, really stupid. It was one of those things where I was glad I could hide behind my computer keyboard. And I, uh… So I really don't know. I don't understand what feminism really is other than the traditional sense of feminism. I don't know what feminism means today, so I can't say that I am or am not.

SCOTT: What's your understanding of the traditional though?

MARGUERITE: Well, the traditional would be the, the sex kind of thing. Where…um…. I would see a feminist in a traditional sense as someone who fights for female equality.

SCOTT: Would you adhere to that?

MARGUERITE: If I felt… I would definitely speak up if I felt that someone was being treated unfairly.

SCOTT: Okay.

MARGUERITE: Because of their gender.

Although she relates this anecdote with a degree of humor, it is regrettable that learning about feminism resulted in her feeling "really stupid" and wanting to "hide." Reflecting on this instance again later in the study, Marguerite comments, "It was almost like I felt 'set-up.' Not one of the students in the class bothered to explain my misconception [about feminism]. Aren't these people teachers?" This negative incident facilitates her rejecting an academic feminist position for one that is more aligned with commonsense traditional understandings of liberal feminism. As seen from this incident, Marguerite does not have easy access to the subject positions provided within the discourse of academic feminism.

MARGUERITE: When I was taking the classes… When I was having to do the writings and all of that. It was like…. I don't recognize myself. …. I was just doing it to get a grade. And uh… It didn't … I don't know. I just can't do that. Yeah, I did it to get the grade and… But I don't feel good about it. You know, I don't feel it was very meaningful. I didn't feel it was meaningful to me.

She does not *recognize herself* within this more political, academic feminist discourse; a discourse that I explicitly tap into for the purposes of this study. Just as Angie constructed herself away from the science positionality I was interested in studying, Marguerite similarly uses academic feminism to negotiate what she is not. What she is, what does feel meaningful to her is a concern that revolves around fair treatment and creating an egalitarian learning environment. When asked how her thoughts about how these ideas affected her decisions/practices in the classroom, she responded:

> MARGUERITE: I don't think about gender. …. I just don't think about, you know, well, this is a little boy, this is a little girl. I don't think of them as that. They are my students.

Her resulting orientation to the curriculum (and classroom culture) is *gender-blind*. By striving for a classroom culture where gender is not explicitly addressed (i.e., all students are the same), the status quo (of both the patriarchy in general and the patriarchal scientific discipline) is sustained. She argues that if gender becomes a consideration, it emerges from within the resources, like the textbook, where the concern is with equal representation of females. She mentions how the chapter they are studying begins with a female geologist.

> MARGUERITE: So maybe, maybe I feel like, you know, well, the resources are covering that material. Then it's like, why do I need to make a big deal out of it?

With the chapter including a female scientist, Marguerite is off the hook and does not feel she needs "to make a big deal out of it." Her "add women and stir" approach works against a recognition of the multiplicities of genders within the single sex category of woman. This stance is not one of indifference, but corresponds to a particular gendered science identity that she constructs.

Protecting and Guarding True Science

Marguerite offers up an example from a class that involved an explicit classroom discussion about gender. Like Angie, Marguerite also teaches both social studies and science. She relates an incident that happened during a conversation in one of her world history classes about women and the military draft in ancient China.

MARGUERITE: The kids got off on, on the draft and what it is. And why um…why it's only the guys that have to sign up. And, have a number. You know, why can't the girls? Or, you know, would that be a right? You know, would that be a privilege or would it be something that they would want to do? So we, we ended up going off on that tangent and talking about that for a while.

Discussing inequitable gender relations within social studies is accessible because of clear-cut, explicit examples of non-participation of the category "women" during specific historic events. This type of knowledge and meaning making about gender equity is in concert with a liberal feminist identity. As we talk about how gender discussions surface in each of her different classes, Marguerite begins to comment about the nature of science.

MARGUERITE: When [my students and I] were talking about the draft. They mentioned that today, "Well, why haven't we ever had a female president?" And so we talked about, you know, the fact that, Geraldine Ferraro and Elizabeth Dole, and it was…. The kids brought that out into history. Maybe in my history class, we do talk more about gender kinds of issues than we do…. I just see science as so unbiased. …. You know, that is something that I fight to, to… I mean that is something that sets science apart.

SCOTT: Okay.

MARGUERITE: The fact that it is unbiased.

SCOTT: Okay.

MARGUERITE: It's unbiased. You're not going to let, you know, social things affect, you know, what the actual outcome is. Whether you like it or not, you've got to accept the outcome, what the numbers say. Whereas in history, you know, there's a lot of give and take and social issues that are causing these things to happen and so... You know, I think maybe in my history class, we are talking, you know, more about "Me Tarzan, You Jane" kind of thing.

SCOTT: So it's more at the forefront?

MARGUERITE: Right. But I think that I, I try very hard to, to, you know, guard the unbiasedness of true science.

SCOTT: To protect that?

MARGUERITE: To protect it, yeah! And, you know, maybe that's one of the things…. Maybe that's why I've got such a….Maybe that's what I'm trying to do? Is to teach science as unbiased?

Marguerite believes that engaging in critical thought about the social institutions of politics and the military, in terms of gender, is an important aspect of a social studies class. To her, the field of social studies, with its emphasis on culture and society, facilitates teachers and students exploring, and critiquing gender. Even when she does address gender explicitly within social studies, the critique does not move into a deconstruction of gender itself, but relies firmly on the traditional dualism of "Me Tarzan, You Jane."

Due to the fact that Marguerite values the unbiased, asocial, objective nature of the scientific enterprise, she finds herself "guarding" and "fighting, " protecting "true science" from such critical examination of it being a social construction. Therefore, gender is not critiqued within the context of her science class as it is within her social studies class. Having gender surface within two different subjects, taught only hours apart by the same teacher to virtually the same group of students, provides an interesting place to begin to understand Marguerite's interactions with discourse of gender.

Picking at the Scab

Marguerite does not find value in addressing the issue of gender inequity in terms of her own science classroom culture. In fact, doing so would threaten her understanding of science as a way of knowing (and her science identity that results from her science classroom practices). Firstly, she does not recognize gender inequity as a significant problem within society as a whole. Secondly, she actively resists the political nature of addressing gender equity, finding it easier to try "leveling the playing field."

MARGUERITE: But I don't see gender as….Maybe I don't want to see it? Maybe I think that making my class unbiased is the way of leveling the playing

field. Instead of building up some kind of feminist issue, that kids may not even be aware of, and building it up brings it to their mind and it's like, it becomes an issue. I don't know. Maybe I'm just trying to take the easy way out and just keep it, keep it controlled.

The identity that she constructs with this language is one of objective scientist, not political feminist. These conversations also shed more light onto Marguerite's understandings about the nature of science. I ask her to elaborate more on what she means by keeping it "controlled:"

MARGUERITE: [pause] I don't…. I think it's just bringing up a…. You know, picking a scab. Or you know, let the thing heal and get over with…. And, you know, the more you pick at it, the more it's…the more attention is going to be called to it and the more it's going to become an issue. Where if it's a non-issue, then everyone's on a level field.

Her finding inconsistencies between the nature of science and feminist/gender discussions influences her decision toward creating a gender-blind classroom. Ignoring it, not picking at its scab, and treating it as a non-issue is her way of leveling the playing field in a non-political manner that does not challenge her understanding of science as particular way of knowing. Her practices include teaching an unbiased science in an unbiased classroom, where females are not singled out within a deficit approach.

MARGUERITE: And, you know, the more you pick at it, the more it's…the more attentions going to be called to it and the more it's going to become an issue. Where if it's a non-issue, then everyone's on a level field. If the girls are taught that they are disadvantaged because they are girls, that they don't understand science as well as boys, so I'm going to have to give you extra help, I'm going to have to teach the way girls are going to understand. That's just….that's a put-down. … I would be very offended. And I've had teachers, you know, talk to me like that.

Rennie (1998) comments on this negative reaction toward being singled out and being in need of help:

> In the case of gender interventions, the spotlight usually falls on women and girls, and they do not enjoy the attention. It seems that by apparently isolating one group (such as females) in an intervention and pointing out aspects of disadvantage, there is an implication that the other group (in this case, males) is somehow to blame. Sometimes the unintended result is anger and aggression as the inference of blame is resisted, often by both sexes. (p. 954-955)

This seesaw imbalance of attention and blame becomes clear as Marguerite describes her reaction to the feminist décor in Angie's classroom.

> MARGUERITE: I'm not picking on Angie. I like Angie. She is wonderful. But when I walked into her classroom, and I saw the "Women in Science" posters right outside the door, I wanted to say, "Well, where are the guys?" You know, "Where are the guys in science?" …I don't understand how you can promote one sex above the other. …You're almost assuming… You're telling that sex, "You're not good enough. You have not done what you are supposed to do as a, you know, as a female community." You know, "I'm gonna boost you up and make you know that you can do better." But to me that is almost a negative connotation; is telling them, you know, "Well, you haven't been good enough. Let's make you good enough."

Marguerite is simultaneously positioning Angie as a feminist who places the onus of change on the individual females (a deficit model) and positioning herself as someone who does not need *a boost up*. These positions, in combination with the "Where are the guys?" really focuses her attention on wiping the science classroom slate clean of gender.

Marguerite makes a similar argument that, in terms of gender inequities within the androcentric/patriarchal history of the scientific enterprise, women *did* participate, but that their participation was likely hidden.

> MARGUERITE: Well, I think that a lot of the science that's been contributed by males was probably generated by females under them. ….I'm sure that there are a lot of male contributions to that. But I'm just saying, you know, historically in the past men got credit for… It didn't matter what a woman did. So, who's to say

> that there wasn't a woman behind the man generating this information? ….And the male's name just went on the credit. So I don't look at science as definitely being always male dominated. I just think that maybe the males got the credit and whatever females were there, you don't know about.

The job of equity becomes one of unearthing female accomplishments, an action similar to the *add and stir* approaches of earlier feminist and multiculturalist thought. While this in and of itself is a worthy endeavor, it comes short of applying a critical lens to science itself (or gender). Societal patriarchy in general is recognized, rather than it's particular enmeshment within Western scientific thought. Kumashiro (2001) would argue that via such an approach, the *story* of science is not envisioned anew: "if the expansion rests at saying 'these other groups were also there, and now we have the full story,' such a move does not really change 'the story'" (p. 6). If the story remains intact, so does her own subjectivity within the story; thus, no challenge to the coherent, stable identity conceptualized within humanist thought.

Instead of judging her decisions in terms of right or wrong, or which best addresses the content standards of her subject area, I instead use feminist poststructuralism to regard these as discourses about gender that are competing for her subjectivity, thus influencing her practices. Science and feminism are saying very different things to Marguerite about what it means to be a teacher, a woman, and a scientist. Therefore, she is engaged in choice-points (Davies, 1989) where she resists feminism in order to maintain the unbiasedness of the science/classroom culture and teacher role.

This effort at sustaining unbiasedness is consistent with my observations in her science classroom. Gender was never explicitly mentioned. Conversations between her and the students rarely took place outside of explaining science content and classroom management/procedure. The personal information I learned about Marguerite emerged from our conversations and interviews, not from my classroom observations. When I ask her about my perceptions about her classroom teaching being mainly void of personal

aspects of herself, meaning that I did not see/feel much of Marguerite in her teaching, she talks about finding it difficult to find personal connections to Earth/space science content.

Toward the end of the study, the negotiation of information within the member-checking process shifted from conversations to actually having the teachers read the finding chapters themselves. Marguerite had a very emotional reaction to the above section in particular and I was extremely appreciative of her candor and honesty about the feelings and thoughts that it provoked. She had emailed me a brief reaction to the writing a week or so before we actually met face-to-face. I was upset about the possibility that I had misrepresented Marguerite or had caused her undo stress. Indeed, I was quite anxious about our upcoming after school meeting.

When we finally did meet, we both took time to reassure one another that we were both comfortable with what had been written. I made sure to give her ample of opportunity to disagree with me about certain points or to question the manner in which I had related her words. Marguerite explained that while she did not disagree with the content of the findings themselves, or the manner in which I had presented them, she did have a rather startling reaction to, as she put it, "hearing myself speak right there in black and white." This response revolved around the ideas presented above about her being resistant to dealing with political/social issues within the context of the teaching science and how her subjectivity as a scientist (personally detached) was in contrast to the middle school teacher subjectivity (more personally invested) that was expected of her. We had spoke about this several times during the study, but this was the first time that the words were on paper and included quotes as supporting evidence.

We spoke at some length about one particular sentence I had written: "my perceptions about her classroom teaching being mainly void of personal aspects of herself, meaning that I did not see/feel much of Marguerite in her teaching." She had written "NOT GOOD" in the margins next to the sentence and I gave her a chance to talk about what this had meant. She felt that this was something that she needed to confront about her own teaching and lamented the fact that she was uncomfortable about engaging as a science teacher in this manner. This generated some talk about the fact that not only

were we looking with a critical lens at her practices, but also at how those practices were directly involved in her creating identities.

I asked Marguerite if her reaction would have been different had I been studying her as a *scientist* and had written: "I didn't see/feel much of Marguerite in her *scientific work*." She replied that it would not have given her as much pause, if any at all. We talked about how this supported the notion that she did not feel that being personally engaged and invested within one's scientific work was an important aspect of the scientific profession (i.e., sustaining an objective and unbiased stance), while it was central to the work of a teacher. While she laments the detached, less personal nature of her own teaching, she uncritically validates that same positionality within the context of science. Thus, political issues of social justice and stances of marginality and identity (e.g., gender equity) are less likely to fit within the pedagogy of a teacher who identifies squarely with this version of scientific thinking.

"I'm not going to mother-hen."

During our conversations about working at Sandhill Middle School, Marguerite makes clear distinctions between a middle school teacher and being a high school or university teacher. Each with its own gendered associations (i.e., ways of understanding what it means to be male and female), these unique teacher identities are available for Marguerite to select from. Tapping into one is to become subjected and to acquire an intelligible means of creating a (gendered) sense of self. Having constructed her professional identity squarely within the discourse of science, the encroaching discourse of middle school becomes a competitor with which she has to deal. Angie's encountering of the novel discourse of science is a similar situation since she too had to renegotiate her gendered teaching identity. Marguerite's strong reaction to this new middle school discourse, and the subject positions she finds available within it, is a useful choice-point for analysis.

Marguerite feels very frustrated with being at a new school and having three preps, in particular the math content. She does not want to be "insubordinate" and question the administration's decisions about her assignment. At the high school level,

she felt more independent and comfortable with a subject-specific professional label. Overall, he sees middle school as a unique population, a very different culture that is more "touchy feely." Marguerite openly struggles with the tension between her title as a middle school teacher and her own pedagogical orientation that she sees as being more aligned with high school or university level teaching.

Marguerite articulates a mismatch between what "feels good" for her to teach and some of the expectations of a "middle school teacher," namely the more affective, personal teacher-student relationships. The advisory/teaming/family-within-family concepts of the middle school are things that Marguerite is struggling with. In essence, she contends that "the middle school concept" validates the affective aspects of classroom life and distracts from the academic rigor of science content teaching. Thus, she rejects what she referred to as "a mother hen" subjectivity in lieu of one that draws more on a university professor as a model. Marguerite places much more emphasis on test-prep, science content, responsibility, and preparing students for the academic rigor expected in high school and college. She draws a clear line in the sand between these important aspects of science teaching and the affective "icing" that also goes on at the middle school level:

> MARGUERITE: Maybe I do not truly understand the middle school concept. Because, the more I've been in it, the more I'm thinking that academics is not the bottom line here. Which bothers me. … Because to me, you go to school for the academics. The social part is the icing on the cake. That's important, but it's not the cake. And I'm seeing, you know, the kids just licking the icing off the cake and not getting the cake here and that bothers me. It really does.

At this point, Marguerite sees her predicament as an either/or situation – she can stay her course or "change [her] gears" and move in the opposite direction. She continues to express a concern that the science teachers at the high school will be surprised at how unprepared the incoming ninth graders will be, lamenting that academics is often not the top priority at Sandhill Middle School.

> SCOTT: What do you see as being more the priority?

> MARGUERITE: I think the social. I think the feel-good. You know …the building up of self-esteem, having the, a lot of parenting going on. …I'm going for the content. And, maybe if I stay in this situation, I need to readdress that and just change my gears. I don't know if that would be giving in or, or doing the right thing, or just giving into the flow. Or… I have to think through that one. But it would be very hard for me to give up the stress on the academics. I've always thought that instead of going down, I should be going up, as far as teaching. Instead of teaching lower, maybe moving up to more of a community college level.

By strictly walling off science from the more affective aspects of middle school teaching, her language reproduces and reinforces the dualism of the academic rigor of classroom science versus the developmentally responsiveness of middle school philosophy (Anfara & Waks, 2000). Thus, in talking about how she defines herself within the specifics of working in a middle school, Marguerite's language works to simultaneously reproduce a) an affiliation between the affective domain (embodied by non-science advisory-like roles) and a natural female essence as well as b) an affiliation between the cognitive domain (embodied by science) and a natural male essence. She powerfully resists subjection by middle school discourse by saying, "I'm not going to mother hen," thus positioning herself far out of its reach.

This functions not only to shape her practice but the ensuing subjectivity she fashions. She wants to be a "science teacher" not a "mother hen." Marguerite describes this middle school affective "icing" as being comprised of: "the social," "the feel-good," "the building up of self-esteem," and "parenting" - all of which are constructed as marginal, very much outside of science. To view the other side of this dualistic thinking, science is constructed as less social, not feel-good, and definitely not "parenting" (not being a "mother hen"). By marginalizing the affective in relation to the cognitive (the *mother hen* to the *scientist*), Marguerite clearly understands these two practices to be in opposition and not something to be engaged in equally by a science teacher. Marguerite's notions of what it means to be a successful science teacher are fall within

the left side of the conventional dualisms: science/non-science, cognitive/affective, rational/irrational, objective/subjective, and masculinity/femininity. This identity, she feels, would be more at home within a higher level of teaching, such as community college science instructor.

> SCOTT: Would it be a fair assessment to say that the body of information, the discourse, the norms that you tap into to understand what it means to be a science teacher is a university model? The ideas about what you would like to teach at the community college level? Is that what feels normal to you?
>
> MARGUERITE: Yeah, it feels good for me to teach that way.

The gendered identity that Marguerite creates does not evolve from tapping into feminist or middle school discourse. Indeed, the identity that is facilitated within those ways of knowing is one that Marguerite feels is somewhat incongruous with science.

Stringing Science to Real Lives

Finding ways to connect her personal life to science, or vise versa, is not a main priority to Marguerite during classroom discussions. However, there were times when socioscientific issues were explored that expressed real-life connections to the Earth/space content. An example of this was her incorporating an article about the large earthquake in Bam, Iran within her unit on earthquakes. Right as class began one day, she read an article from the newspaper that talked about the disaster and its devastating effects on the Iranian people. She explains:

> MARGUERITE: I wanted [the students] to see that, that… Earth science affects…. What we learn in earth science, what's going on in the Earth, affects people's lives. It's not just something you take measurements off a seismograph or … look at models and measure distances and so forth. It's something that touches people's lives and affects them. It's a…. it's attached and interwoven with, you know, social issues.
>
> SCOTT: Okay.

MARGUERITE: Um. And, you know, deep personal issues. You know, if you're injured or lose someone or you lose all your possessions or whatever, you know. It was just a way to, to…. a string to attach it to a real person type of thing.

SCOTT: Okay.

MARGUERITE: I didn't know if that was …. I don't know. It was like one of those just last minute decisions. I read the article, cut it out, brought it in, and read it. It wasn't something I had planned six weeks ago to, saying, "I'm going to find an article and I'm going to read it."

Connecting science to real life is a teaching strategy that Marguerite constructs as a peripheral activity that is marginal to the normal transmission of traditional content standards. This positionality is in agreement with Hughes' (2000) finding that because of the gendered associations between this type of socioscientific curricula and femininity, the discursive marginalization of science-technology-society (STS) curricula reproduces both the marginalization of femininity within science and the inequitable gender hierarchy itself. Hughes remarks that the more political nature of STS, and its gendered associations, places it in an antagonistic relationship with objective, rational, abstract, masculine nature of science that is traditionally supported through classroom science. She argues that some teachers may be wary of STS because it challenges their scientific epistemologies and their roles as transmitters of scientific knowledge.

Marguerite relates how her less personal approach is also influenced by the particular science discipline she is teaching. She explains that in previous years she was able to find many more personal connections with the marine science content than she does with the Earth/space content. Her experiences with diving gives her access to more personal relationships to connect to that curriculum.

MARGUERITE: In marine science, when we were talking about the pressure change, you know, I told them about doing the diving bell. … So, with marine science, I had a lot more personal experience with the science. With [Earth/space science], it's…..um. It's just not personal experience. Um. I can't think of…. Every now and then, I'll come up with something.

One area in which Marguerite encouraged the students themselves to find personal connections to science was during science fair projects. As I watched the students stand in front of the class and give their oral presentations, Marguerite would often ask how the students actually went about deciding on a topic and the ways in which their families were part of the process. Rather than emphasizing individual responsibility to learn specific content, as was the norm throughout most of my observations in her classroom, Marguerite celebrated the ways in which the students found very personal and familial connections to science. As we talk about this, her thoughts include a rather personal memory about her father.

> MARGUERITE: That's the hardest part of a science project: what am I going to do? What's the subject? Once they get a subject, they're gone. But, um… I tried to encourage them to look at things that happen around them, at home, in their daily lives, um things that go on in their family. Um…because that's of interest to them. They have a, they have a stake in that. And I said, you know, "That's where you're going to, you know, probably get the most information. You're going to get the most support. …If you can find something in that that can interest you. And, um…[pause] I, you know, I remember my dad doing a science project with me. Where he helped me. We did it on pulleys. And, I can just remember that as clear as day. And when I was back in junior high school. And I was so proud of that science project. It didn't win a ribbon or anything, but I was so proud of it. And, um… That's one of the best things that I can remember happening to me that, you know, with my parents having to do with school.

Here Marguerite *is* talking about parenting (*mother-henning*), about personal connections with science, and about the benefits of the more affective "touchy-feely" aspects of teaching and learning. I hear this voice arguing with her other statements about rejecting these very same practices when couched against the academic rigor of science content transmission. Rather than finding ways to resolve this argument, a poststructural analysis allows these multiple voices to coexist within her discursive production of identities. This is indicative of "subjectivities that refuse to stand still" (Britzman, 2000, p. 3).

Ironing out these contradictory voices into a stable narrative is tempting within ethnographic writing. However, such a practice would camouflage the competing stories and how they can act as places to challenge the weak points in hegemonic discourses. Why then do socioscientific and emotional connections not find their way into Marguerite's science teaching? Perhaps it is better to probe how traditional science teaching impedes the inclusion of the affective and personal.

Engaging Architects and Animals

Marguerite is emphatic that she does not recognize any gender inequities within her own life:

> I've said I don't see this [gender inequity] happening, it's not happening in my life, it's not happening in my professional life.

However, in a separate conversation, she illustrates how her gender does indeed affect her daily interactions with others. She and her husband are currently in the process of building a house, which requires them to use an architect.

> MARGUERITE: When we went in to talk to the architect with our plans and everything, …You know, he started out, … talking directly to my husband….I mean, this is an older guy. You know, that's fine, I'm…you're used to dealing with that. He started out talking to my husband. My husband doesn't visualize spatially. ... I worked on these things. I visualized it. I understood…. I… My family was in construction when I was growing up, so I had a much deeper understanding than he did. And then about halfway though the, the interview process, you know, he started turning around and started talking directly to me. But, he had started out talking to my husband. And, but…. I just, you know, stuck my face right in there and gave my comments and then… You know, without being offensive and he eventually turned around and came back to me and said, and started talking to me and, you know, asking me things that he had, you know, probably would have wanted to ask my husband.

Marguerite's experiences in the architect's office illustrate how this inequitable power relation influences how she accomplishes gender. Marguerite was forced to alter the way

she did gender: "I just, you know, stuck my face right in there and gave my comments…. without being offensive."

During another conversation about gender inequity, she points to a certain incident years ago where power and subjectivity were implicated in her involvement with science.

> MARGUERITE: When I started community college as a freshman, I went in to talk to my guidance counselor about, you know, selecting my major. I went in, and uh, the guidance counselor was a man. In fact, he was my next-door neighbor. And, I went in and told him; I said, "I want to major in agriculture, in animal science," which ultimately I did. He told me, "You can't do that. You're a girl." He said, "You can't do that." You're a girl." He said, "You would have to *see* things that girls shouldn't be seeing. You would have to be *doing* things that girls shouldn't have to be doing. And, there would be boys there while you were doing these things." And, you know, it was just the first time that anyone had ever told me that I couldn't do something because I was a girl.
>
> SCOTT: So why did you ignore him?
>
> MARGUERITE: Not at first. I thought, well. You know, he doesn't want me to do it. He's my next-door neighbor. He's an authority. He's like my father. He knows my parents. Maybe they're talking. You know, maybe I shouldn't be doing in. Maybe it isn't appropriate. So I changed my major to PE. I went along with the PE thing and then when I finished my junior college in 18 months, and when I applied [to the university], I applied to the college of agriculture. I just did it. In animal science. And they accepted me right into the animal science program and I was in there with a handful of other girls. And we did do things that were nasty – that most girls would just "ooooh". [laughing] But I had no problem with sticking my hand, you know, up to my elbow in animals with boys standing around. It was almost, when I did that, it was almost a "yes!"

Clearly, patriarchy and perceptions of science as a masculine discipline are involved in this scenario. It is also interesting to note the patriarchy that lies within the sentences:

"He's an authority. He's like my father." Marguerite recounts this incident in a manner that reflects her liberal feminist ideals of equality and fairness. The focus of the narrative is her unique ability to overcome the advisor's discouragement and to persevere in a field that the *majority* of females would not attempt. "And they accepted me right into the animal science program and I was in there with a handful of other girls. And we did do things that were nasty – that most girls would just, "Ooooh!" The gendered subject position that is available to her within science is that of a *unique* type of female, one who can deal with what *regular* females cannot – a move away from emphasized femininity (Connell, 1987) toward certain aspects of masculinity. She altered her engagement with femininity, the ways in which she does/accomplishes her gender, to achieve her full participation in science.

These anecdotal stories are not simply being related. They are being retold anew with the language made available to her through taking up certain subject positions within certain discourses. Both the discourses of science and of conventional gender are on the menu, both providing very different ways to define what it is to be female. Both this incident in college, and the meeting in the architect's office, revolve around modifications to Marguerite's behavior (her doing of gender) so that she was more involved in patriarchal situations. Rather than critiquing the institutions of architecture or science (education), the focus of change is on Marguerite herself.

Learning to Weed it All Out

As we discuss the ways in which gender intersects with her teaching, Marguerite mentions her views about the differences between male and female ways of thinking.

> MARGUERITE: I think that um….men can take…. And this does sound sexist. …. I think men can take a little information and come to a conclusion based on a very small amount of information. And, you know, without thinking too deeply about it. It's just [snaps] "Okay, this is this and this is this."
>
> SCOTT: Okay.
>
> MARGUERITE: Whereas, I think, women, myself included a lot of times… I try to bring too much information in. I'll start pulling in, you know, thinking, "Well,

if this happens, then, oh, well, wait a minute. This is going on over here. This is going on over here. And that affected…" So we start building this complicated web of information instead of weeding it all out and just getting to the core of it like, like most men would do in the same situation. You know, men will just look at something and say, "Well, that's gray" and move on. Well, a woman might say, "Well, you know, that's a blend of brown and red, and you've got this happened and this happened, so…"

SCOTT: Now, which one of those ways would be more beneficial to science? Who would be more successful? Or does that affect it at all?

MARGUERITE: [pause] Well, I don't know. It might give the males more of an advantage in something that is, um…quantitative and the females in something that is more qualitative. But, like a male might you know, something that needs to be thought about, needs to be explored deeply, you know, he'd blow it off… "Well, let's just call it this and this" and move on.

Her responses reproduce traditional, commonsense associations of science, thinking, and gender: "masculine qualities are abstract, quantitative, objective (hard) and value free; feminine qualities are contextual, qualitative, subjective (soft), and value laden" (Hughes, 2000, p. 434). These citations of traditional notions of gender fit snugly within Marguerite's prior notions of science vs. social studies, her reaction to Angie's classroom, and her experiences with the architect and advisor. The discourse of science provides her with the language and cultural practices to construct a particular type of femininity through her pedagogical practices.

Crying Crocodile Tears

Marguerite insists that her gender-blind lens toward her classroom results in her seeing her students, not as female or male, but as individuals. Since she works to erase these gender categories (at least explicitly) from her teaching, I asked if she saw herself as fitting into one of those two groups. She quickly responds, "No."

MARGUERITE: No. I wouldn't. I don't see that.

SCOTT: Okay?

MARGUERITE: Because I feel… I feel just as, as comfortable in, you know, male company.

SCOTT: If not more?

MARGUERITE: Right. If not more. That might be the bias there. [laughing] Mainly because, you know, I think males are just, the majority of males, not all males…. I have wonderful female friends. But, the majority of males are easier to get along with. And, you know, not that I'm gonna rock the boat, but it's like, you know, I don't want to put up with the, with some of the things that come along with being, traveling with a group of females. You know, I just… And it's not because I don't like them, it's just because I just don't think… I don't know. I'm not going to go shopping and buy fifty pairs of shoes, you know.

Marguerite comments on how this preference affects how she deals with students as well.

MARGUERITE: I don't know if this is…. Well, I tend to get along better with men than I do with women. … Um. I mean, not that I don't get along with women. I just prefer the company of men. Or, I think I work better with boys than I do with girls. I think a lot of it is because I'm just intolerant of the wussy attitude or the prissy attitude.

Here is a voice that is clearly arguing with her insistence on a gender-blind classroom.

In order to negotiate and maintain a successful *science teacher* subjectivity, Marguerite works toward an "unbiased" "controlled" learning environment where: "I don't think about gender. ….I just don't think about, you know, well, this is a little boy, this is a little girl. I don't think of them as that. They are my students." However, as she negotiates what it means for her to be female, she uses language that defines herself in opposition to a certain type of femininity (e.g., not going shoe shopping and not acting wussy or prissy). It is interesting to note that these negatively essentializing descriptions of femaleness emerge as Marguerite works to construct a gendered identity for herself. In stark contrast, when working to construct a teacher identity within science, the gender-blind objectivity of science stands out. The personal and professional selves are

separated and under subjection by a different discourse, highlighting the fluid nature of multiple identities.

These words "wussy" and "prissy" catch as pejorative in my mind and I ask her to elaborate. She gives the example of a female student who was crying in class that afternoon.

> MARGUERITE: Those were crocodile tears. …But anyway, I've been dealing with that student. ….I just don't let her get away with things that other people let her get away with. And, she's upset now because she's in trouble because of her, what she's been doing. My mother was like that with me. It was like, you know, you can't pull the wool over her eyes. ….You don't manipulate her. And, you know, I do the same with my students. You know, I see through manipulation in a heartbeat and I don't let 'em do it. …. You know, but the crocodile tears, gosh. I just want to send them out of my sight when they start doing, you know, the flirting, and the, the leaning over and the body language and all of that stuff. But uh…. I guess a lot of these girls are just starting to experiment with that sort of thing. And, uh… So they are awakening to a lot of that. And uh. I just don't want them to learn to depend on that. I mean, there is a time and a place, for that kind of thing. But, this is not the time nor the place.

Not only does this type of feminine behavior rub her the wrong way, she actively works against it having any positive import in her science classroom.

> MARGUERITE: You know, trying to make you feel sorry for them or whatever, you know. "Woe is me" kind of thing. And…um…. What was your question?
>
> SCOTT: You answered it. What specifically…. I just wanted you to unpack that "being wussy" phrase.
>
> MARGUERITE: Yeah. Not, not just being girls. I'm talking….Not all girls, I mean…the manipulative. Using the feminist, you know, kind of …. The fluttering eyelids and the tears and all of that…. You know, that just….. That just doesn't turn my crank at all.

This negative reaction to a certain aspect of femininity is contrasted with a positive reaction to another version, one that is more assertive (masculine). This account came up during a separate discussion about the students' science fair project presentations. I mentioned one of the students, Stina, whom I thought had an interesting project. Marguerite relates a story that revolves around her attempts to help Stina come out of her shyness and be more self-assured.

> MARGUERITE: She was so shy! …We had a problem early in the year because Stina wouldn't speak up to do anything. Even if she didn't understand something, she just wouldn't speak up. We had this talk with the mom about her needing to be more assertive and a little bit more proactive in her education that she needs to learn to speak up and she is doing it. …. And it bothered me because… The thing that set it off was, you know, the fact that she was just sitting in class. She didn't know how to do something and so she just sat there the whole period and didn't ask. Didn't do anything. And so, you know, that burned me. …You know. You've got a voice, ask! And so, you know, to see her make that change was, to me, that was a success. I think that is going to help her a lot.

Marguerite relates being very upset with Stina's lack of confident voice and remembers the day when Stina "broke through" and stood up for herself. It revolved around Stina needing Marguerite to re-grade a quiz. However, each time Stina asked, Marguerite was busy. Marguerite was thrilled that Stina was persistent and kept on asking.

> MARGUERITE: She came back again and said, …" If you'll just show me the key, I'll do it." And I said, "Yes, go Stina! You asked me three times and you didn't let me put you off." And so I was real proud of her. And she started speaking out more. …And she can't pass on her test scores alone. So what we're working on is giving her skills in her day-to-day work so that that stays as high as possible. And so that is what we are working on and she's doing a good job. Anyway, that was a little success story with her. So she was petrified. She didn't want to go and I kind of made her go.

Learning to become assertive and proactive and persistent are skills that are also ways of doing gender. They are tools to construct a certain type of gendered identity, one that Marguerite places in a more powerful position than emphasized femininity. Marguerite asks Stina to do gender differently in order to be successful in her science classroom. In order for Stina to find a voice within this classroom, she had to step up to the plate and be more assertive. Marguerite does not question how the discourse of science, or the classroom practices, may have been actively silencing Stina in the first place, perhaps by not providing the tools needed to create a suitable science identity.

A similar response is elicited when certain forms of hegemonic masculinity are involved.

> MARGUERITE: Well, to give you a guy example, I have a student in my third period class that is… He's the big, you know….He's the big jock. You know, he's, you know, the big football player. That type of thing. He just kind of feels like he can sit back and be cool and not do his work and you know…. So, that, that turns me off just as much as, you know, the crocodile tears. …So, when they use that gender to, in a negative way, to try to get ahead, that just…. That doesn't work for me.

Using certain genders in "a negative way" is something that Marguerite works against in her class - again, illustrating a voice that argues with the one opting for a gender-blind classroom. To be blind to something is not to see it. She can be *gender-blind* in her attempts not to favor one sex category (male or female) over the other in terms of her science teaching, protecting science within its objectivist boundaries. However, she is *gender-sighted* when it comes to which genders (i.e., which masculinities and femininities) are more conducive to be a successful student in her classroom (those not at the more explicit ends of the gender spectrum such as emphasize femininity or hegemonic masculinity). To create a classroom environment where one sex is preferred over the other would be labeled a sexist practice and be in conflict with egalitarian notions of fair schooling. I would never describe Marguerite's teaching as sexist. However, to create a classroom environment where certain genders are more conducive

to being successful with a particular discipline is less explicitly attached to conscious teacher actions than to the language and cultural practices within the discourse of the discipline. However, it is within the language and actions of teachers that those discursive norms become crystallized within the classroom. In other words, the ability to be gender-blind while teaching is not possible due to the gendered nature of subject disciplines, the gendered language and practices they provide, and the constant doing of gender in which we all continuously engage.

Becoming one of the Women Worthies

Since she has distanced herself from *normal* females (not shopping for shoes, doing the animal science, and not being a wussy, prissy person) and has "overcome" the obstacles in her path, there is no need for Marguerite to critique the status quo of science. This is similar to Harding's stance of *critiquing bad science*. This viewpoint entails a belief that science is not functioning at its best since it lacks the participation of females; so we add them in. There is no challenging of the patriarchal nature of *science as usual*. Marguerite has in fact tapped into the hegemonic scientific discourse and taken up the subject position as one of the "women worthies" – Harding's term for women who have found success within the existing, male-dominated scientific enterprise. Studies from the lives of these women "do not tell us what we need to know in order to understand the experiences of the majority of women who try to make it into science or who may achieve less distinguished careers than these few" (Harding, 1991, p. 25). Marguerite has little reason to judge the discourse through which she was able to clearly identify herself as a scientist, and as a unique type of female.

The Anxiety Attack

Toward the end of my fieldwork, I noticed that Marguerite looked more stressed than usual. Normally a very fun person to be around and talk to, Marguerite became rather withdrawn and looked frustrated. The Florida Comprehensive Assessment Test (FCAT) was right around the corner and I knew that Marguerite was under a lot of pressure, particularly concerning her math class. I asked her about her stress level and how it affected her teaching.

MARGUERITE: This would probably not be the typical me.

SCOTT: How so?

MARGUERITE: Well, a lot of it is because I have a lot of stress….Because of the three preps, new preps. So, I'm not giving science everything I want to give it. And, I'm stressed out over teaching the math. I don't like it at all. [voice lowers] I do not feel adequate. And I don't feel like I'm giving my students a fair shake on it.

Marguerite often was visibly stressed about preparing her students for the FCAT in both math and science, and supporting the overall efforts in the FCAT reading.

MARGUERITE: Maybe I just feel so overwhelmed with all of the planning and so forth, that, that I'm just in a survival mode.

Because of her life conditions being rather stressful, she admits that her teaching of science was not exemplary. It may be useful to analyze our practices under such stressful times, when we simply rely on what is easy and what comes normally, instead of trying to push the boundaries of our science teaching. Thus, these findings may be illustrative of what lies at the base core of her teaching philosophy. During this time, her overall perspective about teaching was very negative and she seemed to only discuss teaching in negative terms.

MARGUERITE: I've been put in…. I've not been put, I've chosen to be in a situation where I am just having to learn a whole new …. I mean, it's amazing what one grade change means.. I didn't feel…. And the same thing happened last week. I told one of the teachers here, "I'm not doing these kids justice in this math class." And it's just, you know, they're the….. [sigh] They are the main issue here. Whether or not they're being taught properly and whether or not they're learning. So…. When I feel inadequate to teach something, you know, it affects me. It really does. That, um, ……. I just dread walking into that math class. I don't let the students see it.

The power of the high-stakes testing discourse draws Marguerite's practices even more toward the cognitive side of the middle school dualism, giving less credence to those "touchy feely" parts of science teaching.

The Good News and the Bad News

I found a very interesting similarity between Marguerite and one of the participants in a study by Gwyneth Hughes. In her study of science subject positions available to students within physics, Hughes (2001) interviewed Yenlin, a female student who had been very successful in science and had negotiated a positive science subjectivity. Hughes remarked how Yenlin "dissociated herself from other females. [Yenlin] talked enthusiastically about the challenge of physics, while acknowledging that this is not typical for other females. She clearly distanced herself from female peers…" (p. 282). Marguerite negotiates a similar separation, marking herself as unique and different. However, for both Yenlin and Marguerite there remains an "implicit contradiction between her subjectivity as a female successful scientist and anti-physical science discourse of femininity" (p. 282). Hughes relates how Yenlin uses a marginalized ethnicity, and parental pressures to succeed, to ameliorate this contradiction. However, while this allows Yenlin to find access to a science identity, "there is no challenge to dominant discourses of physical science as a masculine and elitist perspective" (p. 283). Such a negotiation of identity is extremely multifaceted, including discourses of gender, science, and ethnicity. Hughes adds that even class discourse enters the picture since it influences the nature of the parental pressure placed on the minority students. Yenlin's situation becomes a very clear call for rejecting simplistic notions of gender roles that neglect the intersectionality of numerous discourses. Yenlin kept popping into my mind as I learned more about Marguerite.

During one of our last conversations, I asked Marguerite how she would react to an inservice that dealt with the issue of gender equity in science education. She said that she would reply,

> "I don't see a problem. And you're pulling this problem out of the air. You're making this problem!" That's probably… Just off the top of my head, that's the

> first thing that popped into my head. You know, because I think a lot of things that are…. You think too deeply about them and you start getting way off base, making it more than it is. So…..But the scary thought is, perhaps it's here and I'm not seeing it. That's, you know, the good news and the bad news. I'm not seeing it. And the bad news is I'm not seeing it.

To some degree, Marguerite lamented the fact that she was not "seeing it" and thus unable to give me more insight during the course of my fieldwork. Although I repeatedly told her that such a perspective was not what I was after, and that I was more interested in how her language and teaching practice related to gender, this frustration surfaced at times.

Overall, Marguerite's objectivist notions of science, combined with her goals of desiring a gender-free classroom, reinforce the heteronormative and patriarchal expectations regarding masculinity and femininity. Marguerite's daily practices in the science classroom revolve around the transmission of science content. By eschewing explicit gender interventions/conversations, the status quo prevails. Marguerite utilizes the discourse of traditional science knowledge as "abstract, rational, and intellectually challenging" (Hughes, 2001) to reconfirm the dualism that surrounds commonsense understandings of gender. Thus, neither science nor gender is challenged. Hughes (2000) points out that both of these terms should be up for deconstructive analysis if we are to open up novel science identities for students.

In an effort to create a coherent self identity (including what it means to be a woman), Marguerite pens herself as a strong, assertive person who at times adopts more masculine norms of assertiveness when needed. She openly rejects taking up of subject positions that were aligned more with emphasized femininity. Valorizing rational assertiveness and problematizing irrational coyness, within the context of what it means to be a female, allows Marguerite to position herself as powerful by being more aligned with characteristics associated with masculinity. What it means to feminine and how Marguerite carves out successful participation in the category of woman, revolves around her adoption/refusal of various discursive practices

CHAPTER 5

LINDA

Linda is in her sixteenth year as a middle school teacher. While she is predominately responsible for teaching science, Linda declares, "I can teach everything and I have taught everything." Currently, she is teaching science, math, and reading for the seventh grade team at Sandhill Middle School. She holds an undergraduate degree in biology and a master's degree in science education. Like Marguerite, she is married with three adult sons.

Since it came up in conversations with Angie, it is worth mentioning that Linda's classroom is more representative of a typical middle school science classroom. Science posters and a giant periodic table of elements (not covered by a baby picture) hang on the wall, and on the back shelves are skulls, bones, an alligator head, antlers, and a conch shell. There are some signs of the math and reading classes she teaches, but it is predominately a science classroom. Students' work is everywhere, hanging on the walls and resting on the back lab areas. There is also a large piece of furniture sitting in the back corner, which I found out later to be a loom.

Linda and/in her Teaching

Linda employs a wide variety of teaching strategies, including whole class discussions, readings, group work, laboratories, demonstrations, student presentations, etc. In addition, she also employs a good deal of technology, such as listening to an online, science-related broadcast on National Public Radio. This instructional variety results in the students interacting with science via a wide range of sources and angles. I would consider her teaching as very student-centered with a great deal of teacher-student

(as well as occasional student-student) science discussions. Linda mediates these science talks from her stool next to the overhead projector, often making notes about students' comments. I would say that during my visits to her classroom, I heard students talking about science just as much as Linda.

Whether she was simply dropping a ball while standing on a stool to talk about wind resistance or striking a beaker of water with a tuning fork to talk about sound energy, Linda frequently managed to create very lively demonstrations that grabbed the students' attention. Involving students during these demonstrations got them out of their seats and active in the lessons. These demonstrations, and their resulting discussions, were often filled with laughter. The mood of her classroom is light, with the students having a unique balance between structure and freedom. Linda values the students' input during classroom discussions and often commented to me after classes that her entire lesson plan was revamped on the spot in order to follow what she considered to be a productive tangent brought on by what the students had to say that day.

I was always intrigued by how Linda orchestrated her laboratory experiences for the students. She did a wide variety of things that marked these lab days as special occasions, an event not to miss. Days in advance, there would be signs in the hallway advertising the topic of the upcoming lab. In class, there would be at least a day of prior preparation about the goals of the lab and the procedures to follow. On the day of the lab, Linda would often wear her white lab coat and take lots of pictures of the students as they worked in their lab groups. The labs required a great deal of student-student collaboration, hands-on manipulation of science equipment, and the traditional recording and analysis of findings. The products of the labs (like chromatography papers or lipid-test sheets) were often hung around the room. In addition, the photographs she took of the labs were displayed in the hallway outside the classroom. This tapped into the team's ideas about celebrating the accomplishments and activities of the students. Following the lab, Linda would hold class discussions about the students' findings and this understanding of the science concepts. Being highly procedural, the laboratory tasks themselves were rather traditional in nature, requiring students to follow a set plan of

instructions, with a pre-determined goal/result. During our subsequent conversations about this aspect of my findings, Linda was interested about how her interactions with students differed between classroom conversations about science and the actual doing of science on lab days. Similar to Angie's situation, she feels that this is a limiting aspect of the traditional ways that school science frames laboratory activities. While she has goals for her students' exploration and discovery of science knowledge, it is mediated by the contextual restrictions of being in a classroom with thirty-something students.

Linda's classroom discussions were filled with references to local places and people so that the students had plenty of opportunities to find immediate relevance to their own lives. In addition, the conversations also contained a great deal of personal information about Linda herself. I learned much about her family, her likes and dislikes, her passions, etc. from the manner in which she drew on her own life to explore the science content. Overall, I would say that her teaching sits squarely within a developmentally responsive, constructivist outlook on middle school students.

The language and cultural practices of middle school discourse provide Linda with the means to negotiate a gendered teaching identity that does not reproduce the "mother hen" / "science professor" dualism. She is teaching science, but via a developmentally responsive pedagogy that is highly student-centered. While she recognizes the affective aspects of her work, she does not construct them as antithetical, or even peripheral, to the teaching of science. Her science teaching, in which the affective domain is constructed as integral, finds relevant connections between science content and the lives of both her students and herself. Her successful performance of a middle school teacher shifts the traditional power relations between students and teacher so that students have more of an ability to create knowledge and meaning about science out of their immediate lived experiences. Anfara and Waks (2001) relate this to Dewey's notions of the difference between creation of knowledge for immediate use versus knowledge to be put on the shelf for later, adult use. "Subject matter in school learning cannot be restricted to the content of academic disciplines, for this would mean narrowing the content of school experiences of even young students to the materials of

adult occupations and concerns" (Anfara & Waks, 2001, p. 27). What it means to be a successful science student in Linda's classroom is less dependent on conforming to an adult scientist identity than it is on expressing more immediate personal connections with the science content. Who is recognized as good in science comes from active participation in science discussions, not merely from passive recitation of science facts. Since the science talks often revolve around local contexts and relevant lived experiences of the students, access is easier. In terms of gender, space is created for a gendered science identity to be fashioned that is distinct from hegemonic masculinity. Linda's teaching thus loosens the association between the masculinized scientific enterprise (adult scientist) and the knowledge created within classroom science. Thus, the gender associations with science are somewhat challenged.

However, these practices are not found as strong within laboratory lessons in which experiments, not discussions, structure the classroom interactions. The traditional discourse of science becomes more powerful and useful during laboratory lessons and thus the gendered associations with the adult scientific enterprise reemerges. This is similar to the shifts in Angie's positionality as feminist discourse found less access during laboratory lessons. It is from Linda's very comfortable middle school teacher identity that I begin to think about her science teaching.

A Rather Seamless Fiction

Hughes (2001) used a poststructural lens to study the available science subject positions offered with physical science. In the description of her methodology and methods, Hughes made an interesting comment concerning the selection of which participants she focused on.

> While many students presented an unproblematic scientist identity directly linked, for example, to science/technology career plans, the participants in the interviews selected revealed ambiguities and inconsistencies in their identity construction. Interviews in which the participants explored complexities of identity were prioritized over ones where a straightforward account was constructed. That is

not to say such complexities do not exist in the lives of the latter group, just that it was not possible to gain insight into these from the data available. (p. 279)

Hughes chose the participants whose contradictory subjectivities were made apparent through, what Britzman (2000) would describe as, more explicit *arguing voices*. This resonated with the difficulties I was facing as I began to analyze and write about Linda. Unlike Angie or Marguerite, I did not find the same levels of tensions and contradictions within the voices that sprang up from the data. This may point toward a limitation in my understanding and application of poststructuralist theory, but my analysis was facilitated when choice-points or arguing voices or contradictions were more explicit.

In contrast to Marguerite's and Angie's negotiation of a gendered identity, which were explicitly indicative of conflicting subjectivities, Linda's negotiation is less presented in a state of tension. This is not to say that her identity is more stable or more coherent than the other participants. Her identity is still in flux, and her gender is still under construction by many competing discourses. Rather, her story about herself seems more stable because she has found a way to more effortlessly resolve the variability of the competing discourses.

Wearing the Big Badge of Science

Like Marguerite, Linda worked in the field of science before entering the teaching profession. One of her earlier jobs came up during a conversation in which I asked her about any ways she saw gender intersecting with her being a scientist.

> LINDA: My first job. Actually, my second job out of college. Um. We moved to Missouri. And I got a job in Kansas City at a brewery as a chemist. And they … I guess I was the only one applying for the job. They hired me. And I got paid seventy-five dollars a month less than they would have paid a man because I didn't have as many responsibilities. I was single. I would have had all the responsibilities financially of a single male. Fortunately, that was the personnel office. My direct supervisor, the head chemist, waited an appropriate amount of time, three weeks, and gave me that seventy-five dollar raise.

A subsequent job at a university brought parenting into the picture:

LINDA: I worked at [the university] when my baby was young. …And um,….it didn't work out for me. I was a tech for [a professor] and um…. My kids were just sick all the time and I was having to take off and leave early. So when I quit work, they never got sick again. [laughing] A real slap in the face.

Linda found the dual jobs of parenting and paid employment outside of the home to be incompatible. "The workforce continues to function as though scientists have no significant familial responsibilities and often excludes those who either choose to give families a priority or must do so" (Brickhouse, 2001, p. 282).

In her beginning years as a teacher, Linda used the discourse of science to define what it meant to be a teacher. However, that faded over time as she rejected that identity for one within middle school discourse.

LINDA: Well, you know, when I first started teaching and people would ask me, I'd say I was a science teacher. Because that was a big badge to wear.

SCOTT: And you carried that science authority in with you?

LINDA: Right. Now I say I'm a seventh grade teacher because it's more meshed together and I've always taught more than one subject. I've almost always taught three subjects. But even in the beginning, I was more insecure about those other subjects and that's why I called myself more science.

There is a gendered difference between the two different teaching identities of "science teacher" and "seventh grade teacher," with the 7th grade team teacher having less of an ability/need to reproduce the masculine nature of science. She adds that in the past, she would more often bring up science positions that she held before becoming a teacher, based in part on the (masculine) authority carried with it:

LINDA: As I made a big point of talking about positions that I've had that could have been seen more as a masculine science position. That was probably some of my insecurities being a new teacher. I wanted to show some validity there. You know. That doesn't come out as much any more. I mean, if it comes out in the natural course of events, but I don't press it. …I guess…. Um, feeling full of myself. You know, it was like, "I'm a science teacher, but, I have been in the

science world and so I can talk to you about things that a science teacher may not be able to talk to you about."

In lieu of flashing that authoritative, masculine badge of scientific experience in order to create a teaching identity, Linda now finds a lot of pleasure within middle school discourse. I use the word *pleasure* here because Linda would often smile or become more animated when we talked about her being a middle school teacher.

What it Means to be a Tiger

As we began to speak about her teaching during our after-school conversations, the topic of being specifically a *middle school* teacher emerged again and again. Linda has a negative reaction when around other teachers who define what they do, and who they are, by their subject specialization. She constructs herself in opposition to these subject specialists.

> LINDA: And it's just so compartmentalized. Because they didn't teach *just* that. They taught many subjects. And the fact that we have a small group guidance program where we're teaching issues and priorities and organization and all of those touchy-feely middle schooler things. I just um… I was kind of taken aback and came to see myself as more of a teacher. A facilitator. And science is one of things that is part of it.

Unlike Marguerite, we immediately see Linda invoking the "touchy feely" facilitator identity – finding value in the affective side of the dualism with no conflict with science.

Linda is one of three teachers on the seventh grade Tiger team and she views teaming as a very strong positive factor in her teaching. This philosophy provides the basis for many of her daily practices.

> LINDA: I think the students see me as a Tiger…on the Tiger team and the Tiger teacher who teaches science. Because I have them all for science, but I have a third of them for reading and a third of them for math.

During my time at the school, I would often see Linda talking with her team members. While I knew the other teachers on Angie's and Marguerite's teams, the Tiger identity

and team concept came through much stronger and held more of a productive role in the classrooms.

One particular activity is illustrative of the degree to which the Tiger team philosophy and practices permeates Linda's science classroom. The class was learning about the periodic table of elements and Linda had assigned them each to create a brochure about one of the elements. In order to co-construct the project rubric with the students, she gave them an example of a brochure that she had made. The brochure was very colorful and used lots of team and middle school terms and images. The element was Ti (symbol for Tigerium) and was discovered by the LOP teacher (LOP being initials of the three teachers on the team). The element was an inert gas and there is a picture of a person being lazy on a couch. The properties of the element were a combination of characteristics of early adolescents and the properties of Tiger team students. Linda's favorite animal is a rhinoceros, so the back cover said, "Rhino Productions."

The kids reacted enthusiastically to the project, the rubric, and the interesting way the Linda managed to bring who they were (as a team and as early adolescents) into the science content.

> LINDA: It was just sheer inspiration. I didn't want to use a known element. Because I didn't have my list with me of who had what element and I didn't want to give them a concrete example. …So I thought, "Oh, well ….!" We try to work that team thing in as much as possible. So I thought, well these are not the best of seventh graders and in every class there was someone who recognized, "Oh, that sounds like us." And that kind of thing.

The students were able to find personal connections with the science content – "that sounds like us". The affective and the cognitive again blend together as the students simultaneously learned about elements and what it means to be a member of the Tiger team.

Another way that the science classroom activities reinforce the team philosophy is with photography. Every time there was an activity in the classroom, Linda walked around with her digital camera, taking pictures of the students working. She creates

posters for each activity and puts them out in the hallway. These posters are then raffled off at the end of the year. In addition, the science pictures (as well as all the other pictures from the other team activities) are put on CD-ROMS as "e-yearbooks" for the students. Linda also says that they use these pictures during open house so that the parents connect with the teaming concept as well.

I ask Linda how the Tiger team functions outside of her science class. She comments that it is very successful and she is quite proud of "the strength of our team."

> LINDA: We have probably one of the most cohesive teams as far as the teachers go. And at the beginning of the year, we make a big deal out of it. The first day of school, we have a big team meeting. We talk about how we are the best team in the school, how what our expectation are of them, that we will cover their back and we will stand up for them, but in return we expect this and this and this. What different things look like. …We still do, try to be as cohesive as and consistent with each other and our expectations as we can.

There is a sense of camaraderie and solidarity that works to renegotiate what a traditional science teacher identity would be. The affective (i.e., Angie's "hand holding" or Marguerites "mother hen-ing") is integrated *within* the teaching of science. Thus, Linda and her teammates find ways to challenge the dualism, and the gendered associations, that Anfara and Waks (2000) described between academic rigor and developmental responsiveness. Rather than seeing them as opposites, Linda finds that they complement each other well and create an overall increase in science learning.

Middle school discourse provides a way for Linda to reconcile the masculine nature of science with the feminine nature of teaching. She is not using the discourse of science to define what it means to be a female science teacher. The discourse of middle school provides her with the language and the cultural practices to construct a gendered identity that does not explicitly cite the norms of science.

> LINDA: Like I'm a middle school teacher first and a science teacher second. And that's part of the middle school concept …

Since middle school discourse has provided Linda with such a comfortable and productive science teaching identity, there is less of a need for her to be political about her own positionality, and thus science. Her science teaching does not come from a problematized positionality, thus restricting the development of a more critical eye toward science (one that goes beyond representational aspects of female participation). She talks about science, teaching and the interdisciplinary nature of her work as being "all meshed together." The boundaries of *what is science* and *who can be a scientist* are implicitly blurred within this approach, thus reducing the need for students' gendered identities to find correlations with hegemonic masculinity. However, the discourse of middle school may be creating too seamless of a situation that does not place Linda in an explicitly political position to critique the masculine nature of science itself.

Making Sweet Tea

Heteronormative aspects of being a female are reproduced in Linda's use of a kitchen example during a lesson on solutions. To better explain the concept of concentrations, she draws connections to making iced tea. She begins by telling the students, "Most moms in the south make sweet tea" and then talks about how moms probably would want less sugar, a lower concentration, in their tea compared to other family members. She later explains her thoughts behind this example:

> LINDA: Because they could all relate to somebody wanting less sugar or more sugar…and the coating of sugar at the bottom. I try to use things that they can think about themselves.
>
> SCOTT: When you use phrases like, "most moms in the south do this" …
>
> LINDA: I hadn't thought about that… I should have asked….Cause I did say in one class, "How many of your moms make tea" and I should've said, "How many dads…" cause I know my husband makes it every night.

Linda is very much aware of the gendered aspects of her words. While this simple example, in and of itself, is not glaringly striking, it does represent the type of examples normally provided in science: ones that are deeply connected to our commonsense, taken-for-granted notions of gender. When contrasted with the feminist narratives generated in

Angie's class, one can see how they differ in terms of (gender) (science) subject positions presented to students. It is important to note that from this example that we can see the responsibility that comes with bringing lived experiences into the science classroom. While the approach is a very useful one, it also carries with it the need to be mindful/critical of the language and cultural practices that may contain more explicitly inequitable gendered notions.

Taking Care of the Giggling

Later on that same class period, the students read a section in the text about suspensions and colloids. They are reading out loud and there are some giggles when they get to the words "homogeneous" and "heterogeneous." Linda stops the reading and says, "You've all had prefixes with Ms. Norton." Her explanation is serious and she reminds the students about what the prefixes mean. The conversation then quickly moves into other food items and away from the homo/hetero incident. When I ask Linda about this, she says that it is a common topic for the students to giggle about.

> LINDA: I know, you can't get around it. ...I've always been one to think, "Well, we've just got to get it out of the way." …There used to be a *Science World* that was based on farts. Bathroom humor. Farts and belches. You, know. I'm just, "Alright, just get it out of the way now." Um, we have a couple of students…. I mean, they make such a big deal if someone passes gas and their shirts are up over their faces.
>
> SCOTT: Right.
>
> LINDA: And you know… if they'd just ignore it.
>
> SCOTT: Right.
>
> LINDA: You know, I've always kind of dealt with it like that … at the prefixes meaning "the same" and "different." And, if they want to go further with that, then we do.
>
> SCOTT: And I noticed that you didn't go further with it.
>
> LINDA: No.
>
> SCOTT: You just gave a very scientific…

LINDA: Yeah.

SCOTT: "This is a scientific prefix that means this and this."

LINDA: Right, and that's all they're going to get from me unless the discussion comes up otherwise. And it would *probably*, then I would say, "Well, maybe we should discuss this in small group or, you know, after class or something."

SCOTT: But not in the context of a science class?

LINDA: Right.

Within this situation, homophobia (with its obvious links to sexism in general) is involved in talking about science. The homo/hetero prefixes are ubiquitous in science and many teachers, including myself, have had to deal with a similar situation. It is interesting to note that although Linda talks with the students about the terms being prefixes within the context of science, she does not address the homophobic context that causes the laughter. Prefixes can be talked about in science, but homophobia should be talked about in small group (advisory). Overall, she wishes that they would, "just ignore it" so that she wouldn't have to deal with it. "Silence exists where critical dialogue could exist" (Letts, 2001, p. 268). Linda also draws parallels between this incident about homosexuality and previous situations in which she has had to negotiate learning environments in which there were students with developmental disabilities, such as autism. Suppressing students' negative reactions to difference, whether it be homosexuality or ability levels, is thus a recurrent aspect of her science teaching.

Being a "Craftsman"

One day, I asked Linda about the large piece of furniture in the back corner of her classroom. She explained that it was a loom and that she weaves and does leather work and other types of crafts. Its presence in the classroom allows students insight into who she is a person; the professional and the personal are bridged. As we continue talking about her craftwork, she brings up the fact that she does not like to be called a "craftswoman," preferring the title of "craftsman."

LINDA: For years, I was a craftsman. And I objected to the whole gender change of being politically correct and saying "craftswoman." I don't know that I

> could actually verbalize that but I do not see myself as a craftswoman, I see myself as a craftsman. And there are many positions where the term has become masculine, but it is really a generic term to me … No, I don't like crafts-woman. I don't know that I can really… It's just craftsman to me is like…. Is not a gendered word. It has to do with person who does a specific thing, whoever that person may be.

When I revisit the topic later in the semester, she adds that she feels that the word "craftswoman" is "frivolous" "or not serious" or "doesn't have the weight." Her thoughts resonate with the two important aspects of gender discourse that are important here: a) the fact that "woman" is not the simple opposite of "man," and b) the term "woman" is seen as placing gender on things that were genderless when they contained the term "man."

In terms of this first presupposition, it is important as we look at gender equity interventions. Her awareness that "woman" does not mean the simple opposite of "man" means that *adding women and stir* approaches do not balance the gender seesaw in science. "For a woman to 'behave like a man' does not mean the same thing a man behaving like a man" (Davies, 2000a, p. 49). Behaviors are not equal when taken up by individuals on different sides of an inequitable dualism: "the members of one sex cannot simply appropriate the iconography of the other sex because the image is translated in terms of the sex of the user to not mean something entirely different" (Davies, 2000a, p. 49)

In terms of the second, placing the female signifier into a situation (whether it be linguistically as it is in this example or theoretically as it is within feminist concerns), means that you are adding gender (a political positional aspect) into a context that was assumed to be "genderless" or "generic" beforehand. This is true whether we are talking about Linda's linguistic adding on of a female term (to "craftsman") or Marguerite's adding on of feminist politics (to "scientist"). There are similarities between Marguerite's resistance to feminized science and Linda's resistance to a feminized title: "frivolous," "not serious," or "doesn't have the weight." These examples point to how

masculinity is assumed to be the genderless norm, thus making challenges to it much more difficult.

"A Little Experiment"

Years ago, as a result of an overcrowded classroom, Linda separated her students in terms of sex.

> LINDA: I did something really interesting one year. I had too many students, a large class. And I made an arrangement with the librarian to send half the class to the library, to the lab, and then they would have an assignment to do and then they would rotate. So, I did girls one day and did boys the next day. The girls were extremely focused, very end-result oriented. They wanted to get though it. They did everything. They made their observations. They came to the conclusions, they did the….they did the whole thing. Guys…goofed off.

She had been doing some reading about single-sexed education and wanted to try it out on a small scale. Reflecting on the experience, she relates the temptation to essentialize all of the females as being more able to stay on task and all the males as being goofy distractions. However, by comparing the students in the past with the ones in her current classes, she hits upon the futility of such generalizations.

> LINDA: I don't know if it's just a special incident? I uh, certainly our girls this year are more goof-offy than the boys, I would think. Um. Maybe I'm just more attuned to the boys because I have boys in the house, never had to deal with girls on a daily basis. But, um… You know, that was just a little experiment I tried one time because my classes were so big. … And, I, I think for a while, I deliberated whether or not, when I had groups, then they should be same-sex groups because the boys had a tendency to pull the girls, keep everybody off task. …That they, they're more end-result oriented maybe. Boys may just be kind of go like that. And that's not always the case. You know, I hate even saying that. Because it's not true.

She concludes by saying, "I don't know if I'd do it again." Such separation of the sexes does not have any substantive impact here on the way science is represented in the class.

Removing individuals who were more likely to be able to tap into hegemonic forms of masculinity altered power relations among the students. Classroom dynamics among students, not science, is being placed under scrutiny. Linda discusses how she currently looks at students' behaviors, rather than an assumed gendered essence, when constructing groups.

> LINDA: And then there's a whole way to put [students] together in groups so that you get the most benefit. So, you've got someone who's really solitary… I'm not sure, it seems to me … I don't know… To me, if I put somebody who really likes to work alone with a group, that they are ride on their coat tails.

Linda does not insist on a "gender blind" classroom, where students' genders are taken out of consideration. In fact, she has *experimented* with using gender as a very concrete tool in the past. However, the interventions remain confined to considerations of males and females as homogeneous, undifferentiated groups (i.e., two sexes/two genders).

CHAPTER 6

DISCUSSION

This chapter focuses on a discussion of the above findings as well as their implications for science teacher education. It is my desire that this discussion will not only contribute to the gender equity conversation within science education, but also the field of teacher professional development in general. Understanding that "teaching in commonsense ways cannot help but maintain social inequities" (Kumashiro, 2001, p. 9), this discussion helps to explicate how to disrupt commonsense aspects of science teaching and the naturalized and normalized gendered subject positions it offers. In addition, I attempt to reflect on how this dissertation functions as a means of negotiating my own identity as a science teacher educator.

> Who we are, our subjectivity, is spoken into existence in every utterance, not just in the sense that others speak us into existence and impose unwanted structures on us, …but in each moment of speaking and being we each reinvent ourselves inside the male/female dualism, socially, psychically, and physically. (Davies, 2000a, p. 85)

Doing Gender/Teaching Science

Each of the participants acknowledged and used the "label" and "categorization" of *female middle school science teacher*; however, the data show that this is far from being a fixed description. As this study has found, negotiating and maintaining these subject positions is an effortful and ongoing process that is bound within the language and cultural practices of available discourses. "These subject positions – ways of being an individual – and the values inherent in them may not all be compatible and we will

learn that we can choose between them" (Weedon, 1987, p. 3). In turn, identity becomes unstable and the participants reacted to these shifts in different ways: either by reproducing or by interrogating taken for granted assumptions about gender and/or science.

Broadly speaking, Angie's use of feminism, Marguerite's use of science, and Linda's use of middle school philosophy, in combination with their resistance to other discourses, work in unique ways to reproduce and/or challenge what it means to be male or female or scientist or science teacher. These identities, as effects of practice, were accomplished through a variety of ways, from room décor to pedagogical strategies to the nature of teacher/student relations. The resultant gendered negotiations affect both their own identity constructions as well as the way science is represented in their classrooms. I find fascinating this intimate relationship between teacher identity and the way science content is portrayed.

Through middle school philosophy, Linda expresses/creates compatibility between her gendered, science, and teaching subjectivities. Being a "Tiger team teacher who predominately teaches science" is her ideal. Her constructivist practices, as well as an emphasis on finding connections between science and students' immediate lives, create a very student-centered science classroom. Linda's contentment keeps everything at the status quo, challenging neither the scientific enterprise nor gender itself. Constructivist orientations often rely on building upon students' prior knowledge bases and using prior lived experiences as foundations for constructing more personally connected science meaning. However, this orientation can often be overly individualistic and rely too blindly on the authority of experience (i.e., assuming a transparency of language and a immediate mirroring of reality/truth via experience). I address this limitation of centering lived experiences below.

In order for Angie to find compatibility between her gendered and scientific subjectivities, she taps into the discourse of feminism in order to critique *science as usual* (Harding, 1991). However, as the data pointed out, there was a great deal of emotional work involved in maintaining that feminist positionality. In addition, the existing power

relations marginalize this positionality (both in terms of science and middle school teaching), therefore marginalizing the knowledge that is generated from its location. I have argued that both *science* and *gender* must be deconstructed within local teaching contexts in order to open up new science identities for students. Although Angie manages this in some contexts (even including heteronormativity), her science teacher identity is so marginalized that the resulting knowledge runs the risk of being viewed as too peripheral.

Meyer (1998) argues "science education has the responsibility of reconceptualizing science away from its masculine stronghold, educating for change and equity, and including culturally diverse perspectives" (p. 470). Angie's feminist pedagogy works toward this goal. However, the socioscientific/STS recourses that she uses as vectors for critiquing *science as usual* (and thus creating a positive science teacher identity for herself) are limited. Thus, she is often forced to fall back on textbook or other resource material that transmit scientific content in a more abstract, de-personalized manner. In addition, Angie is silenced by the technical equipment that she feels is needed to "do" classroom science labs and activities. "What counts as 'doing science' is often justified in terms of how well it matches what professional scientists do" (Brickhouse, 2001, p. 289). Thus, her resulting classroom practices can be understood as a) socioscientific discussions in which her feminist science outsider positionality is used to critique both gender and science (and their entanglement) and b) more traditional "doing" of classroom science that perpetuates that which she critiques. "The traditional image of science as unemotional, detached and politically unbiased may have crumbled under feminist critique, but this has not necessarily changed the ways of 'doing science' in classrooms" (Letts, 2001, p. 263). Therefore, the marginalization of STS perspectives within the discourse of science results in a marginalization of Angie's science teacher identity.

Marguerite resists middle school discourse's "mother hen" subjectivity because it is incompatible with her gendered teaching subjectivity, one that is aligned with conventional notions of science. Thus, *middle school* and *science* become incompatible.

The winner is science since it holds the more relatively powerful position for Marguerite. Indeed, science remains unchallenged. Also, there is no subject position available from which she can challenge what it means to be a middle school teacher; that is not a possibility. Marguerite has the "experience" and the "degree" to back up her claim of a science identity. It is the maintenance and renegotiation of this identity, under the novel pressure of a rather powerful middle school discourse, that becomes interesting.

Marguerite strengthens the masculinist enmeshment of science by eschewing emphasized feminine characteristics both within the construction of her own gendered teaching identity, and also within her representation of science in the classroom. The gendered identity that she negotiates, specifically for use in being a scientist/teacher, is that of a "pick yourself up by the bootstraps" female who can independently overcome patriarchal contexts by being "rational" and "assertive" not "wussy" or "prissy." I was interested in how this type of femininity was created, negotiated, and maintained through Marguerite's use of the language of certain positionalities within competing discourses. This is not a constant identity and there were instances in which her voices argued with each other and exposed contradictions (e.g., the wavering of traditional teacher authority and subject specialization in light of middle school discourse; not wanting to be insubordinate and question her administration). It is within these contradictions, and the choice-points that underpin them, that the discursive nature of identities in progress can be made explicit. This gendered performance (accomplishing this specific type of femininity) creates an identity for Marguerite that is distinguishable from those typically found within conventional gender discourse (i.e., a subversive accomplishment). However, this same gendered identity is one that fits snugly within the discourse of science.

Just as a person must sustain membership within a sex category by continually doing gender "correctly," the same can be said of science or feminist subjectivity. As the web of competing discourses changes and shifts the power relations among them swing. For example, as Marguerite entered the middle school context, she experienced a shift in power relations and had to constantly renegotiate a science identity under the pressures of

a novel discourse entering her practice. The same can be said for Angie's feminist identity that was challenged under the new role of science teacher. I began this study to trace the subjects' movements through the available discourses, not fully appreciating the fluidity of the discourses themselves over time. In other words, both individuals and discourses are fluid entities that exist in an iterative practice/structure relationship.

Regimes at Sandhill Middle School

Feminist poststructuralism has provided a way to talk about the moment-to-moment personal interactions with gender within science teaching. However, these three teachers are situated in a very specific school context. Connell uses this term *gender regime* to refer to "the state of play in gender relations in a given institution" (1987, p. 120). The heteronormative gender regime of Sandhill Middle as a whole is tangible. Separate bathrooms, heteronormative Valentine's day celebrations, and female cheerleaders and male football players are but a few of the explicit ways in which the patriarchal, dualistic gender structure functions as a way to organize what it means to be a student at Sandhill Middle. In addition, one must remember to place these findings about the teachers, their practices, and their subjectivities back within the context of the school. They do not teach in total isolation, but rather "down the hall" from each other and share common students.

There is something to be said for the wide range of sciences that are represented by these three teachers. To consider the range of available gendered subject positions within each science classroom (as facilitated by each teacher) is also to consider the cumulative experiences of a single student flowing through these three classrooms over the course of three years at Sandhill Middle. While each teacher provides only a partial perspective on science, scientist, maleness, and femaleness, that effect broadens when we consider their cumulative effect. In addition to a unique array of genders, there is a spectrum of answers to "what is science" and "who do you have to be to be successful in science" (Barton, 1998b) when we look across these three classrooms/teachers/years. Perhaps we can conceive of this "state of play" of science at Sandhill as the *science regime* of the school?

Dissatisfaction

I was constantly bothered by the question of why Linda's negotiations were less visible to me through the lens of poststructuralism. One thought may be that Linda had less *pedagogical dissatisfaction* (Gess-Newsome et al, 2003) than the other two? While Angie's pedagogical dissatisfaction is approached by taking up a feminist science insider/outsider position in order to challenge both the commonsense gender and scientific status quo, Marguerite's solution (for the future) is a change of contexts/teaching environments toward one that is more conducive to her gendered scientist identity. Due to the fact that Linda presented herself as being very much "at home" in her current position, there is little explicit dissatisfaction going on. However, rather than viewing this as a static situation, it can be viewed as a way to look at even more nuanced intersections between gender and science teaching. "By examining, problematizing, and owning one's own positional limitations and possibilities, and the institutional constraints in which the learning activity is conducted, the possibility for emancipatory education is greater than if one ignores dealing with these issues" (Tisdell, 1998, p. 153). Linda has chosen subjection within the teaming facets of middle school discourse (subjecting to the discourse of the Tiger team rather than science), thus resolving the affective/cognitive dualism that so troubles Marguerite.

The Sisters in Science (1999) study found that there was a relationship between the teachers' comfort level with the scientific topic being taught and their ability to engage in gender equitable teaching practices. "The teachers did express concern that when they are confronted with teaching a science topic that is new and unfamiliar they tended to revert back to a more traditional teaching approach" (p. 36). Such a finding questions the effectiveness of professional development programs that simultaneously introduce novel science concepts and gender equity issues. Both Angie and Marguerite are dealing with new situations, science and middle school respectively, which may influence how they are looking at this issue.

Constructing Gender(s) Against Science(s)

Letts (1997) points out that the male science teachers in his study would construct a gendered identity "by telling what they were not" (p. 14). Letts' theme of *contradictory self-description* may be useful in thinking about the teachers in my study and the roles that science plays in their lives. In particular, Angie and Marguerite often defined their gendered identities via describing the types of people they were *not* (e.g., retracting from scientism and emphasized femininity, respectively). Paralleling poststructuralist thought on language, Letts notes "theoretically, this idea makes sense, for things only get their definitions when there are other things to compare them to in order to see what they are not" (p. 10). Within gendered discussions concerning school science, we often talk about how its androcentric and masculine nature impedes equal participation by *all* students via facilitating males and hampering females. Perhaps we should pay equal, if not more, attention to the power science has for defining femininity (as well as non-hegemonic forms of masculinity). The authority and formidable nature of science can act as a unwavering wall, off of which genders, other than hegemonic masculinity, define themselves.

The Nature of Science and the Politics of Teaching

The predominant flow of theoretical influence (and theoretical silence) from science to school science is pivotal. The "norms of science instruction drive from the norms of science, and gender/equity is not a concern of science" (Lederman, 2003, p. 604). Therefore, *the nature of science* (NOS) (as theorized from the actual practices/languages of doing science in the "real world") is of great importance to those of us who wish to teach science in less oppressive ways.

In my study, there emerged important intersections between the teachers' gendered practices and their understandings about NOS. While the focus of the dissertation was not to tease out the intricacies of the individual teachers' conceptions of the nature of science, there are salient aspects that are worthy of discussion. I do this in recognition of the prominent role NOS research plays within the science education research community.

Lederman, Abd-El-Khalick, Bell, and Schwartz (2002) define NOS as "the epistemology and sociology of science, science as a way of knowing, or the values and beliefs inherent to scientific knowledge and its development" (p. 498). While there is not a universal agreement about a set NOS canon, there is a general consensus concerning several facets of NOS that a) are particularly salient for science teaching and b) have been recognized within current science education reform (Abd-El-Khalick & Akerson, 2004; Lederman, Abd-El-Khalick, Bell, & Schwartz, 2002; Southerland, Settlage, Johnston, Scuderi, & Meadows, 2003):

> Scientific knowledge is tentative; empirical; theory-laden; partly the product of human inference, imagination, and creativity; and socially and culturally embedded. Three additional important aspects are the distinction between observation and inference, the lack of a universal recipelike method for doing science, and the functions of and relationship between scientific theories and laws. (Lederman, Abd-El-Khalick, Bell, & Schwartz, 2002, p. 499)

The mere presence of NOS as a field of research signals that less sophisticated conceptions about science predominate within commonsense, everyday scientific discourse. Thus, the manner in which a teacher hails/resists the NOS discourse is often reflected in the representation of science in their classrooms.

Speaking across the three participants in my study, there were obvious parallels between NOS conceptualizations and the degree of willingness to engage in progressive feminist/gender activities in their science classrooms. There seemed to be a discordance between more naïve NOS understandings and a desire to critically examine the cultural underpinnings of the scientific enterprise and its resulting knowledge. While not fully objectivist at all moments of teaching, Marguerite often used language that described scientific work as being highly objective, unbiased, and often disconnected from any social embeddedness. This contradicts more sophisticated NOS understandings that describe science as very much a human endeavor and scientific knowledge as invented not discovered. "Once aware that science is invented rather than discovered, students, teachers, and scientists may use this knowledge to create more egalitarian scientific

theories and practices" (Lederman, 2003, p. 604). Marguerite's positionality can be juxtaposed with Angie's strong and persistent desire to challenge objectivist science and to acknowledge the culturally laden nature of scientific work. There are parallel political intentions between Angie's pedagogical goals concerning both science ("Don't sell yourself short saying [science] is just for old, white men in lab coats") as well as gender ("They don't have to settle for what they are being told"). It is fruitless here to debate the chicken/egg nature of NOS and orientations to equity teaching, but I will situate these findings within a science education discussion concerning how we assess and portray individuals' NOS knowledge.

Science education researchers are currently engaged in discussions about the use of "conceptual ecology" (Abd-El-Khalick & Akerson, 2004; Demastes-Southerland, Good, & Peebles, 1995; Johnston & Southerland, 2002) within attempts to better understanding how individuals learn certain NOS concepts. This work is attempting to open up the seminal *conceptual change model* of learning (Posner, Strike, Hewson, & Gertzog, 1982) that has been criticized for being overly rational and neglectful of more affective and social factors. In essence, rather than simply focusing on a rational transition from a naïve to a sophisticated NOS understanding, the use of a "conceptual ecology" framework allows researchers to provide a much more holistic portrait of individual learning, one that includes a wider array of intervening features, such as motivation, goals, worldviews, or other cultural factors.

Sophisticated teaching about the nature of science is very much a political act since it holds somewhat of a marginalized position in relation to the teaching of traditional, more abstract scientific concepts. For example, the nature of science is traditionally taught early on in the course sequence as an insolated piece of the content, no different from the structure of DNA or the laws of thermodynamics. On the other hand, to teach the nature of science as an overarching set of foundational assumptions about science as a particular way of knowing has greater potential to frame the way students understand the rest of the science curriculum. In other words, to talk about

photosynthesis as a tentative and invented human theory, rather than a fixed and discovered list of facts, is more political.

In a similar light, gender does not mean the same to all teachers and asking them to engage in critical thought about maleness and femaleness is asking them to recognize teaching as a political act. However, **"**crafting a political identity while playing a teaching role is difficult in a society and university environment which has traditionally valued 'objective' and 'apolitical' knowledge" (Ropers-Huilman, 1997, p. 334). Therefore, it may be worth further investigations whether or not a political orientation toward the act of teaching is part of one's "conceptual ecology," and thus a mediating factor in learning/teaching more sophisticated NOS concepts.

Indeed, the language and cultural practices required to engage in explicit and reflective teaching about the nature of science are similar to those required of feminist pedagogy that challenge masculine science and/or the existing gender structure. Marguerite's resistance to the feminist discourse paralleled her resistance to viewing the *doing of science* and the *doing of teaching* as political endeavors. However, the opposite very much holds true for Angie who views teaching as quite a political act and science very much up for critique. Angie clearly frames teaching as a means toward social justice and I find her work resonating with Giroux's (1988) concept of a teacher as a *transformative intellectual*. Giroux and McLaren (1985) define this type of educator as "one who exercises forms of intellectual and pedagogical practice which attempt to insert teaching and learning directly into the political sphere by arguing that schooling represents both a struggle for meaning and a struggle over power relations" (p. 215). I reacted strongly to their use of Sharon Welch's (1985) concept of *dangerous memory* in conceptualizing this type of teacher - individuals who can "link knowledge to power by bringing to light and teaching the subjugated histories, experiences, stories, and accounts of those who suffer and struggle within conditions that are rarely made public or analyzed through the official discourses of public schooling" (Giroux & McLaren, 1985, p. 226-227). I wonder how successful Angie will be in continuing to use her dangerous

memories and position as a transformative intellectual as she progresses in the field of science education.

Finally, from my poststructuralist perspective, I value the contribution that Elby and Hammer (2001) bring to this conversation about the nature of science. They challenge the very way that current science education research categorizes individuals' NOS conceptualizations as either *naïve* or *sophisticated* (e.g., students correctly describe scientific knowledge as tentative or they incorrectly describe it as fixed). In other words, either "you get it right" or "you get it wrong." Rather than this reliance on "blanket generalizations about the nature of knowledge and learning" (p. 555), Elby and Hammer make an eloquent argument for paying attention to the contexts and nuances of both practicing scientists' and nonscientists' NOS understandings. For example, they point out that not all scientific knowledge is *equally* tentative, nor is it productive for practicing scientists (or even elementary students) to even think so. I agree with Elby and Hammer that such generalizations are "neither correct nor productive" (p. 554) and often iron out insightful complexities. Here lies a possible fruitful connection between challenging dualistic thought about science learning and challenging dualistic thought about gender.

Middle School Discourse

During their research into middle school teachers' beliefs about advisory programs, Anfara and Brown (2000) revealed, "that the analysis of data involving teachers' impressions of advisories would involve gender issues was unexpected" (p. 28). In contrast, within my research on gender and science teaching in a middle school context, I did not anticipate the affective/advisory construct to emerge as such a forceful theme. Thus, in some ways, our research findings meet in the middle. From this intersection, I can explicate how incorporating the discourse of middle level education (specifically the debates surrounding developmental responsiveness versus academic rigor) into a poststructuralist analysis of science teaching, can provide a more holistic and robust understanding of the issue of gender equity.

I argue that our understanding of how science teachers approach the issue of gender equity is greatly augmented when middle school discourse is also placed under

the lens of poststructuralism (e.g., questioning taken-for-granted assumptions about the feminization of affective programs). Jane Gilbert (2001) provides a passionate theoretical push for gender research in science education to deconstruct the very terms that underpin such work: "woman" and "science." She argues that by doing so, research can better challenge the "enmeshment of science/technology and masculinity" (p. 292). I argue a similar analysis of the concept of "middle school" may also prove fruitful and point toward novel directions for gender equity research in science education. Rather than functioning merely as a descriptive concept used to contextualize a study, "the middle school" can become an important point of analysis under a poststructuralist lens. In addition, incorporating a poststructural analysis of gender may strengthen the middle grades research community's exploration of teachers' interactions with the affective aspects of a developmentally responsive pedagogy.

The data clearly suggest that *what it means to be a good middle school teacher* plays a unique role in the gendered identity negotiations of the participants. We can see the degrees to which the three participants hail/resist the subject positions offered to them within middle school discourse. The language that worked to solidify the distinction between academic rigor and developmental responsiveness within middle school discourse (and their corresponding alignment with the male/female dualism) often worked to reproduce the oppressive entanglement of masculinity and the scientific enterprise (e.g., Marguerite's assertion that a mother-hen would not be a good science teacher). In other words, the everyday language these teachers used to talk about working in a middle school context would often overlap with the language they used to talk about what it means to address the issue of gender equity within their science teaching. Thus, in talking about the specifics of working in a middle school, the teachers often used language that worked to simultaneously reproduce a) an affiliation between the affective domain (embodied by middle school advisory programs) and a natural female essence as well as b) an affiliation between the cognitive domain (embodied by science) and a natural male essence. The very structure and philosophy of middle

schooling makes explicit the affective/cognitive dualism in ways that elementary, high school, or university level teaching does not.

Engaged Pedagogy

> In so much of reform-centered and change-centered writing about teaching and leading, it is as if educators only ever think, manage and plan in coldly calculative (and stereotypically masculine) ways. It is as if teachers (and indeed students) think and act but never really feel. (Hargreaves, 1998, p. 837).

Research into the emotional aspect of formal education has often emerged from feminist scholars who have valorized the role of caring within the teaching profession. These writers have illustrated "how essential caring is to good quality teaching and learning, yet how ignored and marginalized it is within the official politics of education reform and administration" (Hargreaves, 1998, p. 836). However, it is also important to see beyond the association of femininity and caring within the context of teaching. "Within the emotional/rational split, the rational has been traditionally equated with maleness and the emotional with femaleness" (Evans, 2002, p. 30-310). Indeed, we should interrupt the discourse of teacher caring so that we do not portray all females are inherently caring nor all males are inherently uncaring.

While unseating emotion from the unproductive grip of essentialism is important, it is then necessary for a reconceptualization of its role in teaching. "Good teachers are not just well-oiled machines. They are emotional, passionate beings who connect with their students and fill their work and their classes with pleasure, creativity, challenge and joy" (Hargreaves, 1998, p. 835). To a certain degree, each of the teachers in my study expressed very strong moments of pleasure and creativity and joy, not only while they were teaching science, but during conversations with me as they taught me about their lives, both in and out of the classroom.

The emotional and pleasurable aspects of teaching are eloquently expressed by bell hooks' notion of *engaged pedagogy*. Drawing on the work of Brazilian educator Paulo Freire and Buddhist monk Thich Nhat Hanh, hooks places emotion as a powerful tool for anyone to use.

> Progressive professors working to transform the curriculum so that it does not reflect biases or reinforce systems of domination are most often the individuals willing to takes the risks that engaged pedagogy requires and to make their teaching practices a site of resistance. (hooks, 1994, p. 21)

Karen Meyers (1998), a science educator, draws on hooks' engaged pedagogy in her own work, commenting that it "is surely a leap for science education in which the formal content is emphasized over the above (p. 466). Both Myers and hooks comment on the risk-taking aspects of an engaged pedagogy because of its relationship to a more traditional teacher-centered, content-transmission model of teaching. I address this notion of risk-taking later, in relation to finding a place for more progressive notions of gender within current science teaching practices.

The Authority of Experience

Drawing on experience in the classroom is a problematic issue, one that I have just begun to think about as a direct result of this study. Since experience only gains meaning through words, words which are bound within specific discourses, what does that mean for validating students' and teachers' individual experiences within the classroom? In particular, how can we validate the lived experiences of those within marginalized locations (such as non-hegemonic masculine genders) while not falling back on the trappings of essentialism?

When either Linda or Angie talks about how science intersects with real life, gender becomes enmeshed, either implicitly or explicitly. Since gender is a ubiquitous facet of our daily lives, it inevitably becomes instrumental in science narratives that are created during classroom discussions. These can be used either to reproduce or challenge the existing binary. However, in Marguerite's class, where these types of personal narratives are largely absent, the science content is presented in, what Marguerite would describe as, a very gender-blind, detached manner. There is an underlying presupposition here that the injection of gender is actually an injection of femininity, which is a political act when done in the context of a masculine discipline like science. "We perceive the world from a gendered subject position and we re-create the sexist world by re-creating

the male/female dualism in the things we say and do" (Davies, 2000a, p. 40). Not speaking of gender results in reproducing the unarticulated status quo and the entanglement of science and masculinity. However, the same risks are also involved in more constructivist, student-centered practices, that work to draw upon (even center) lived experiences. For example, within Linda's use of the "all mom's in the south make sweet tea" analogy, there are heteronormative gender expectations that come from the conventional discourse about the family. While making connections between the science content and aspects of daily life, it also inadvertently draws up (and reinforces) certain "normal" ways of being female.

M. Lederman (2003) critiques situated learning and constructivist pedagogical orientations to teaching science due to the fact that they require students to become enculturated into a predetermined scientific discourse. Instead, she calls for science teaching to be "grounded in learners' and instructors' standpoints" so that "it would validate perspectives other than those already privileged, thereby eliminating androcentrism and racism from science" (p. 605). I see this stance as being representative of current, progressive reform conversations about issues of equity in science education. I hope that my work here simultaneously validates and interrogates the use of such standpoint pedagogies.

Indeed, there emerges an ethical responsibility when centering lived experiences within the science classroom. How do we do so without silencing others through the authority of experience? I agree with hooks (1994) that the *authority of experience* can be used to both "silence and exclude" (p. 90). Since lived experiences are often given meaning through humanist language, a resulting iteration of conventional gender discourse is likely inevitable. Thus, how do teachers shape their own, and help students to shape, lived experiences so that they find connections with science without the oppressive and normative aspects of gender discourse?

Utilizing the authority of experience within science teaching has both positive and negative possibilities: a) it can validate the lived experiences of marginalized individuals, thus simultaneously giving voice and providing personal connections to the science

content; and b) it can also be used to seamlessly equate experience with truth, thus increasing the possibilities that the lived experiences of those in less marginal positions dominate what is true and legitimate. Thus, we must be aware that engaging in these practices may give voice/silence in unique ways that are not always productive.

If lived experiences are brought into the classroom, either to be used as tangential references for (or the very foundation of) co-creating scientific knowledge, an ethical responsibility surfaces to constantly interrogate the authority of those experiences. How are students *reading* the experiences that surface within classroom discussions about science? Where do they contain normative and/or subversive expectations about what it means to be a "normal" male or female or a "normal" scientist? "To theorize about identity, then, we must be concerned with how language positions experience as it inscribes the self" (Britzman, 1992, p. 32).

Teacher Vertigo

Hesitant and arguing voices within each of the participants highlighted the unstable language and cultural practices that underlie their performances/doing of *gender*, *scientist*, and *teacher*. Indeed, performing a *female science teacher* identity relies on certain assumptions about science, about femininity, and about teaching. As these are disrupted by emerging and competing discourses, so are the teachers' assumptions about *what they do* and *who they are*. Subsequently, it is useful to reflect upon the different responses the teachers had to this disruption. In particular, I focus first on Marguerite's dizzying and unsettling reaction, which I refer to as *teacher vertigo* – a feeling that emerges when substantive disruptions occur within the language and cultural practices one uses for identity negotiations. For example, in Marguerite's case, we saw shifts in her notions of subject-specialization, teaching, and gendered self. [I borrow this notion of "vertigo" from Connell's (1995) and Risman's (1998) discussions about the undoing of the gender structure, as it is currently conceived, resulting in the uncomfortable experience of "gender vertigo."]

Palmer (1998) writes that we as teachers are "drawn to a body of knowledge because it [sheds] light on our identity as well as on the world" (p. 25). I agree with this

association between content and identity, but would argue that rather than simply shedding light on a preexisting essence of identity, it actually works to construct us as we hail it into our lives. Central to Marguerite's vertigo is the contradiction she finds between the subject positions offered her within middle school science teaching – the dualism between cognitive rigor and affective responsiveness. Her prior identity as "a science teacher" is infringed upon by novel discursive expectations.

In her exploration of the influence of subject-specific departments on secondary teachers' professional lives, Little (1995) comments,

> 'Subject' is not merely the stuff of curriculum, texts, and tests; it is more fundamentally a part of being a teacher. Teachers experience shifts in the social organization of their work not only as a demand on their subject expertise, but as a fundamental matter of professional identity, community, and authority. (p. 184-185)

The creation of a teacher identity can be accomplished via the language and cultural practices of a particular discipline (e.g., science). "Just as teachers make assertions about what is and is not 'the subject,' they also make assertions about who they are, and are not, as teachers" (Little, 1995, p. 186). As this pool of discipline-specific resources for identity negotiation is infringed upon by competing discourses (e.g., feminist notions of gender equity or affective aspects of middle level education), there is a challenge to both the teacher's subject and her own subjectivities. "We desire hearing only certain ('scientific') stories about the world in order to affirm our knowledges, identities, and practices" (Kumashiro, 2001, p. 6-7). There is an alluring comfort in the stability a teacher finds through the construction of self through subject specialization.

Hargreaves, Earl, and Ryan (1996) relate Durkheim's warning that "tampering with such norms can create a sense of panic among teachers, as they hold the 'sacred' to be unquestionably true" (Hargreaves et al., 1996, p. 86). Indeed, during our last meeting together, Marguerite made it very clear that she was feeling "a loss of identity," in particular because of her shift from high school to middle school teaching.

> As the debate swings between the teacher-centered model, with its concerns for rigor, and the student-centered model, with its concern for active learning, some of us are torn between the poles. We find insights and excesses in both approaches, and neither seems adequate to the test. The problem, of course, is that we are caught in yet another either-or. Whiplashed, with no way to hold the tension, we fail to find a synthesis that might embrace the best of both. (Palmer, 1998, p, 116)

I would add that subject-centeredness and student-centeredness also contain gendered associations that draw upon commonsense notions of teacher authority and caring. However, I do agree with Palmer that our lives never fit into dualistic modes of thought and this applies to our gender as well as our teaching. Poststructuralist thought not only permits a window beyond the limits of the gender dualism, but may also be a way out of the cognitive/affective categories that are creating this whiplashed feeling for Marguerite.

Compounding this unsettling shift, Kumashiro describes the upsetting and discomforting experience of "learning that the very ways in which we think and do things is not only partial but oppressive" (p. 8). Marguerite had very emotional reactions to the findings we talked about in terms of the enmeshment of masculinity and science, especially in relation to her own gendered practices in the classroom. What teaching can actually foster (beyond traditional notions of content transmission) became much more apparent and disquieting for Marguerite.

Finally, poststructural problematizing of what it means to be male and female can also create a sense of "gender vertigo, the dizziness that we would feel without gendered selves and interactional expectations to give meaning to our lives" (Risman, 1998, p. 151). The ubiquitous nature of commonsense discourse about gender (i.e., the hierarchical and heteropatriarchal dualism) creates a taken-for-granted situation about what it means to be male and female. When that humanistic notion is disturbed, one's sense of self is also disturbed.

Such *disruption on top of disruption on top of disruption* may be too distracting and unsettling to occur simultaneously within any one moment in a teacher's professional

life. How a teacher such as Marguerite works through this teacher vertigo is also contingent on the discourses available at this time. Whereas Angie and Marguerite have incorporated feminist and/or middle school philosophy, Marguerite is still searching for a way of knowing that will help her to appease these disruptions. Kumashiro (2000) contends, "Learning to overcome one's desire for the comforting repetition of normative knowledges, identities, and experiences involves learning to desire the discomforting process of unlearning. Desiring change involves *desiring to learn through crisis*" (p. 8). However, he adds that this type of engagement is the exception to the rule since "what happens in classrooms is often not crisis, and not change, but rather, repetition and comfort for the student and teacher" (p. 8). The question then arises as to how feminist poststructuralism can then lead to greater agency.

Power and Resistance within Discursive Authorship

Tisdell (1998) remarks, "As learners examine the impact of social systems of privilege and oppression on their own identity, inducing their beliefs and values, the 'discourse' is disrupted, thus shifting their identity, as well as increasing their capacity for agency" (p. 146). I agree with Tisdell but question her use of the word "capacity" which suggests that individuals can either be empty or full of a *thing* called agency. Rather, I see an individual's engagement with poststructural notions of identity as unveiling the (usually concealed) power/resistance of agency/authorship that continually exists as discourses are hailed and/or refuted during the moment-to-moment negotiations of identity. Thus, what increases is not *capacity* for agency, but the *visibility* of agency.

The agency to overcome *teacher vertigo* and to *learn through crisis* can emerge from a deeper understanding of being subjected through a particular discourse. Rather than a passive event, discursive positioning can become a very powerful experience, once it is unearthed from its humanist hiding place.

> By making clear the way in which a person is subjected by discourse, poststructuralist theory shows how agency is fundamentally illusory. However, it opens up another possibility, related to the idea of the speaking/writing subject

> who can use some of the understandings of poststructuralist theory itself to regain another kind of agency. (Davies, 2000a, p. 60)

Agency thus becomes palpable through an individual's *authorship of self* within a particular discourse. It is access to a way of defining/negotiating an identity. However, one needs to first make visible the simultaneous empowering and limiting aspects of discursive positioning. The dualistic nature of subjection (i.e., the power to define oneself in a certain way and the simultaneous limitations to not define oneself in other ways) allows the individual the power to resist inscription and to challenge the available "normal" subject positions. Davies (2000a) also describes this as the *dual sense of appropriation* where "it is both the case that being an individual involves the appropriation of the words of the collectives of which one is a member, and that that collective appropriates the individual at the moment that the individual speaks" (p. 61). Hailing the discourse of science, for instance, means to take up its language and cultural practices. In other words, the individual appropriates the tools of science as the individual is appropriated by science. This process calls up prior language, knowledge, and other cultural aspects of science in order to create an intelligible identity. In her discussion of gender construction within physical education in Australia, Wright (1995) comments:

> Teachers and students in their interactions with each other draw on the institutional and cultural resources provided by their experience of other situations (other lessons, other experiences of physical activity outside schools, and so on); however in their interactions they have the potential not only to reproduce those discourses and practices (e.g., patriarchal expectations concerning femininity and masculinity) but also to be productive by challenging them. (p. 9)

This is similar to Butler's *iterability*, which is pivotal to performing gender. Rather than viewing power as a formidable, exterior, negative influence, Butler "shares with Foucault the view that power is not only prohibitive but also enabling" (Alsop, Fitzsimons, and Lennon, 2002, p. 100). While nonconformist gender performances can result in social punishment, they themselves are also powerful vehicles for social change. In order to

explicate Butler's push for social change through performativity, the notion of *iterability* must be revisited. When performances of gender (teaching) (science) are conducted, individuals engage in iterability by repeating and calling up previous notions of gender (teaching) (science) within certain situations. "In different contexts and times a repetition can take on a different meaning, undermining or subverting the dominant norms" (Alsop et al., 2002, p. 103). Iterability creates the freedom for change to occur and for the dominant gender (teaching) (science) dogma to be challenged.

To *do* science/gender differently is to "take up the act of *author*ship, of speaking and writing in ways that are disruptive of current discourses, that invert, invent, and break old bonds, that create new subject positions that do not take their meaning from their genitalia and what they have come to signify" (Davies, 2000a, p. 66). As an example, Angie's creative use of feminist narratives within science classroom discussions can be seen as subversive authorship within the discourse of science. Her agency emerges from the ability to hail the discourse of science and then reconfigure less hegemonic identities using the existing language and practices.

> Agency is never freedom from discursive constitution of self but the capacity to recognize that constitution and to resist, subvert, and change the discourses themselves through which one is being constituted. It is the freedom to recognize multiple readings such that no discursive practice, or positioning within it by powerful others, can capture and control one's identity. (Davies, 2000a, p. 67)

Implications for (my role in) Teacher Education

How do these teachers' gendered science teaching subjectivities, under the influence of various discourses, work to inform what they can and cannot say/do about gender in their science classrooms? These ideas are brought to light via poststructuralist discussions about what it means to be a "normal" female middle school science teacher. I agree with Adams (1997) that the use of poststructuralism can move teacher education beyond the "technocratic and rationalist view of teaching" (p. 119), which may be especially evident in science classrooms.

I begin this section by putting my future self under this lens. Foregrounding and problematizing my positionality as a researcher, as I do within the confines of this dissertation, will not feel the same as doing so as an instructor. The relative safety that I find within the written word may not hold true in front of a class of preservice teachers. Using my instructor positionality as a teaching tool (Barton, 1998a; Ropers-Huilman, 1998) may prove more unsettling and unsafe. But as Tisdell (1998) accurately puts it, "In good postmodern form, poststructural feminist educators would deconstruct the notion of the 'safe-unsafe' learning environment and the question perhaps becomes 'safe for whom?' and 'under what conditions?'" (p. 149). Unequal power relations often grant instructors the ability to declare what knowledge and whose experiences are valid and true. Thus, to question the allure of teacher authority, especially in the context of a beginning professor, will be difficult. In addition, I will need to ask myself how to temper the authority of my own experiences so that I do not a) inadvertently silence certain students or b) only view silence in a deficit light as "a lack of voice or a lack of power" (Tisdell, 1998, p. 151).

Brickhouse, Lowery, and Shultz (2000) make an important conclusion by declaring, "When teaching girls science and trying to explain why it is they are or are not doing well in science, we need to know more than that they are girls. We need to know what kinds of girls they are" (p. 457). I extend this to my future students within science education methods courses – what types of men and women are they and how does my teaching limit/expand on those identities?

> There is a problem when the teacher's identity is taken for granted, when it is approached in some a priori way, as an outcome of pedagogical skills, an aftermath of being there in the classroom, or as a function of experience. This a priori view is embedded in the normative discourse of teacher education where the glorification of first-hand experience non-problematically scripts teacher identity as synonymous with the teacher's role and function (Britzman, 1992, p. 23)

One can never *fully* or *eventually* "become" a teacher by accumulating experiences in the classroom. Indeed, my job as a science teacher educator is not to merely provide a body of extant "how to be a science teacher" information which students will use to "build" a predetermined teacher-hood. "The problem of identity in learning to teach begins when it is positioned as a place of arrival. This essentialist view is only capable of assuring identity as a noncontradictory and fixed essence" (Britzman, 1992, p. 42).

The same is true with respect to my desires to challenge science teachers to engage in less oppressive pedagogies, with particular emphasis on gender. Professional development experiences that *produce the proof* of the androcentric and patriarchal nature of science, through readings or through examples of female non-participation, merely scratch the surface. I can have them read Kuhn or Harding or Fox Keller, or a variety of other readings that question science's heteropatriarchy or the mythic notion of a value-fee, unbiased, objective scientific enterprise. However, that "set list" of proof means so many different things to so many people. I know that if Marguerite, Angie, and Linda were to participate in an inservice concerning gender equity in science education, regardless of its philosophical approach, each would receive a different message. There is no such thing as a "generic woman" or "generic adult learner" (Tisdell, 1998) to whom we can uniformly teach.

By promoting an understanding of the interconnectedness of teaching practices and personal identity negotiations, feminist poststructuralism may be able to reconfigure professional development (and preservice science teacher education) into more of a personal engagement with one's own shifting identity, rather than a mechanistic learning/changing of teaching tools. This has greatly affected my perceptions about my own role as a teacher educator, especially within the context of preservice teacher education. Just as I have interrogated the ways in which science teaching is involved in constructing gendered identities, I would like to carry the same lens into my teaching about teaching. What subject positions do I make facilitate within my representation of what it means to be a science teacher? The discourse of preservice science teacher education too provides a range of normal means of constructing a teacher identity. How

do I constantly challenge the feminization of teaching, the masculinization of science, and the patriarchal nature of the gender dualism all within the context of ushering in others into a profession that I love? How do I impart the notion of authority that Davies (2000a) describes as *author*ity – "with emphasis on authorship, the capacity to speak/write and be heard, to have voice, to articulate meanings from within the collective discourses and beyond them" (p. 68)? A large part rests within my reconceptualizing of teacher education knowledge not as an extant body of facts, but as multiple discourses, each with the capacity to restrict/expand and/or sustain/challenge the very identities of the students I encounter.

> Knowledge of more than one discourse and the recognition that meaning is plural allows for a measure of choice on the part of the individual, and even where choice is not available, resistance is still possible. (Weedon, 1987, p. 102)

Part of the answer also rests in me keeping in mind Angie's powerful and passionate feminist narratives, Marguerite's honesty about her fears and frustrations about change, Linda's enthusiastic embracing of middle school philosophy, and how each of them strived to be effective and content science teachers.

APPENDIX

INFORMED CONSENT FORM AND IRB APPROVAL LETTER

Informed Consent Form

I freely and voluntarily and without element of force or coercion, consent to be a participant in the research project entitled "Doing Gender / Teaching Science: Feminist Critical Ethnographies."

Scott Sowell, a doctoral student in science education at Florida State University, is conducting this research. I understand the purpose of his research project is to better understand the relationship between gender and teaching/learning science at the secondary level. I understand that if I participate in the project I will be asked questions regarding my beliefs about teaching and learning science, as well as about gender.

I understand I will be frequently observed during my classroom teaching over a time span of several months. Interviews will be used by the researcher to better understand these classroom observations and to gain insight into my beliefs. I understand that I will be tape recorded by the researcher during these interviews. The tapes will be stored in a locked filing cabinet. I understand that only the researcher will have access to these tapes and that they will be destroyed by May 1, 2004.

I understand my participation is totally voluntary and I may stop participation at anytime. All my responses will be kept confidential and identified by a subject code number. My name will not appear on any of the results. The information obtained during the course of the study will remain confidential, to the extent allowed by law.

I understand there are benefits for participating in this research project. First, my own awareness about my teaching practices may be increased. Also, I will be providing educational researchers with valuable insight into the relationship between gender and science education. This knowledge can assist in addressing the issue of gender equity within science education.

I understand that this consent may be withdrawn at any time without prejudice, penalty or loss of benefits to which I am otherwise entitled. I have been given the right to ask and have answered any inquiry concerning the study. Questions, if any, have been answered to my satisfaction.

I understand that I may contact Scott Sowell, Florida State University, Department of Middle and Secondary Education, 209 Carothers, at (904) 644-6553, or via email at scottpsowell@hotmail.com, for answers to questions about this research or my rights.

I have read and understand this consent form.

_____ _____

(Signature of Participant) (Date)

Florida State
UNIVERSITY

Office of the Vice President
For Research
Tallahassee, Florida 32306-2763
(850) 644-8673 · FAX (850) 644-4392

APPROVAL MEMORANDUM

Human Subjects Committee

Date: 10/28/2003

Scott Sowell
1546 Rankin Ave
Tallahassee, FL 32310

Dept.: **Middle & Secondary Education**

From: **David Quadagno, Chair** DQ/ph

Re: **Use of Human Subjects in Research**
Doing Gender / Teaching Science: Feminist Critical Ethnographies

The forms that you submitted to this office in regard to the use of human subjects in the proposal referenced above have been reviewed by the Secretary, the Chair, and two members of the Human Subjects Committee. Your project is determined to be exempt per 45 CFR § 46.101(b) 2 and has been approved by an accelerated review process.

The Human Subjects Committee has not evaluated your proposal for scientific merit, except to weigh the risk to the human participants and the aspects of the proposal related to potential risk and benefit. This approval does not replace any departmental or other approvals, which may be required.

If the project has not been completed by **10/27/2004** you must request renewed approval for continuation of the project.

You are advised that any change in protocol in this project must be approved by resubmission of the project to the Committee for approval. Also, the principal investigator must promptly report, in writing, any unexpected problems causing risks to research subjects or others.

By copy of this memorandum, the chairman of your department and/or your major professor is reminded that he/she is responsible for being informed concerning research projects involving human subjects in the department, and should review protocols of such investigations as often as needed to insure that the project is being conducted in compliance with our institution and with DHHS regulations.

This institution has an Assurance on file with the Office for Protection from Research Risks. The Assurance Number is IRB00000446.

Cc: Dr. Alejandro Gallard
HSC No. 2003.527

REFERENCES

Abd-El-Khalick, F., & Akerson, V. L. (2004). Learning as conceptual change: Factors mediating the development of preservice elementary teachers' views of nature of science [Electronic Version]. *Science Education*, *88* (5), 1-26. Retrieved September 4, 2004 from http://www3.interscience.wiley.com/cgi-bin/abstract/109086403/ABSTRACT

Adkins, A. & Gunzenhauser, M. G. (1999). Knowledge construction in critical ethnography. *Educational Foundations*.

Alsop, R., Fitzsimons, A., & Lennon, K. (2002). *Theorizing gender*. Cambridge, UK: Polity Press.

Anfara, V. A. & Brown, K. M. (2000). An unintended consequence of a middle school reform: advisories and the feminization of teaching. *Middle School Journal*, (jan).

Anfara, V. A., & Waks, L. (2000). Resolving the tension between academic rigor and developmental appropriateness, Part I. *Middle School Journal, 32* (2), 46-51.

Anfara, V. A., & Waks, L. (2001). Resolving the tension between academic rigor and developmental appropriateness, Part II. *Middle School Journal, 32* (3), 25-30.

Association of Supervision and Curriculum Development. (1975). *The middle school we need*. Washington, D.C.: Author.

Anzaldúa, G. (1987). *Borderlands/La frontera: The new mestiza*. San Francisco: Spinsters/Aunt Lute.

Apple, M. (1986). *Teachers and texts: A political economy of class and gender relations in education*. New York: Routledge.

Bailey, B.L, Scantlebury, K.C., & Johnson, E.M. (1999). Encouraging the beginning of equitable science teaching practice: Collaboration is the key. *Journal of Science Teacher Education, 10*, 159-173.

Baker, D. (2002). Where is gender and equity in science education? *Journal of Science Teacher Education, 39*, 659-663.

Baker, D. & Leary, R. (1995). Letting girls speak out about science. *Journal of Research in Science Teaching, 32*, 3-27.

Bakhtin, M. M. (1986). *The dialogic imagination*. (C. Emerson and M. Holqust, Trans.). Austin: University of Texas Press.

Barton, A. C. (1998a). *Feminist science education.* New York: Teachers College Press.

Barton, A. C. (1998b). Teaching science with homeless children: Pedagogy, representation, and identity. *Journal of Research in Science Teaching, 35*, 379-394.

Barton, A. C. (2001). Science education in urban settings: Seeking new ways of praxis through critical ethnography. *Journal of Research in Science Teaching, 38*, 899-917.

Belenky, M. F., Clinchy, B. M., Goldberger, N. R., & Tarule, J. M. (1986). *Women's ways of knowing: The development of self, voice, and mind*. New York: Basic Books.

Bogdan, R. C., & Biklen, S. K. (1998). *Qualitative research for education: An introduction to theory and methods.* Boston: Allyn and Bacon.

Brandt, C. B. (2004). *To walk in beauty: Performance, gender, and discursive space in western science.* Paper presented at the annual meeting of the National Association of Research in Science Teaching, Vancouver.

Brickhouse, N.W. (2001). Embodying science: a feminist perspective on learning. *Journal of Research in Science Teaching, 38*, 282-295.

Brickhouse, N.W., Lowery, P., & Schultz, K. (2000). What kind of a girl does science? The construction of school science identities. *Journal of Research in Science Teaching, 37*, 441-458.

Britzman, D. P. (1992). The terrible problem of knowing thyself: Toward a poststructural account of teacher identity. *Journal of Curriculum Theorizing, 9* (3), 23-46.

Britzman, D. P. (2000). "The question of belief": Writing poststructural ethnography. In E. A. St. Pierre & W. S. Pillow (Eds.), *Working the ruins: Feminist poststructural theory and methods in education* (pp. 27-40). New York: Routledge.

Butler, J. (1999). *Gender trouble* (10th Anniversary ed.). New York: Routledge.

Carnegie Council on Adolescent Development. (1989). *Turning points: Preparing American youth for the 21st century*. *The report of the task force on education of young adolescents*. Washington DC: Author.

Carspecken, P.F. (1996). *Critical ethnography in educational research*. New York: Routledge.

Collins, P. H. (1998). *Fighting words: Black women & the search for justice*. Minneapolis: University of Minnesota Press.

Collins, P. H. (2000). What's going on? Black feminist thought and the politics of postmodernism.. In E. A. St. Pierre & W. S. Pillow (Eds.), *Working the ruins: Feminist poststructural theory and methods in education* (pp. 41-73). New York: Routledge.

Connell, R. W. (1987). *Gender & power: Society, the person and sexual politics*. Stanford, CA: Stanford University Press.

Connell, R. W. (1995). *Masculinities*. Berkeley: University of California Press.

Connell, R. W. (1998). R.W. Connell's "Masculinities": Reply. *Gender & Society, 12*, 474-477.

Cooney, M. H. & Bittner, M. T. (2001). Men in early childhood education: Their emergent issues. *Early Childhood Education Journal, 29*, 77-82.

Crotty, M. (1998). *The foundations of social research: Meaning and perspective in the research process.* London: SAGE Publications.

Davies, B. (1989). The discursive production of the male/female dualism in school setting. *Oxford Review of Education, 15* (3), 229-241.

Davies, B. (2000a). *A body of writing, 1990-1999*. Walnut Creek, CA: Altamira Press.

Davies, B. (2000b). Eclipsing the constitutive power of discourse. In E. A. St. Pierre & W. S. Pillow (Eds.), *Working the ruins: Feminist poststructural theory and methods in education* (pp. 27-40). New York: Routledge.

Davies, B., & Banks, C. (1992). The gender trap: a feminist poststructuralist analysis of primary school children's talk about gender. *Journal of Curriculum Studies, 24* (1), 1-25.

Demastes-Southerland, S., Good, R., & Peebles, P. (1995). Students' conceptual ecologies and the process of conceptual change in evolution. *Science Education*, *79*(6), 637-666.

Derrida, J. (1976). *Of grammatology* (G. Spivak, Trans.). Baltimore: Johns Hopkins University Press.

de Saussure, F. (1959). *Course in general linguistics.* London: Fontana.

Emerson, R. M., Fretz, R. I., & Shaw, L. L. (1995). *Writing ethnographic fieldnotes*. Chicago: University of Chicago Press.

Evans, K. (2002). *Negotiating the self: Identity, sexuality, and emotion in learning to teach.* New York: RoutledgeFalmer.

Fenstermaker, S., West, C., & Zimmerman, D. H. (2002). Gender inequality: New conceptual terrain. In Fenstermaker, S. & West, C. (Eds.), *Doing gender, doing difference: Inequality, power, and institutional change* (pp. 25-39). New York: Routledge.

Firebaugh, G. (2001). The ASR review process. *American Sociological Review, 66*, 619-621.

Fontana, A., & Frey, J. H. (2000). The interview: From structured questions to negotiated text. In Denzin, N.K. & Lincon, Y. S. (Eds.), *Handbook of qualitative research* (2nd ed.). (pp. 645-672). Thousand Oaks, CA: Sage Publications, Inc.

Foucault, M. (1990). *The history of sexuality, vol. 1: An introduction*. (Robert Hurley, Trans.). New York: Random House. (Original work published in 1976)

Keller, E. F. (1985). *Reflections on gender and science*. New Haven: Yale University Press.

Francis, B. (1999). Modernist reductionism or post-structuralist relativism: can we move on? An evaluation of the arguments in relation to feminist educational research. *Gender and Education, 11* (4), 381-393.

Freire, P. (2003). *Pedagogy of the oppressed*. (30th Anniversary ed.). (Myra Bergman Ramos, Trans.). New York: Continuum.

Gess-Newsome, J., Southerland, S. A., Johnston, A. & Woodbury, S. (2003). Educational reform, personal practical theories, and dissatisfaction: The Anatomy of change in college science teaching. *American Educational Research Journal, 40*(3), 731-767.

Gilbert, J. (2001). Science and its 'Other': looking underneath 'woman' and 'science' for new directions in research on science education. *Gender and Education, 13*, 291-305.

Gilligan, C. (1982). *In a different voice*. Cambridge, MA: Harvard University Press.

Giroux, H. A. (1988). *Teachers as intellectuals.* Granby, MA: Bergin & Garvey Publishers, Inc.

Giroux, H. A., & McLaren, P. (1986). Teacher education and the politics of engagement: The case for democratic schooling. *Harvard Educational Review, 56* (3), 213-238.

Habermas, J. (1987). *The theory of communicative action, volume two: Lifeworld and system: A critique of functionalist reason*. (Thomas McCarthy, Trans.). Boston: Beacon Press.

Hall, G. (1904). *Adolescence: Its psychology, and its relations to physiology, anthropology, sociology, sex, crime, religion, and education*. New York: D. Appleton & co.

Hammrich, P. L., Richardson, G. M., & Livingston, B. (2001, March). *The Sisters in Science program: Teachers reflective dialogue on confronting the gender gap*. Paper presented at the annual meeting of the National Association of Research in Science Teaching, Boston.

Harding, S. (1986). *The science question in feminism*. Ithaca, NY: Cornell University Press.

Harding, S. (1991). *Whose science? Whose knowledge? Thinking from women's lives*. Ithaca, NY: Cornell University Press.

Harding, S. (1997). Comment on Hekman's "Truth and method: Feminist standpoint theory revisited": Whose standpoint needs the regimes of truth and reality? *Signs, 22*, 382-392.

Harding, S. (1998). *Is science multicultural? Postcolonialisms, feminisms, and epistemologies*. Bloomington, IN: Indiana University Press.

Harding, S. (2000). Gender, development, and post-Enlightenment philosophies of science. In Narayan, U. & Harding, S. (Eds.), *Decentering the center: Philosophy for a multicultural, postcolonial, and feminist world* (pp. 240-261). Bloomington, IN: Indiana University Press.

Hargreaves, A. (1998). The emotional practice of teaching. *Teaching and Teacher Eductaion, 14* (8), 835-854.

Hartsock, N. (1983). The feminist standpoint: Developing the ground for a specifically feminist historical materialism. In Harding and Hintikka (Eds.), *Discovering reality* (pp. 283-310). Dordrecht, Holland: D. Reidel Publishing Company.

Hartsock, N. (1997). Comment on Hekman's "Truth and method: Feminist standpoint theory revisited": Truth or justice? *Signs, 22*, 367-374.

Henwood, E., & Miller, K. (2001). Boxed in or coming out? On the treatment of science, technology and gender in educational research. *Gender and Education, 13* (3), p. 237-242.

Hochschild, A. R. (1983a). *The managed heart: Commercialization of human feeling*. Berkeley: University of California Press.

Hochschild, A. R. (1983b). Smile wars: Counting the causalities of emotional labor. *Mother Jones,* December, 35-43.

hooks, b. (1994). *Teaching to transgress: Education as the practice of freedom*. New York: Routledge.

Hughes, G. (2000). Marginalization of socioscientific material in science-technology-society science curricula: some implications for gender inclusivity and curriculum reform. *Journal of Research in Science Teaching, 37* (5), 426-440.

Hughes, G. (2001). Exploring the availability of student scientist identities within curriculum discourse: an anti-essentialist approach to gender-inclusive science. *Gender and Education, 13* (3), 275-290.

Jackson, A. Y. (2004). Performativity identified. *Qualitative inquiry, 10* (5), p. 673-690.

Johnston, A., & Southerland, S.A. (2002, April). *The impact of learners' conceptual ecologies and their conceptual change in the nature of science.* Paper presented at the annual meeting of National Association for Research in Science Teaching International Conference, New Orleans, LA.

Jones, L.S., Letts, W., Lewis, B., & Rodriguez-Munoz, M. (1998). *Working and learning on the margins: Experiencing doctoral programs in science education as nontraditional graduate students.* Paper presented at the annual meeting of the National Association of Research in Science Teaching, San Diego.

Jones, M. G., & Wheatley, J. (1990). Gender differences in teacher-student interactions in science classrooms. *Journal of Research in Science Teaching, 27*, 861-874.

Keller, E. F. (1985). *Reflections on gender and science*. New Have: Yale University Press.

Keller, E.F. (1986). How gender matters: Or why it's so hard for us to count past two. In J.Harding (Ed.), *Perspectives on gender and science* (pp. 168–183). London: Falmer Press.

Kennelly, I., Merz, S. N., & Lorber, J. (2001). What is gender? *American Sociological Review, 66*, 598-605.

Klein, D. (1996, April). *Convergent inquiries: Gloria Anzaldúa's "Mestiza" consciousness and critical ethnography.* Paper presented at the annual meeting of the American Educational Research Association, New York.

Kumashiro, K. (2001). "Posts" perspectives on anti-oppressive education in social studies, english, mathematics, and science classrooms. *Educational researche*r, *3*0 (3), 3-12.

Lareau, A. (2000). *Home advantage: Social class and parental intervention in elementary education.* Updated edition. Rowman and Littlefield.

Lave, J. (1992, April). *Learning as participation in communities of practice*. Paper presented at the annual meeting of the American Educational Research Association, San Francisco.

Lederman, M. (2003). Gender/InEquity in science education: A response. *Journal of Research in Science Teaching, 40* (6), 604-606.

Lederman, N. G. (1992). Students' and teachers' conceptions of the nature of science: A review of the research. *Journal of Research in Science Teaching, 29*, 331-359.

Lederman, N. G., Abd-El-Khalick, F., Bell, R. B., & Schwartz, R. S. (2002). Views of nature of science questionnaire: Toward valid and meaningful assessment of learners' conceptions of nature of science. *Journal of Research in Science Teaching, 29*, 331-359.

Letts, W. J. (1997). *Gender (in)forms self image: The case of five male secondary science teachers.* Paper presented at the annual meeting of the American Educational Research Association, Chicago.

Letts, W. J. (1999). *Teaching science / learning gender: Preservice elementary teachers write about science, gender, and identity.* Paper presented at the annual meeting of the American Educational Research Association, Montreal, Canada.

Letts, W. J. (2001). When science is strangely alluring: interrogating the masculinist and heteronormative nature of primary school science. *Gender and Education, 13* (3), 261-274.

Lewin, E. (1995). Writing lesbian ethnography. In Behar, R. & Gordon, D. A., (Eds.), *Women writing culture* (pp. 322-335). Berkeley: University of California Press.

Lincon, Y. S., & Guba, E. G. (2000). Paradigmatic controversies, contradictions, and emerging influences. In Denzin, N.K. & Lincon, Y. S. (Eds.), *Handbook of qualitative research* (2nd ed.) (pp. 163-188). Thousand Oaks, CA: Sage Publications, Inc.

Little, J. W. (1995). Subject affiliation in high schools that structure. In Siskin, L. S. & Little, J. W. (Eds.), *The subjects in question: Departmental organization and the high school* (pp. 172-200). New York: Teachers College Press.

Lorber, J. (2000). Using gender to undo gender: A feminist degendering movement. *Feminist Theory, 1*, 79-95.

Lorde, A. (1984). *Sister outsider: Essays and speeches by Audre Lorde*. Freedom, CA: The Crossing Press.

MacLeod, J. (1995). *Ain't no makin' it: Aspirations and attainment in a low income neighborhood.* Second edition. Boulder, CO: Westview Press, Inc.

Manning, M. L. (1993). *Developmentally appropriate middle level schools*. Wheaton, MD: Association for Childhood Education International.

Manning, M. L. (2000). A brief history of the middle school. *Clearing House, 73*(4), 192.

Manning, M. L. (2002). Revisiting developmentally appropriate middle level schools. *Childhood Education, 78*(4), 225-227.

Mason, C. L., & Kahle, J. B. (1988). Student attitudes toward science and science-related careers: A program designed to promote a stimulating gender-free learning environment. *Journal of Research in Science Teaching, 26*, 25-39.

McComas, W. F. (1998). The principal elements of the nature of science: Dispelling the myths. In W. F. McComas (Ed.), *The nature of science in science education* (pp. 53-70). Netherlands: Kluwer.

McGinnis, J.R. & Pearsall, M. (1998). Teaching elementary science methods to women: a male professor's experience from two perspectives. *Journal of Research in Science Teaching*, *35*, 919-949.

Merriam, S. B. (1998). *Qualitative research and case study applications in education*. San Francisco: Jossey-Bass Publishers.

Meyer, K. (1998). Reflections on being female in school science: Toward a praxis of teaching science. *Journal of Research in Science Teaching*, *35* (4), 463-471.

Miller, E. M., & Costello, C. Y. (2001). The limits of biological determinism. *American Sociological Review, 66*, 592-598.

Moloney, M., & Fenstermaker, S. (2002). Performance and accomplishment: Reconciling feminist conceptions of gender. In Fenstermaker, S. & West, C. (Eds.), *Doing gender, doing difference: Inequality, power, and institutional change* (pp. 189-204). New York: Routledge.

Moore, F. (2003). Professional development and poststructural analysis: Stories of African American science teachers. (Doctoral dissertation, Florida State University, 2003). *Dissertation Abstracts International, 64*, 3585.

National Middle School Association. (1982). *This we believe*. Columbus, Ohio: author.

National Middle School Association. (1995). *This we believe: Developmentally responsive middle level schools.* Columbus, Ohio: author.

National Middle School Association. (1996). *NMSA research summary #9: Advisory programs*. Retrieved July 7, 2004 from: http://nmsa.org.

Newton, E. (2000). *Margaret Mead made me gay: personal essays, public ideas*. Durham, N. C.: Duke University Press.

Noddings, N. (1984). *Caring: A feminine approach to ethics and moral education*. Berkeley: University of California

Oakley, A. (1981). Interviewing women: A contradiction in terms. In H. Roberts (Ed.), *Doing feminist research* (pp. 30-61). London: Routledge & Kegan Paul.

Olesen, V. L. (2000). Feminisms and qualitative research at and into the millennium. In Denzin, N.K. & Lincon, Y. S. (Eds.), *Handbook of qualitative research* (2nd ed.) (pp. 215-255). Thousand Oaks, CA: Sage Publications, Inc.

Palmer, P. J. (1998). *The courage to teach: Exploring the inner landscape of a teacher's life.* San Francisco, CA: Jossey-Bass Inc.

Pinar, W. F., Reynolds, W. M., Slattery, P. & Taubman, P. M. (1996). *Understanding curriculum: An introduction to the study of historical and contemporary curriculum discourses.* New York: Peter Lang.

Posner, G. J., Strike, K. A., Hewson, P. W., & Gertzog, W. A. (1982). Accommodation of a scientific conception: Toward a theory of conceptual change. *Science Education, 66*, 211-227.

Qualitative Solutions & Research Pty Ltd. (1999). QSR NUD*IST Vivo (Version 1.0.118) [Computer software].

Rennie, L. J. (1998). Gender equity: toward clarification and research direction for Science teacher education. *Journal of Research in Science Teaching*, *35*, 951-961.

Risman, B. J. (1998). *Gender vertigo: American families in transition.* New Haven, CT: Yale University Press.

Risman, B. J. (2001). Calling the bluff of value-free science. *American Sociological Review, 66*, 605-611.

Rofes, E. (1999). What happens when the kids grow up? The long-term impact of an openly gay teacher on eight students' lives. In Letts, W. J. & Sears, J. T. (Eds.), *Queering elementary education: Advancing the dialogue about sexualities and schooling* (pp. 83-93). Lanham, MD: Rowman & Littlefield Publishers, Inc.

Ropers-Huilman, B. (1997). Constructing feminist teachers: complexities of identity. *Gender and Education, 9* (3), 327-343.

Ropers-Huilman, B. (1998). *Feminist teaching in theory and practice: Situating power and knowledge in poststructural classrooms*. New York: Teacher College Press.

Roulston, K. & Mills, M. (2000). Male teachers in feminised teaching areas: marching to the beat of the men's movement drums? *Oxford Review of Education, 26,* 221-237.

Sears, J. (1991). *Growing up gay in the south: Race, gender, and journeys of the spirit*. New York : Haworth Press.

Sisters in Science. (1999). *Sisters in Science: Intergenerational partnerships in science, engineering, and mathematics education.* Retrieved June 4, 2003, from http://www.temple.edu/sis/

Smith, D. (1987). *Everyday world as problematic*. Boston: Northeastern University Press.

Smith, D. (2002). Foreword. In Fenstermaker, S. & West, C. (Eds.), *Doing gender, doing difference: Inequality, power, and institutional change*. (pp. ix-xii). New York: Routledge.

Southerland, S.A., Settlage, J., Johnston, A., Scuderi, A., & Meadows, L. (2003, March). *Development and application of a web-based NOS instrument: Making students aware of their NOS conceptions*. Paper presented at the annual meeting of National Association for Research in Science Teaching International Conference, Philadelphia, PA.

Stevenson, C. (1998). *Teaching ten to fourteen year olds.* (2nd ed.). New York: Addison Wesley Longman, Inc.

St. Pierre, E. A. (2000). Poststructural feminism in education: An overview. *Qualitative studies in education, 13* (5), 477-515.

Stromquist, N.P. (1998). Roles and statuses of women. In Stromquist, N.P. & Monkman, K. (Eds.), *Women in the third world: An encyclopedia of contemporary issues* (pp. 3-12), New York: Garland.

Thomas, J. (1993). *Doing critical ethnography*. Newbury Park, CA: SAGE Publications, Inc.

Tisdell, E. J. (1998). Poststructural feminist pedagogies: The possibilities and limitations of feminist emancipatory adult learning theory and practice. *Adult Education Quarterly, 48* (3), 139-156.

Tolley, K. (2003). *The science education of American girls: A historical perspective*. New York: RoutledgeFalmer.

Treagust, D. F. (1980). Gender-related differences of adolescents in spatial representational thought. *Journal of Research in Science Teaching, 17*, 91-97.

Udry, R. (2000). Biological limits of gender construction. *American Sociological Review, 65*, 443-457.

Udry, R. (2001). Feminist critics uncover determinism, positivism, and antiquated theory. *American Sociological Review, 66*, 611-618.

Weedon, C. (1997). *Feminist practice and poststructuralist theory* (2nd ed.). Malden, MA: Blackwell Publishing.

Welch, S. (1985). *Communities of resistance and solidarity: A feminist theology of liberation*. New York: Orbis.

West, C. & Fenstermaker, S. (1993). Power, Inequality and the Accomplishment of Gender: An Ethnomethodological View. In England, P. (Ed.), *Theory on gender/feminism on theory* (pp. 151-174). New York: Aldine.

West, C. & Zimmerman, D.H. (1987). Doing gender. *Gender and Society, 1*, 125-151.

Willis, S. (1996). Gender justice and the mathematics curriculum: Four perspectives. In L.H. Parker, L.J. Rennie & B.J. Fraser (Eds.), *Gender, mathematics and science: Shortening the shadow* (pp. 41-51). Dordrecht, The Netherlands: Kluwer Academic Press.

Wright, J. (1995). A feminist poststructuralist methodology for the study of gender construction in physical education: Description of a study. *Journal of Teaching in Physical Education, 15*, 1-24.

BIOGRAPHICAL SKETCH

After earning bachelor's degrees in biology and Spanish from the University of North Florida in 1995, I began teaching middle school science in Jacksonville. Although teaching full-time during the day and taking certification classes at night created a hectic schedule for a first-year teacher, I was hooked from the start. I then taught for two years at Damascus Community School in Damascus, Syria. Living and working in the Middle East was an incredibly life-changing experience, both personally and professionally. Returning to Jacksonville, I taught one year of high school biology and Spanish at a performing arts school before enrolling as a graduate student at Florida State University. I completed my master's degree in science education in 2002 and became involved in both regional and national science education professional organizations. I have been fortunate to hold several research and teaching assistantships that have provided a wide array of experiences in the realms of both teacher education and science. As I complete my doctorate, I look forward to teaching science education at the university level and conducting research with a focus on issues of equity.