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WOMEN AND MATHEMATICS:
NEGOTIATING THE SPACE/BARRIER

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate School
of The Ohio State University

By

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* * * * *

The Ohio State University
1996

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ABSTRACT

Researchers have long sought answers to questions regarding women's interactions with mathematics. Women's ability and choices have been questioned as have the influences of sociocultural factors on women's performance or involvement in mathematics. In an effort to describe the emerging complexity of women's relationship with mathematics, this study explored how women negotiate the Space/Barrier which exists between and with them and mathematics. The Space/Barrier, the elements and Elements comprising it, and its fluid and dynamic nature are described in this qualitative study. Mary Daly's (1984) Elemental Feminist Philosophy provides the essence of the definitions of the Space/Barrier E/elements.

Seven women who are certified Elementary school teachers participated in the study, each contributing to the creation of her own mathematical biography through group and individual interviews, questionnaires and other writing requests, and participant review of developing written biographies. Moments of the women negotiating the elements of the Space/Barrier emerged through the biographies and were described in terms of the epistemological perspectives of Belenky, Clinchy, Goldberger, and Tarule's Women's Ways of Knowing: The Development of Self, Voice, and Mind (1986).

The women of this study used particular ways of knowing situationally, sometimes in resistance to environments and influences, and at other times in apparent
compliance. All of the women demonstrated Moments of Amazonian-warrior action, Moments of courage, of fighting for their own voices in confronting elements of the Space/Barrier.

The Space/Barrier, its elements, and women's confrontations and negotiations within and around it provide a theory of how women can and do make choices for themselves as they move through the Space/Barrier toward mathematics. Awareness may help women fully and most consistently perform the Amazonian acts that assist their movement toward mathematics. Women might help raise the awareness of others by teaching the Space/Barrier, and may also transform hindering elements into nurturing or otherwise supportive Elements through teaching. Determining ways in which women as teachers might alter the Space/Barrier by transforming elements into Elements is a recommended direction for future research.
Dedicated with love to my first feminist teacher,
my mother, Rita Muzzie
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TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>ii</td>
</tr>
<tr>
<td>Dedication</td>
<td>iv</td>
</tr>
<tr>
<td>Acknowledgments</td>
<td>v</td>
</tr>
<tr>
<td>Vita</td>
<td>vi</td>
</tr>
<tr>
<td>List of Tables</td>
<td>xiii</td>
</tr>
<tr>
<td>Chapters:</td>
<td></td>
</tr>
<tr>
<td>1. Space/Barrier</td>
<td>1</td>
</tr>
<tr>
<td>1.1 From Dis-Ease To Space/Barrier</td>
<td>1</td>
</tr>
<tr>
<td>1.2 About The Space/Barrier</td>
<td>3</td>
</tr>
<tr>
<td>1.2.1 Questions about the Space/Barrier</td>
<td>3</td>
</tr>
<tr>
<td>1.2.2 Dis-Covering The Space/Barrier</td>
<td>5</td>
</tr>
<tr>
<td>1.2.3 Perceptions of Mathematics In The Space/Barrier</td>
<td>5</td>
</tr>
<tr>
<td>1.2.4 Math As A Male Domain</td>
<td>6</td>
</tr>
<tr>
<td>1.2.5 Beyond The Consequences of Choices:</td>
<td></td>
</tr>
<tr>
<td>Consequences of Discussion?</td>
<td>10</td>
</tr>
<tr>
<td>1.3 Moving On?</td>
<td>13</td>
</tr>
<tr>
<td>1.3.1 The Problem Is Not Women and Mathematics</td>
<td>13</td>
</tr>
<tr>
<td>1.3.2 Emerging Wanderings</td>
<td>15</td>
</tr>
<tr>
<td>1.3.3 Research Questions and Qualifications</td>
<td>16</td>
</tr>
<tr>
<td>Section</td>
<td>Title</td>
</tr>
<tr>
<td>---------</td>
<td>-------</td>
</tr>
<tr>
<td>5.3.2</td>
<td>Amy</td>
</tr>
<tr>
<td>5.3.3</td>
<td>Bridget</td>
</tr>
<tr>
<td>5.3.4</td>
<td>Carrie</td>
</tr>
<tr>
<td>5.3.5</td>
<td>Claire</td>
</tr>
<tr>
<td>5.3.6</td>
<td>Claudia</td>
</tr>
<tr>
<td>5.3.7</td>
<td>Leigh</td>
</tr>
<tr>
<td>5.3.8</td>
<td>Lindsay</td>
</tr>
<tr>
<td>6.</td>
<td>Points Of Convergence</td>
</tr>
<tr>
<td>6.1</td>
<td>My Selves In The Space/Barrier</td>
</tr>
<tr>
<td>6.1.1</td>
<td>My Woman-Self</td>
</tr>
<tr>
<td>6.1.2</td>
<td>My Mathematician-Self</td>
</tr>
<tr>
<td>6.1.3</td>
<td>My Educator-Self</td>
</tr>
<tr>
<td>6.1.4</td>
<td>Summing The Selves</td>
</tr>
<tr>
<td>6.2</td>
<td>Re-Searching The Space/Barrier</td>
</tr>
<tr>
<td>6.2.1</td>
<td>What Is The Space/Barrier?</td>
</tr>
<tr>
<td>6.2.2</td>
<td>What About The Women's Ways Of Knowing Mathematics?</td>
</tr>
<tr>
<td>6.2.3</td>
<td>How Do These Women Negotiate The Space/Barrier?</td>
</tr>
<tr>
<td>6.2.4</td>
<td>A Word On Memorable Moments In The Space/Barrier</td>
</tr>
<tr>
<td>6.2.5</td>
<td>Sugar And Spice And Everything Nice</td>
</tr>
<tr>
<td>6.2.6</td>
<td>Continuous Messages In Teaching And Learning</td>
</tr>
<tr>
<td>6.2.7</td>
<td>Niches Or Not - Choosing A Way</td>
</tr>
<tr>
<td>6.2.8</td>
<td>What Does This Mean For Women?</td>
</tr>
<tr>
<td>6.2.9</td>
<td>Further Re-Searching: What Next?</td>
</tr>
<tr>
<td>Appendices:</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>Initial Requests And Letters</td>
</tr>
<tr>
<td>B</td>
<td>Interview Protocols</td>
</tr>
<tr>
<td>C</td>
<td>Individual and Follow-up Questionnaires</td>
</tr>
<tr>
<td>D</td>
<td>Manuscript: Women's Voices And The Experience Of Mathematics</td>
</tr>
</tbody>
</table>

Bibliography 288
<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>49</td>
</tr>
</tbody>
</table>

Sample of coding process matrix
CHAPTER 1

SPACE/BARRIER

I begin this dissertation with a discussion of the concept of the Space/Barrier that exists between and with women and mathematics. I explain how I came to this concept and how research and experience give evidence of its existence. I attempt, too, to describe the complexity of the Space/Barrier and its interrelationships with women and mathematics.

From Dis-Ease To Space/Barrier

My starting point is my own sense of dis-ease about experiences of women interacting with mathematics. I know of these experiences from reading both research literature and mainstream press. I have learned of hopes for women in mathematics, hopes coming from the leaders of the mathematics education community, from voices of feminist researchers, from scholarly writers, and from women who have experienced some form of mathematics. I have learned from the voices of women who have excelled in mathematics also from women who have been less than successful in mathematics. I
know of experiences of women who teach mathematics confidently and those who
teach mathematics fearfully. I know, too, of my own experiences as a woman in
mathematics.

Women have spoken both of moments from deep within their pasts of feelings
evoked in current experiences in mathematics. Women raised in urban, rural, and
suburban environments, women of privileged, middle, and working class families have
shared experiences with me. I have not heard, and will not ever be able to hear, all
mathematics stories of all women. However, all I have heard has contributed to the
development of my sense of dis-ease about women's relationship with mathematics.

My sense of dis-ease is what prompted me to wonder and formulate my first
and broadest questions about women and mathematics. Embedded in my own sense of
dis-ease, my questioning and my view of women and of mathematics, I see
mathematics occupying one place in the world and women occupying another place.
There seems to be some common ground between the two, although this ground is
uncertain and unmapped. I believe in the existence of a connection between women and
mathematics, and as a woman who is a mathematician, I have experienced that
connection myself.

Even though I recognize the existence of a connection between women and
mathematics, I also believe there to be a chasm between women and mathematics. The
chasm separates the women and the mathematics. In the beginning of my musings, I
was not certain what comprised the chasm, whether the chasm was an open space,
some solid barrier, or something that was neither space nor barrier. I was not certain
whether the chasm was a solid obstacle, a vaporous haze, or an invisible and intangible
entity. Even without definite identification, this chasm - what I call the Space/Barrier-
became the foundation for a further line of questioning.
Questions About The Space/Barrier

Is the Space/Barrier a creation of women whose contact with it and stories about it contributed to my developing sense of it? Or, is the Space/Barrier created by the science of mathematics itself? Is the Space/Barrier created by environments, people, or things connected to one or the other of the women or the mathematics? Is it connected to both the women and the mathematics? Is the Space/Barrier visible/apparent/relevant to all women when they interact with all mathematics? Is it visible/apparent/relevant only to certain women and all mathematics? Is the Space/Barrier visible/apparent/relevant to all women and certain mathematics, or only to some women and only with certain mathematics? Is it something that women with varying degrees of success in mathematics avoid, breach, bridge or somehow disallow interference from? Is the Space/Barrier something the women work with(in), negotiate themselves through?

I have searched scholarly research, poetry, and theories seeking answers to my questions about the Space/Barrier, women and mathematics. I have explored my own experiences and have heard of the experiences of others. In this search for answers and clarity, I find little satisfaction. Instead, I find interconnections and more questions.

I find this lack of definitive answers to my questions to be an indication of the complexity of each and all of women, the Space/Barrier, and mathematics. My vision of this complexity includes non-solid boundaries for each of the entities: women, the Space/Barrier, and mathematics. These boundaries are vaporous edges, clouds of elements, Elements, Elementals and elementaries that are extensions of the denser cores
of the entities themselves. It is the essence and meaning of Mary Daly's (1984) definitions of Elements, Elementals and elementaries that I take to develop meaning and determine a place for these concepts within the Space/Barrier.

Within the world and within the Space/Barrier, Elements are "the spoken letters of the alphabet; the primal Race of Words - their cosmic sounds, meanings, rhythms, and connections" (Daly, 19887, p. 73). They are the natural and Wild connections between and among all be-ings. They are simple, natural, unrestrained, and undisciplined. They are basic, fundamental and Earthy. They often are replaced in society by elementaries.

Elements: simulations of and planned replacements for the Elemental, the Wild; fabrications which distort experience of the Elements and which are largely invisible by reason of being all-pervasive;... man-made phenomena lacking depth, radiance, resonance, harmonious interconnectedness with living be-ing. Examples a: the poisonous fumes and radioactive emissions of phallotechnology b: the transmissions of popular media and the erudition of specialized fields c: traditional assumptions spoken and unspoken d: shopping malls e: plastics (Daly, 1987, p. 73)

Existing with the Elements and the elementaries are Elementals, the Spirits of the Elements, the essences that remain, always, even when the Elements have been replaced or distorted by elementaries. When elementaries replace Elements they do so with elements, fabricated concepts within the Space/Barrier. While the elementaries distort our experience of the Elements, they offer a view of the elements that is seemingly clear and simple, camouflaging the need to question. The elements become the concepts confronted by women when they attempt to interact with mathematics.

Contact, then, between and among women, mathematics, and the Space/Barrier becomes an act of interaction among elements, Elements, elementaries, and Elementals and an intermingling of all. From this interaction and intermingling comes the complexity I envision. Through the merging, some of what defines women and
mathematics contributes to an evolving definition of the Space/Barrier. Likewise, some of what the Space/Barrier becomes contributes to more of what women and mathematics are defined to be.

**Dis-covering The Space/Barrier**

The Dis-covery and exploration of elements within the Space/Barrier point not only to the existence of the Space/Barrier, but also to its description and complexity. Dis-covery reveals, too, the complexity of the women and the mathematics connected to the Space Barrier, and the interwoven web of connections among the women, the mathematics, and the Space/Barrier. Some characteristics of the Space/Barrier are revealed through a perception of what mathematics is and what the culture surrounding mathematics defines women to be. Other characteristics are revealed in terms of the expectations of opportunities and performance of women in mathematics.

**Perceptions of Mathematics In the Space/Barrier**

Dictionaries, students, teachers, mathematicians, and everyday people define mathematics in various ways. Mathematics is a "group of related subjects ... concerned with the study of number, quantity, shape, and space, and their interrelationships, applications, generalizations and abstractions" (Borowski & Borwein, 1991, p.365) and mathematics consists of "mathematical processes involved in the solution of a problem or the study of some scientific field" (Borowski & Borwein, 1991, p.366). Some define mathematics as the "science of numbers" (Webster, 1981, p.702). Others say mathematics is a language, a tool, a way to describe the world or a way to view the world. It is what Mom did when she measured feed on the farm, or what Dad did when he ordered seed. It is what my aunt did at work or what my uncle did in the lab. It is how we order the universe. Math is what you did when you got your first paycheck. It is a structure, a place, a way to think. Math is reasoning; it is what you
do when you don’t know what to do. It is the number of course withdrawals on the transcript for the same college math course. “Math is a four-letter word.” Math is what mathematicians do.

Math As A Male Domain

The diversity in the definitions of what mathematics is precludes convenient synthesis into a single definition. Still, whatever mathematics is to women and how women feel about doing mathematics is connected to what women perceive mathematics to be. For example, Fennema and Sherman (1977b) studied how females receive messages from peers and society at large regarding the lack of usefulness of mathematics in their lives. Their findings indicated that low levels of confidence in mathematics for females were related to the perception that mathematics was a male domain. As student perceptions of mathematics as a male domain become a part of the Space/Barrier, so do the related low levels of confidence in their mathematics abilities.

Fox (1980) reported, too, that high school girls maintained some belief in the stereotype of mathematics as a male domain. The impact of this belief becomes apparent when considering female choice in mathematics. Attitudes that stereotyped mathematics as a male domain were among the factors that affected females’ choices to opt out of the field (Armstrong & Price, 1982). Additionally, studies found many teachers perceiving mathematics as a male domain (Fox, 1980). Since teacher encouragement had a positive effect on the choices of females to study mathematics (Casserly, 1980; Luchins & Luchins, 1980), teacher perception of mathematics as a male domain becomes another factor strengthening the Space/Barrier.

The implication behind the perception that mathematics is a male domain warrants comment here. If mathematics is a male domain and if males can do mathematics, does this mean that males can do mathematics primarily because it is a
male domain? If so, does this imply that females can not do mathematics, or cannot do mathematics as well as males, because mathematics is a male domain? Could females only do mathematics if it were defined as a female domain? Since 'teachers' encouragement of the girls' pursuit of mathematics or science was related to the teachers' view of female abilities' (Fox, 1980, p. 18) the notion that mathematics is a male domain is more dangerous than might be thought. Teachers, with the belief that mathematics is a male domain, can find themselves actually contributing to the density of the Space/Barrier, by supporting an elemental expectation that the girls cannot participate in a male domain.

This identification of mathematics as a male domain is described by feminist essayist Susan Griffin (1978):

His certainty:
How he rules the universe
He says that through numbers 1 2 3 4 5 6 7 we find the ultimate reality of things 8 9 10 11 He says 12 13 14 that quantities are the most rigorous test of things 12 13 ... 14 15 16 He says the final proof 16 17 is always a sum 18 19 20. ... He measures the distance from his land to his neighbor's land. He measures his wealth. ... He calculates his feelings. ... He measures his intelligence. ... He measures productive acres. He calculates the value of his existence. ... He counts 82 83 necessity. He counts what he imagines to be necessary. He says six combat divisions are necessary. ... Counting. They have counted the targets ... 71 were cities ... they count 263 bombs. ... they count the dead to be 42 million. ... He tells us how powerful he is (p. 125-127).

Griffin's description of this domain as "his" and consequences of such a perception invoke further speculation. Perhaps perceiving mathematics as a male domain leads to more than the low levels of confidence identified by Fennema and Sherman (1977a). Perhaps it sends more messages to females than that of their inability (Armstrong & Price, 1982). What if perceiving mathematics as a male domain is about the aggression and power that Griffin describes?
If some women perceive that mathematics is about males telling us about "power over", those women may not want to participate in such a mathematics. In particular, this would be especially true for the woman who was viewing mathematics from the connected or constructivist perspective of *Women's Ways of Knowing* (Belenky, Clinchy, Goldberger & Tarule, 1986). For her, needs for connectedness conflict with the "power over" message of mathematics. Those needs, deeply personal and a part of who the woman is, take precedence over a need to do mathematics (Erchick, 1996) and the epistemological preferences of the woman become a part of the Space/Barrier separating her from mathematics.

**Choices (?) Within the Space/Barrier**

If a woman's need for connectedness becomes a part of the Space/Barrier separating her from mathematics, she might actively choose not to study mathematics. Indeed, some women *have* separated from mathematics, and have done so "by choice". My focus of choice here is deliberate and is connected to more questions surrounding the Space/Barrier.

For instance, Fox (1980) reported on findings from National Assessment of Educational Progress (NAEP) and the College Entrance Exam Board. In 1978, the NAEP second mathematics assessment revealed difference by sex favoring males in enrollments or completion of courses beyond Algebra II. In that same year, the College Entrance Exam Board reported that males were more likely than females to complete four or more years of mathematics by a 63 to 43 percent ratio (Fox, 1980). The female's "choice" not to study then itself seems to emerge as a self perpetuated part of the Space/Barrier.

However, the choice is what I question, primarily in terms of its position and role within the Space/Barrier. Is that choice a part of woman, a part of the culture
defining who she is? Is the choice a part of the rules the woman receives that define what she should be and do? Is it a part of what she has chosen to be? Or is the element named "choice" dependent on some part of mathematics, or the culture surrounding it? And how do we even separate the two?

Is the "choice" not to study mathematics related, again, to the notion of mathematics being "his" and therefore unnecessary for her? Or, might the "choice" not to study mathematics be a part of a perception that mathematics is unnecessary for her for other reasons? In considering future educational goals, women who plan to continue education through college are more likely to find mathematics courses in high school to be useful (Armstrong & Price, 1982). For them, mathematics becomes a means to an end somewhere in, or outside of, the Space/Barrier. Those with different ends in mind move away from mathematics, as do those with a limited perception of the value and place of mathematics in their worlds. In any case, decisions not to study mathematics become a part of the Space/Barrier, and the women making these choices strengthen the Space/Barrier.

As the women who choose not to study mathematics separate from mathematics, their choices add strength Lucy Sells' (1980) "critical filter". Not only do women who choose not to study mathematics position themselves further from mathematics. They also strengthen the Space/Barrier as a barrier and thus limit the ease with which they might again move toward mathematics. Such choices not to study mathematics decrease readiness for further study in mathematics, and increase limitations for the women's future career opportunities. Thus, a woman's needs lead to choices, and the choices often lead to limited preparation in the field of mathematics. Limited preparation then becomes an element which merges the realm of a woman's choices with the realm of the Space/Barrier.
Beyond The Consequences of Choices: Consequences of Discussion?

Still, some women do choose to continue on paths which involve mathematics or even to enter the field as a final destination. Sorting through the evidence of women's involvement and representation in mathematics becomes complex in much the same ways as does the exploration of the Space/Barrier. I find myself wondering, though, about the consequences of the discussion of women's levels of representation in mathematics. I wonder if the Space/Barrier is being dissipated by the discussion, or if the discussion is actually adding to the density of the Space/Barrier.

For example, consider a time when fewer women studied mathematics than today. Women's absence from mathematics might have been attributed to a number of conditions, one of which would be the perception of the effect of women's biology on their ability to learn mathematics. Susan Griffin describes this perception.

It is decided that the minds of women are defective. That the fibers of the brain are weak. That because women menstruate regularly the supply of blood to the brain is weakened. All abstract knowledge ... must be abandoned to the laborious and solid mind of man. 'For this reason ... women will never learn geometry.' There is controversy over whether or not women should be taught arithmetic.

(Griffin, 1978, p. 14)

No doubt, one might argue that this perception no longer prevails. However, whether the perception is or is not still alive, a residue of the view permeates what women know of themselves, and becomes a part of the Space/Barrier.

The messages that are sent to girls and women about their abilities to do mathematics remain as a part of the culture and of the Space/Barrier even after the words are no longer spoken. More importantly elementaries of the Space/Barrier move into the women themselves.

Girls and women internalize the ... (messages about their ability). Even when nobody else is saying that girls "don't" do mathematics, the girl's subconscious
is reminding her. Later, the fact that many people have questioned her "seriousness" about mathematics may cause a woman to doubt her own commitment more than a man, and the self-doubts that are universal more often become overpowering. (Kenschaft, 1991, p. 15)

The perpetuation of internalized messages of women's inferiority strengthens elemental notions of an inappropriateness of mathematics for females. Not only is the Space/Barrier element strengthened by the continuation of stereotypes, but women who have accepted the stereotypes participate in the strengthening. They recognize, often in spite of their own awe and respect for any woman who is a mathematician, that the woman mathematician is "admired" but "still unothodox" (Claire, F12). In such cases, the women add to the substance of their own internalized beliefs as they thicken the complexity and density of the Space/Barrier.

Whether or not these messages are spoken consistently is less relevant than the impact of their existence. Messages which question women's innate inferiority in mathematics do more than become a part of the women hearing them. As long as messages of women's innate inferiority continue to be legitimate questions for research, the messages and questions further reinforce their own power (Damarin, 1990). The messages iteratively become a part of the ever-evolving Space/Barrier.

The iteratively reinforcing quality of the evolution of the Space/Barrier continues with other messages as well. For instance, in the biographical study of the lives of women who have achieved and contributed to the development of the science of mathematics, the women are recognized as extraordinary. The women biographed by Lynn Osen (1974), most of whom lived during the eighteenth and nineteenth centuries, needed an extra dimension of stamina and fortitude to cope with the prejudice against women in this 'male preserve'. Society has senselessly confronted these women with a certain fine edge of reproof; only the hardest personalities could ignore the narrow parochialism of their times or transcend the barbarous conflict of contemporary opinion (p.3).
While helping to thin some sections of the Space/Barrier by sending the message that women are certainly capable of doing mathematics, such stories of extraordinary women do more. These stories also contribute to the thinkening of the Space/Barrier by sending the additional message that to do mathematics as these women did, one must indeed be extraordinary. After all, "only the hardiest personalities" could succeed, and unless a woman perceives herself as such, she may not expect to be capable of doing mathematics.

In the times of which Osen writes, women were not permitted to enroll in university classes and in many cases were not permitted to walk onto university campuses. Many professors refused to mentor women mathematicians. The Space/Barrier that was to keep women from learning arithmetic and geometry grew, and women were prevented from experiencing university learning and higher mathematics.

Those women who managed to find mentors, professors, and ways to study mathematics, were indeed extraordinary. However, the consequences of their efforts were not all rewarding in society. For example, some women were de-feminized for their efforts and abilities. Emmy Noether (1882-1935) was given the masculine title of Der Noether when her colleagues recognized her genius (Damarin, 1990). The message that mathematics is indeed a male domain is reinforced, as is the warning within the Space/Barrier that women risk losing the femininity which they need to maintain to be acceptable within society. The Space/Barrier evolves, and notions of issues such as the perceived maleness of mathematics and the expected femaleness of women combine to further thicken Space/Barrier.
Moving On?

[D]eciding not to study mathematics can be seen as both cause and effect in a somewhat circular pattern of reinforcing stereotypes and behaviors (Fox, 1980, p. 26).

If Fox's perspective on the circular nature of what I define as the Space/Barrier is extended to all of the components of the Space/Barrier, the intricacy of the dynamics among women, mathematics, and the Space/Barrier can truly be imagined. In all of this, it seems unnecessary to expend much energy trying to further explain more of the components and dynamics of the concepts involved. Rather, we might now accept the existence of the Space/Barrier, and begin to learn more about how women negotiate their way through or around it.

The Problem Is Not Women and Mathematics

Within/In spite of the Space/Barrier, women of many and varied interests, ages, races, cultures, careers and more develop and maintain relationships with mathematics. To do so, they negotiate a continuously evolving and sometimes dissolving Space/Barrier. The women connect to and develop with a growing and variously defined mathematics. The problem, then, is not the Space/Barrier alone, nor the women or mathematics contributing/connecting to the Space/Barrier. Rather, the problem is a lack of understanding of how women negotiate their passage through, over, under, or around the Space/Barrier, and thus come to know mathematics.

In particular, I wonder about the women who teach children mathematics at the Elementary level. My choice of the word Elementary is deliberate. The dominant use of the adjective "elementary" to describe the traditional schooling of the beginning years fits with the definition of the term as "characterized by artificiality, lack of depth, aura
and interconnectedness with living being (Daly, 1987, p. 73). I choose to capitalize Elementary to place the work of the women participating in this study within the realm of the Elementals, within the realm of connected, primal, Reality. This is the sense of meaning I feel many attach to the work and space of teaching children mathematics.

Some who have watched teachers have developed opinions about who and what teachers are. They have found that Elementary Education majors experience the highest levels of mathematics anxiety of all college majors (Hembree, 1990). Additionally, the leaders in the Mathematics Education community, such as the Mathematical Association of America (1966, 1983, 1988, 1991), have repeatedly bemoaned the lack of mathematical training in E/Elementary teacher programs and have made recommendations for change. Collected mathematical autobiographies of E/elementary teachers reveal that many of the teachers studied as little mathematics as possible in high school and college. Still, these same women experienced mathematics daily in their lives and used their own experiences to varying degrees as a foundation on which to base their instructional choices. Some felt inadequately prepared, and yet knew of a mathematics that they themselves could define and use (Erchick, 1993; 1995).

The National Council of Teachers of Mathematics (NCTM) initiated reform in Mathematics Education and published standards describing its vision (NCTM, 1989). This vision of reform addressed the inclusion and extension of mathematics concepts in the E/Elementary school curriculum that were often beyond the formal mathematical experiences of the teachers. This has led to women who are E/elementary teachers teaching children mathematics concepts from the very fields of mathematics avoided by these teachers as students of mathematics.

Still, the women teaching children mathematics do as they are required in their professions. They interact with mathematics almost daily in teaching their students.
Some teachers have chosen to pursue professional development in mathematics education, experiencing more interaction with mathematics. Many feel they have grown considerably in their relationship with mathematics. These are the women that interest me in this study. They choose to move into the depths of the Space/Barrier, and they find their own ways of negotiating that place and coming to know more about mathematics.

Emerging Wanderings

Some women's relationships with mathematics seem very successful. For others, their relationships with mathematics seem minimally so, or even not successful at all. The relationships that women have with mathematics seem comfortable, distant, exciting, fearful, and invigorating. Those relationships sometimes seem to be all of these and sometimes seem to be none. For all of these women, questions arise. Do the relationships between women and mathematics merely seem successful? Or are they actually successful? How do we/they know? Who or what determines the success, comfort, excitement of a woman's relationship with mathematics? How do we/they judge? Whose standards are used? What values are honored? Do the women who maintain relationships with mathematics determine a way to negotiate the Space/Barrier, and thus a way to come to know mathematics? Or, do they first come to know mathematics, and only then determine a way to negotiate the Space/Barrier? Is the relationship that women maintain with the Space/Barrier as complex as the Space/Barrier itself? Does a woman's relationship with mathematics become as recursive and evolutionary as the Space/Barrier with which the women interact with and/or act within?
Research Questions and Qualifications

This is not a study of women in general, but, rather, of particular women in particular situations at particular times. The women participating in this study are all certified Elementary classroom teachers. They all share a distinction of teaching mathematics in some exemplary way, as determined by administrators in their districts, and as recognized by colleagues. They seem continuously to negotiate the Space/Barrier in some way, as they connect with mathematics in their teaching. They all see themselves as having experienced considerable growth in their relationships with mathematics, however they might define that growth.

All seven of Amy, Bridgett, Carrie, Claire, Claudia, Leigh, and Lindsay are mathematics specialists in their schools or districts. They have participated in extensive professional development both within their districts and through one of the state's regional professional development centers. For all of the women, their designation as mathematics specialists followed their own individual initiatives both for professional growth in mathematics, and for working toward, or defining a relationship with mathematics.

In my exploration of the women, mathematics, and the Space/Barrier, I have the following questions to guide my inquiry:

1) What ways of knowing mathematics have the women of this study developed in the past? What ways do they continue to develop now in themselves as students and teachers of mathematics?

2) How do the women of this study maintain or move away from a particular way of knowing?

3) How do the various ways of knowing contribute to the women’s (dis)connection with mathematics?

4) How have the experiences of mathematics content and pedagogy supported a (dis)connection between the women and mathematics?
CHAPTER 2

ACTIVITY WITHIN AND AROUND THE SPACE/BARRIER

Those Braving the Terrain of the Space/Barrier

Many have braved the terrain of the Space/Barrier. Some have done so in an effort to understand the Space/Barrier or to try to dissipate some of the density of it. Some have worked within/around the Space/Barrier in an effort to (dis)connect with mathematics in some way that allows them to live their (mathematical) lives with some sense of comfort. Although these two groups of people are not necessarily mutually exclusive, each group, as well as the work they do, can be described individually. I will describe efforts first of these two groups, those hoping to dissipate density, understand the dynamics of, and eliminate elementals within the Space/Barrier. More about the second group, those working within/around the Space/Barrier with the hope of (dis)connecting, will come later.

Warriors Of Dissipation

Those who have attempted through persistent research to dissipate some of the density of the Space/Barrier, to expose and hopefully eliminate elementals, I call researcher-warriors. These warriors have (re)searched and written, have hypothesized
about, and have explored the issues and elements connected to women's interactions with mathematics. They have confronted and uncovered elements, and have worked towards eliminating them. Yet, the researcher-warriors hit boundaries, too, that prevent their further movement within the Space/Barrier.

By not accepting the innate inferiority of women in mathematics as a given, researcher-warriors have looked for explanations for sex-related differences in mathematics. In so doing, they have encountered the elements of anxiety and fear of success, of attitudes and choices, of influences in society. The result is a creation of elements in the Space/Barrier, and an acceptance of a boundary that prohibits movement/spiraling outward towards the fringes of the Space/Barrier. The result creates a spiraling inward.

Consider Sheila Tobias (1976, 1978a, 1978b, 1980a, 1980b) and her work with mathematics anxiety. She confronted the element of low achievement for women in mathematics, the element that sent the message that women were inferior to men in mathematics. Tobias was unwilling to accept the innate inferiority ascribed to women in mathematics, and instead found a reason for women's poor performance and low levels of participation in mathematics.

With anxiety as the culprit, the element in the way of women's connection with mathematics, Tobias suggested classroom activities, test-taking strategies, family support, and what she believed psychologists would recognize as "group therapy" (1978a) to help. All of this was to fix the women, to help them do the dominant form of mathematics that they avoided or seemed unable to do. It was to help women pass by, go around, or pull themselves through the elements. The women could be helped
to do what Tobias believed they were able to do, and the element of anxiety, as well as the element of the question of women's ability, would be cleared away, or at the very least, weakened.

Working toward the dissipation of the element of anxiety is not a problem. However, a problem may arise in the recognition of the element as a barrier and the choice to give the element power. In a society that defines women as "other" and less than simply by virtue of being female, a description of the woman as powerless in confronting a barrier, may present her as a victim, and cause a thickening of the Space/Barrier, instead of the intended attempt to assist women's movement through it.

Still, Tobias is not alone in her efforts as a researcher-warrior. Others have confronted elements as well. Gilah Leder (1982), for example, reported on a fear of success in women as the women interacted with mathematics. Leder, like Tobias, hoped to thin a part of the Space/Barrier surrounding the element of women's perceived inability. She concluded that a fear of success in mathematics was likely to be connected to being female, particularly in terms of the females' performance in a traditionally male field. A shift of attention away from women as deficient and toward the societal gendering of mathematics as male contributes to the dissipation of the element of women's perceived inability in mathematics. The Space/Barrier thins. However, with the thining that results from a focus on gendering comes a thickening of the Space/Barrier as well. Both the language of "fear" and the notion of avoidance of success disempower those to whom they are applied. An act toward dissolution becomes, at the same moment, contributory toward an increasing density, and new elements emerge in the Space/Barrier.

Other researcher-warriors considered elements of women's attitudes and women's choices, and found them to be interconnected (Armstrong & Price, 1982).
However, the study of these elements, too, is problematic. The elements of attitude and choice do not victimize women as much as blame them. Women could control both their attitudes and choices, and if they would, they could study more mathematics. Even though the element of women's (in)ability is thinned, the Space/Barrier gains a density as the elements of attitude and choice grow denser.

The act of warrior-ing is continued by others concerned with gender equity in mathematics, as researcher-warriors turn to elements that could help support women and girls in mathematics, elements that have the potential to become Elemental. Such elements/Elements were/are the influences of people interacting with women, girls, and mathematics. Parents, counselors, teachers, peers, and the society at large are found to be influential as they coexist in the Space/Barrier terrain.

An example of an elemental influence is the high school counselor. Some girls not only have not been encouraged, but actually have been discouraged from participating in mathematics (Luchins & Luchins, 1980). A redefined counseling situation in the form of advisorships and mentorships in the college environment, is also elemental. Men have dominated the professorships at the post secondary level (not only because of hiring practices, but because women have had higher attrition rates than men (Fox, 1980; Ruskai, 1994)). There are fewer women available as mentors for women students, and women students are less likely to be chosen as protégés than are men (Fox, 1980). Women students are then less likely to find support for their passage through the Space/Barrier than they might otherwise, and the Element of positive influence is less available to help the women who need it.

Hoping to find Elements, or to turn elements into Elements, some researcher-warriors turn to teachers as influences in the mathematical lives of women and girls.
Teacher influence on girls and women is connected to more than attitudes and perceptions of mathematics. That influence is also connected to teacher classroom behaviors.

Teachers generally have fewer interactions with girls than with boys and have differently styled interactions with boys than with girls (Becker, 1981; Fox, 1980; Hart, 1989). Teachers might ask boys for extended explanations or reflection, and merely acknowledge responses from girls as right or wrong. The message that boys are to think further, while girls need not do so, becomes a Space/Barrier element as do expectations of the roles of women in doing mathematics, and definitions for how both genders do mathematics within the Space/Barrier.

To transform teaching behaviors from elements to Elements, the warrior might suggest more teacher contact with girls, and equal treatment of boys and girls in the mathematics classroom. Such changes might help girls move more freely through the Space/Barrier. However, for some girls, performance is better in classes where they receive less teacher help, and where more independence is thus fostered (Koehler, 1990). It could be then, that for girls, equal treatment becomes the element, and differential treatment the Elemental to connect them with mathematics.

Women's passage through the Space/Barrier has much to do with being female (Fauth & Jacobs, 1980; Burton, 1979). It is the notion of what woman is defined and expected to be, rather than what she can or cannot do in mathematics, that influences what she does in mathematics. Expectations for behaviors are grounded in societal definitions of gender roles, and these expectations become elements. They determine the ease with which a woman may pass through any piece of the Space/Barrier terrain.

Some might argue for a focus on cultural influences, believing that the raising of awarenesses is what women and girls need most in their efforts to negotiate the
Space/Barrier. Others may disagree, arguing that the implication of the cultural reasons for "why too few women win at math" (Kenscaft, 1991, p. 11) is that women cannot reason to resist these influences, that they are powerless in interactions with them. It is not women's ability to resist the cultural messages that is most problematic in these arguments, but, rather, the cultural expectation that she will not.

Transforming the elemental messages into Elements may appear as an overwhelming task. The elemental messages which have told girls what they can(not) or need (not) do in mathematics are layered and ever-present. What immediate families tell girls is reinforced in the broader circle of peers and again in the enveloping circle of society (Armstrong & Price, 1982; Becker, 1981; Fox, 1980; Sherman and Fennema, 1977). Not only are the elements of the Space/Barrier interconnected and interwoven; they are embedded and re-embedded within themselves and each other.

Warrior Boundaries

A boundary seems to circumscribe many researcher-warriors. Whether the intent of inquiry is curing anxiety or providing support for a fear of success, the assumption is that the ends include having women be able to do the dominant mathematics in the dominant way. When women's attitudes and choices are examined or criticized, when ways are explored to adjust or redirect those attitudes and choices, warriors seem to assume the direction for improvement is toward the dominant form of mathematics. While teachers, counselors and parents send messages to women and girls, warriors suggest ways to reconstruct those messages so that they help direct women and girls, again, toward the dominant form of mathematics.

The element of women's aptitude as determined by achievement, the foundation for the (re)search within the Space/Barrier, is itself grounded in and determined by the structure and skills of the dominant mathematics. Researcher-warriors ultimately seek a
way for women to do the dominant form of mathematics as well as and, mostly, in the same way as, the men. As long as women are not doing so, the element of "difference as deficit" remains.

Ultimately, with the element "achievement", the researcher-warriors accept a boundary for themselves and their work. This boundary prevents the researcher-warriors from moving freely into the Space/Barrier. It also creates a space where their work, confined within the boundaries, creates more elements in a downward spiral into its enclosed space.

More Warriors

Amazon: a Wild Woman Warrior who fights for her Self and other women
(Daly, 1987, p. 103)

I stated earlier that I was first going to discuss those who have braved the terrain of the Space/Barrier in an effort to understand the Space/Barrier and to try to dissipate elements within it. I have done that and have called those brave souls researcher-warriors. I also promised to talk of another group, those who work within or around the Space/Barrier in an effort to (dis)connect with mathematics in some way. Their efforts allow them to try to live their mathematical lives with some sense of comfort. I call this second group Amazon-warriors.

Imagine a woman who has heard the elemental messages about her inability in mathematics and is aware of her own lack of formal mathematical experiences in her schooling. Know that she often has a low comfort level with the mathematics that she has studied. Often into adulthood she continues to experience panic, fear, confusion, or lack of understanding in school mathematics. She is one who might have gone into
architecture, but for the mathematics. She might have gone into medicine, but for the mathematics. As it is, she decided to teach Elementary school children. The choice just happened to include teaching mathematics.

This woman does what she can to teach mathematics. She listens and does what she has been told. She does what her teachers had done. She covers one page in the book, and then another, and then the next. She remembers that when she was a student "then do this...then do this...then do this" (Claire, F10) was what she heard. It is easy to teach math one page at a time.

Some things change, though, and this woman watches and hears. She sees children not understanding mathematics. She knows what they were feeling, having been one of them once. She wants to break the cycle. Education is in the midst of reform, and others are telling her how much her children do not understand (as though she does not know). Mathematics education leaders mandate changes for classroom practice (She will have to learn how to do things differently.). The leaders also change what the children would learn (She will have to learn more mathematics.). She is often afraid.

She might ignore the mandates, and her own recognition of her students' lack of understanding. She might wait it out until retirement ("2 years, 37 days", she said.). She might scoff at administrators' attempts to force her to change. After all, she has tenure. She might close her heart and her mind to her students, and continue with one page at a time, until the end of the year and the end of the book are reached; but she does not. She chooses, instead, to brave the terrain of the Space/Barrier.

She knows that something in the elemental messages was missing. She did/does know/do mathematics. She measured on her parents' farm and studied...
economics in college. She figured solutions to problems in her own way, even though she was punished for not doing it the "right" way.

She seeks out professional development workshops to learn about the new ways to teach mathematics and ends up learning mathematics. Sometimes she learns that she had not understood the mathematics of her childhood. Sometimes she learns that she actually had understood.

In any case, she takes the mathematics she knows, and the way she believes it needs to be taught, and integrates those with what was mandated for her. She teaches herself and her children, and her children teach her. She braves the terrain of the Space/Barrier daily, and develops ways to come to know mathematics.

She is a woman warrior, an Amazon. She is one who fights for her Self, as she says she will never be silent again. She has overcome some moment of fear, or finally "stood up to" a man in mathematics. She has come to be a leader. She helps others like herself, to traverse the Space/Barrier terrain. She is an Amazon-warrior sharing her story as a participant in this study.

Holding On As Opposed to (En)Framing
While Exploring the Space/Barrier

If I situate myself within the Space/Barrier and all that transpires there, I find myself in an overwhelming place. I find the dynamics of social factors and science, of everyday lives of women, and of my own growing self swirl around me like a dust cloud in a storm. With visibility limited by complexity, I need to choose a perspective from which to explore this question of women coming to know mathematics, a perspective from which I can view the goings-on within and around the Space/Barrier.
A perspective that is currently uncommon in research in mathematics education research, and one that seems particularly applicable here, is a feminist perspective (Fennema and Hart, 1994). The feminist perspective holds the potential of opening, unfolding re-searched space, to create a place for women, their questions and voices. The questions in my study are of women's development in ways of knowing mathematics. Above the noise and chaos of the Space/Barrier, the voices of the women who are interacting with mathematics are what I most want to hear.

Recognizing that research from a feminist perspective is a concept whose time has come, I turn to Suzanne Damarin's (1995) beginning of a "reorganization of the familiar ways of thinking about and interpreting issues and studies of gender and mathematics" (p. 242). Within a reorganization of thinking, a reorganization that includes a turn toward ways as yet not fully utilized, I also move to a choice of qualitative methodology. This choice again creates a place to hear the voices of women, and is also a recommended move in Elizabeth Fennema and Laurie Hart's discussion of mathematics education research (1994).

Joanne Rossi Becker (1994) has made a particular recommendation for mathematics education research with a feminist perspective. She suggests future studies test the model of Mary Field Belenky, Blythe McVicker Clinchy, Nancy Rule Goldberger, and Jill Mattuck Tarule as presented in Women's Ways of Knowing: The Development of Self, Voice, and Mind (1986). Indeed, this model may serve well as a handle on which to grasp, as I situate my self to explore what transpires within and around the Space/Barrier. I choose the Women's Ways of Knowing model as a handle in this inquiry. Conceptualizing "a handle", I distinguish between use of the model as a grip as opposed to a frame.
My dictionary defines "frame" as "an enclosing border" (Merriam-Webster, 1981, p.452). As such, mathematics education researchers would use a frame as a "structure that guides research" (Eisenhart, 1991, p. 205). By both enclosing in a border and guiding research questions, perspectives, and methodology, a frame also has the potential to confine, restrict, and contribute to the de-selection of data. What does not fit within the confines of the frame is overlooked. Emergent themes of meaning are not heard, seen, or recognized.

When using a frame, I find both myself as a researcher and the voices I hear confined. My analysis consists of fitting data revealed through the voices of my study's participants into parts of the frame. I manipulate the pieces, and fabricate a fit. The process is (en)framing and restrictive; I reject it for these reasons.

As an alternative to using a model as a frame, to escape (en)framing, I choose to use the *Women's Ways of Knowing* as a handle. I use this handle as a tool, not for (en)framing or shaping, but for hearing. With the *Women's Ways of Knowing* handle I can lift certain themes and ideas from the noise of the Space/Barrier. I can draw out from the chaos of the Space/Barrier those voices and messages that help me understand the ways that the women in my study negotiate the Space/Barrier.

Knowing The Ways In and Around the Space/Barrier

Belenky, Clinchy, Goldberger, and Tarule's¹ (1986) model represents an alternative to the dominant model of intellectual development of William Perry (1970). Although some women have experiences that are in common with Perry's model,

¹ I find that the stylistic tradition of citing Belenky, Clinchy, Goldberger, and Tarule as "Belenky et al." silences the voices of Clinchy, Goldberger, and Tarule. Therefore, so as not to participate in that silencing I will cite all authors in referring to their work.
others do not. For those who do not fit Perry's model, attempts to force a fit within the model (en)frames and restricts the women. Psychologists interpret the discrepancies of fit as deficiencies for women. The dominant model is adequate for describing the misfit of certain people with the model; it is inadequate for describing the intellectual development of those who mis-fit.

By identifying themes not revealed in the Perry model, the Women's Ways of Knowing model is an attempt to dis-cover those patterns which more adequately describe women's intellectual development. Women's Ways of Knowing was constructed to draw from the chaos of the field of voices of the women in the study. It pulled from the noise; it allowed the hearing of voices that were otherwise hard to hear.

The Women's Ways Of Knowing model is based on ten years of research with 135 women of diverse backgrounds with respect to education, culture, race, age, and class. Experiences Belenky, Clinchy, Goldberger, and Tarule considered as educational were not limited to formal schooling. The authors explored learning experiences in schools, in public assistance programs, in family structures and in social communities. All learning and all voices were valued.

The perspectives that emerged from their study are organized into the five categories: silence, received knowing, subjective knowing, procedural knowing (both separated and connected), and constructed knowing. The authors intend for these categories to be neither fixed nor exhaustive, but to be recognized as components of a model worth sharing.

Silence

The silent women had limited experience and ... were lost in the sea of words and numbers that flooded their school. For them school was an unlikely place to "gain a voice."

(Belenky, Clinchy, Goldberger & Tarule, 1986, p.34)
Belenky, Clinchy, Goldberger, and Tarule found silence infrequently in the women of their study. Those cases of silence they did find emerged in women who had experienced extreme abuse, violence, or isolation. For such silent women, all power lies with the authorities, and blind obedience to those authorities is necessary for the survival of the women. The silent woman does not hear, or for that matter, believe she can hear, any explanations from authorities. There is no choice to obey. It is simply done. The silent women are "like puppets moving with the jiggle of a thread. To hear is to obey" (p. 28).

Joanne Rossi Becker (1995) illustrates the Women's Ways of Knowing perspectives as they might be applied to a particular mathematical statement, namely "The base angles of an isosceles triangle are equal." In Becker's application, a silent knower would express an "awareness that teachers think the base angles are equal" (p. 165). This silent knower, like the student who asked for no explanation from the teacher for a problem marked wrong, has not enough inner voice even to agree or not with the teacher (Erchick, 1996). The teacher does the thinking and knowing. The student merely recognizes the teacher's knowledge claims.

Received Knowledge: The Inner Voice

Feeling capable of hearing, understanding, and remembering, women at the position of received knowledge have faith that if they listen carefully enough they will be able to do the "right thing."

(Belenky, Clinchy, Goldberger, and Tarule, 1986, p. 45)

The received knower retains much of the perspective on authorities that the silent knower holds. The authorities own all knowledge, and dispense it at will. However, for the received knower, there is not the lack of hearing of the silent knower,
but rather, a dependence on words. Where the silent learner does not believe she can hear the authorities explain why, the received knower insists on hearing. She focuses on listening, and views the holder of the knowledge in terms of "Authority-right-they" (p. 44). The received knower's thinking is sharply dichotomous and these women are intolerant of ambiguity. Knowing that there is "only one way" is a comfort to the received knower.

Becker's illustration of the case of the base angles of an isosceles triangle again demonstrates a way of knowing mathematics. Where the silent knower is aware that the teachers think the base angles are equal, the received knower believes the base angles are equal because the teacher has said that they are. Even though the teacher is still the ultimate authority, the words of the teacher are heard by the learner and reflected by her.

**Subjective Knowledge: Personal, Private, and Subjectively Known**

Although they may not have taken the next step of speaking out to others about their perceptions of the world, of acquiring a public voice, they engage in self expression ... [t]hese women are "gaining a voice" and a knowledge base from which they can investigate the world. (Belenky, Clinchy, Goldberger, and Tarule, 1986, p.86)

For the subjective knower, knowledge is personal and private. She becomes aware of her inner resources, and realizes that the "authority" does not hold all knowledge. She begins a move to become her own authority. Movement into this perspective is less dependent on age or educational experience and more dependent on the experience of a failed male authority. In a society that "teaches women to put their trust in men" (Belenky, Clinchy, Goldberger, and Tarule, 1986, p. 57) for defense,
economics, and power, the absence of or loss of a male authority leads the *Women's Ways of Knowing* subjective knowers to disappointment and outrage. It is women from such failed experiences who move themselves in the subjective perspective.

Most of the subjective knowers of the *Women's Ways of Knowing* study were positive and forward-looking. They maintained an openness to new experiences. While learning in this perspective, a woman listens and watches inwardly, and is aware of an ever-changing self.

For women in the subjective perspective, that the base angles of the isosceles triangle are equal is obvious. These knowers recognize gut feelings. In a mathematics class, they might say of the isosceles triangle, "I know that base angles are equal. Just look at them; they're equal" (Becker, 1995, p. 165). The authority begins to move from the teacher to the student, and the student recognizes that authority in herself as her own opinion.

**Separated and Connected Procedural Knowledge: The Voice of Reason**

...others have discovered that the inner voice sometimes lies.

... [and they want] to see things 'the way they really are' (Belenky, Clinchy, Goldberger, and Tarule, 1986, p. 99)

The women in the procedural perspective choose neither a ready acceptance of authority nor a trust of their own intuitive knowings. They are critical of their own thinking, and careful and reflective in speech. They desire to see from multiple perspectives, integrating reason and intuition.

The procedural knower emerges positioned within one of two strands of separated and connected procedural knowing. The separated procedural knower reveals
a separation between the knower and the object, as well as elements of control, mastery, and the impersonal. She learns what it is "they" want her to think, and learns to view the world through the lens supplied for her.

The separated knower prefers to remove and suppress the self, to "weed out the self" (Elbow, 1973, p.171 as cited in Belenky, Clinchy, Goldberger & Tarule, 1986, p. 109). She maintains a distant, separated relationship with knowledge. Feelings and personal beliefs are excluded from the separate knower's moments of meaning making. She takes an impersonal stance toward the object. In the case of the isosceles triangle, the separated procedural knower might respond with "I know these are equal, but maybe all base angles are not. I need a proof" (Becker, 1995, p. 165).

In the connected procedural knower, understanding dominates the knower's needs. She maintains a sense of a connection between her knower-self and the knowledge; she prefers to be intimate with the knowledge. Belenky, Clinchy, Goldberger, and Tarule explain that this intimacy between a person and an idea "is not so different from the joy we feel in close relationships with friends" (1986, p. 102). Logic is used solely for the purpose of understanding, and for the subjective knower, understanding means that "the object-other has responded to us" (Noddings, 1984, p. 169).

The connected procedural knower works to build common experiences with others and group connections within those experiences. That search for a common experience includes a desire to connect with other people's knowledge. Instead of wanting a proof that in all isosceles triangles, the base angles are equal, the connected procedural knower would want to examine the triangles and conclusions of other people (Becker, 1995).
Although a dominance of one form of procedural knowing or the other is usually apparent in procedural knowers, the women in this perspective display the presence of both strands. It is the presence of both strands that indicates a procedural perspective.

**Constructed Knowledge: Integrating The Voices**

These women want to embrace all the pieces of the self in some ultimate sense of the whole ... They want to avoid what they perceive to be a shortcoming of men - the tendency to compartmentalize thought and feeling, home and work, self and other. (Belenky, Clinchy, Goldberger, and Tarule, 1986, p. 137)

The constructed knower integrates thought, feeling, and experience. She sees the development of a sense of whole as a goal, and begins putting together the pieces of her being. She creates not only her own authorities and her own system of knowledge and knowing, but also her own voice with which to communicate her understandings. The constructed knower appreciates complexity, especially the complexity of her own self. She stays aware of the workings of her mind, and finds this awareness vital to her well-being. The constructed knower would want to know why another person thinks the base angles of an isosceles triangle are equal (Becker, 1995).

Some women display what Belenky, Clinchy, Goldberger, and Tarule call passionate constructed knowing. This is "the elaborated form connected knowing takes after women learn to use the self as an instrument of understanding" (p. 141). It's the integrating, the weaving through of their passions and their intellectual life. As with all of the constructed knowers, attentive caring becomes important both in understanding
people and the written word. Constructivists also attempt "real talk" or talking and sharing that is more than didactic talk. Real talk is a sharing that results in new understanding.
CHAPTER 3

RESISTING METHODOLATRY

methodolatry: common form of academic idolatry; glorification of the god Method; boxing of knowledge into prefabricated fields, thereby hiding threads of connectedness, hindering New discoveries, preventing the raising of New Questions, erasing ideas that do not fit into Respectable Categories of Questions and Answers. (Mary Daly, 1987, p. 82)

Valerie Janesick (1994) discusses methodolatry and her concerns over it. She believes that preoccupation with methods can consume the energy and substance of the story being told. "Methodolatry is a way to move away from understanding the actual experience of the participants in the research project" (p.215). An over-involvement with method results in a separation of experience from knowing.

With my chosen methods revealing threads of connectedness, and the opportunity for raising New Questions, they are intended as an effort toward the resistance to methodolatry. As such, these methods may break the boundaries of expectation and allow the growth of the further resistance to methodolatry. Still, appreciating the value of
voice and expecting my researcher voice to be heard, I know the need not only for
describing my methods, but for justifying them. Some of my efforts toward that end
follow.

Crystallizing Complexities

As she sits near me
    and
    I feel her power
    I relax with her ... in safety
and I look at her.
My sights explore
    more deeply at every turn
I see in her such intricacies -
    affecting influences
    like frozen memories
    seemingly suspended in air
and I see (imagined?)
    flashes of color
    as she reacts to
    light-energy.
Knowing this crystal
    - it's just a rock -
    there are lessons to be learned
    in knowing you, friend,
and in knowing me.

Virginia Olesen (1994), in her discussion of feminist models of qualitative
research, addresses both a history and a description of various models of feminist design.
In her discussion, she recognizes that issues abound, and it is the existence of issues and
the range of feminisms that precludes the resolution of feminist methodology into a single
comprehensive model. However, since the "complexities and problems of women's lives, whatever the context, are sufficiently great that multiple approaches via qualitative research are required" (p. 169), it seems that the notion of attempting to resolve feminist methodology into a single model is a moot point.

I believe women's negotiation of the Space/Barrier to be quite complex. The concepts of women, mathematics and the Space/Barrier themselves are clearly complex. Therefore, the use of multiple methods to explore my problem in this study is appropriate. The use of multiple methods provides multiple data sources and indeed a broad view, as with a wide-angle lens, of the phenomenon of how women develop as they move through the Space/Barrier.

In employing multiple data sources, my effort is not to validate findings through triangulation, as some may be inclined to think. Triangulation, the opportunity to view a particular object from multiple perspectives, carries with it the assumption that there is an object to be viewed. Hoping to see as much of the view and to flesh out as much information as I am able so as to grasp some meaning within the complexity, I prefer to follow an alternative proposal. Laurel Richardson (1994) suggests that validation be modeled not by a triangle, but by a crystal. With crystallization we can combine "symmetry and substance with an infinite variety of shapes, substances, transmutations, multidimensionalities and angles of approach" (p. 522). The model of the crystal thus allows a "deepened, complex, thoroughly partial understanding of the topic" (p. 522).

To the end of developing a complex and extensive enough understanding to expose a "thoroughly partial understanding" of my participants' ways of knowing mathematics as they negotiate the Space/Barrier, I have pursued crystallization in my selection of methods. I have included the gathering of oral mathematical autobiographies and individual interviews, group interviews, demographic information, participant written
responses to open ended questionnaires and demographic requests, participant responses
to synthesized data sets, as well as researcher field notes and reflections, and peer
debriefing opportunities as data sources. Additionally, even though I had designed a
sequence and timeline for data collection and had followed my design, places for variation
emerged in the process. As I collected my data, and began early synthesis, I found needs
and opportunities for further components in the design. I addressed those needs as they
arose, thus adding to the overall design. A more explicit delineation of the data collection
process follows.

The Who And How of Participation

The Amazon-Warrior Participants

The women participating in this study belong to a group of E/elementary school
teachers who participated in a regional program to become Mathematics Teacher Leaders
(MTL), and from which they were solicited. The regional program was an on-going
professional development effort of one of the state's Regional Professional Development
Centers. The purpose of the program was to support K-6 teachers of mathematics in the
implementation of the state mathematics model. A cohort of 146 teachers, representing all
12 counties in the region, participated in the program by attending 2-3 sessions per year
since the summer of 1993. Program meetings were designed to help teachers improve
their understanding of mathematics teaching and learning, as well as to help them support
other teachers in district and county reform efforts. I was a part of the planning and
implementation of the program since the summer 1993 cohort's first involvement.

In a grounded survey administered to the full group of teachers enrolled in the
regional program two years prior to this study, many of these women were found to have
had negative experiences in mathematics before becoming teachers. This finding was
similar to pilot study findings regarding past experiences of elementary teachers of mathematics (Erchick, 1995). The pilot study teachers were elementary classroom teachers, and were not specialists in teaching mathematics. In contrast, the regional program's teachers were selected for the program because they were viewed as exemplary teachers of mathematics, or particularly innovative or comfortable with teaching mathematics. The experiences of the teachers of the regional program differed from those of the pilot study teachers in that the regional program's teachers had more extensive and varied experiences as students of mathematics. That is, the regional programs' teachers chose to study more mathematics than their pilot study counterparts both as students and as developing professionals.

The strategy for the sampling for this study was purposeful, with the intention of gathering information-rich cases for study (Patton, 1990). This study involved the exploration and description of women's development of their ways of knowing mathematics. Previous work with the regional program's teachers and discussions with the program coordinator supported my own hypothesis that many of the program's teachers demonstrated change in their perspectives on mathematics as they participated in the program. Therefore, the women of the regional program held the potential of being "information-rich" cases in my exploration of their development in mathematics, and subsequently, their negotiation of the Space/Barrier.

The foremost strategy guiding the recruitment of volunteers was the notion of intensity sampling (Patton, 1990). Intensity sampling provided the logic that cases chosen for study were those which were information-rich because they were unusual in some way. With the decision to recruit from the regional teacher group, I limited descriptions of change to a sample where cases of growth in mathematics occurred more intensely than in the overall teacher population. These regional teachers were special in
their experience of prolonged, ongoing, and connected professional development, as well as in their participation in mathematics study (as mentioned earlier). Data contained in an initial demographic request informed my selection of participants as well (Appendix A).

Following a discussion with the coordinator of the regional program, an agreed-upon program session was chosen as an appropriate opportunity to begin soliciting volunteers. As stated in the oral solicitation script (Appendix A) and the letter of solicitation (Appendix A), volunteers were asked to self select as women who have experienced change in their relationship with mathematics and mathematics education. The process of recruiting volunteers involved rounds of recruitment, and a snowball sampling strategy. "By asking a number of people who else to talk with, the snowball gets bigger and bigger as you accumulate new information-rich cases" (Patton, 1990, p. 176). In this way, a sampling of the most information-rich cases was more likely. Additionally, once the process began generating a repetition of names already solicited, it was assumed that the most information rich cases had been found.

The process of recruitment began with the selection, with the help of the program coordinator, of a program session where initial solicitation would occur. The solicitation of first round volunteers occurred at the selected meeting, and those volunteers were asked to suggest other program teachers who have exhibited evidence of change in their perspectives on mathematics for possible involvement in the study. Some of the suggested participants were program teachers who were not in attendance at the selected meeting.

Second and a third solicitations were made from among the recommended program teachers, and the list of volunteers was compared to an initial list of recommendations made by the program coordinator. Since, in snowball sampling, "the chain of recommended informants will typically diverge initially as many possible sources
are recommended, then converge as a few key names get mentioned over and over" (Patton, 1990, p. 176) it was appropriately found that, three solicitation rounds sufficed to bring the sampling to the point where some repetition began to occur. Repetition assured me that I had found the most information-rich cases.

The first, second, and third round solicitations resulted in 6 regional program participants and one mathematics specialist who was not a part of the regional program. I decided to include the seventh teacher, Lindsay, for a number of reasons, even though she was not a member of regional program. First, Lindsay was an E/elementary certified teacher, with experiences as a student of mathematics that were much like the experiences of the others in the sample. She had also had extensive and ongoing professional development which she had pursued independently. She had experienced professional development in programs through her school and through the regional professional development center. Lindsay was also what I would call a second generation regional program teacher. Another teacher in her building who was a regional program teacher had been teaching and mentoring her. The two had also collaborated on presenting professional development in mathematics in their building.

The Settings for Data Collection

Individual interviews and autobiographies were recorded at sites chosen by the individual participants. The recording felt comfortable to me and seemed to be comfortable for the participants. The atmosphere was relaxed, and much more than the official data collection time was spent talking about school, homes, children and often life as a maturing woman. The autobiographies were recorded early enough in a warm fall season that some of the data collection occurred out of doors. Leigh shared her autobiography with me at a picnic table outside a fast food restaurant over a cup of tea. Bridgett and I sat on the grass outside a local public library and Claudia and I moved from
her classroom to a sunny porch at her school. Amy and I went to a local specialty coffee shop to record her autobiography, and Carrie and Lindsay told their stories in their classrooms. Lindsay brought out a pile of candy that she used as rewards for her students for us to partake. She said it had been that kind of day.

Claire was on maternity leave until November of the school year, so her autobiography was recorded before she went back to school. She told her story at her home. We sat in her living room and she rocked her newborn daughter, Elizabeth, and took care of some usual baby needs. It was interesting to have the baby there because Claire often referred to Elizabeth when talking of her own experiences with mathematics. She mentioned often that she hoped that things would be different for Elizabeth whenever she was in school and learning mathematics. Claire also was able to talk of what would matter for a girl to know about learning mathematics in terms of her own child.

The locations of the two group interviews were as different as they could be. One group chose to meet in a conference room at a local public library after the dinner hour. The room was quiet and private. The other group chose to meet at a restaurant after school. We ordered appetizers, and were interrupted many times by personnel. In both cases, I took responsibility for making arrangement for the space; again, the participants seemed comfortable for the interview.

By the time of the recording of the follow-up interviews, the weather had turned cold and out of doors recording was not as possible. Claire again asked to meet at her home with Elizabeth, and Bridgett again met me at the local public library; this time, though, we met indoors. Leigh and I met at a coffee shop and the rest of the teachers had me come to their classrooms.
First Steps In Data Collection: The Autobiographies

As already mentioned, autobiographies were taped as a first step in data collection. Participants were informed in advance of the intentions of the study and understood the purposes. They were therefore able to reflect on their herstories if they so chose. For the interview, the participants were first asked to share their math stories. At the conclusion of each participant story, selected questions were asked. The questions were intended to elicit elaborations on topics mentioned, or to address topics not mentioned (Appendix B).

Preliminary Analysis and Reading

I completed a preliminary analysis of the autobiographies following their transcription, and developed questions for the group interview to follow. While I was conducting the preliminary analysis, the participants were asked to read a paper about the application of the Women's Ways of Knowing theoretical frame of the study to the field of mathematics education. The paper, "Women's Voices and the Experience of Mathematics" (Appendix D) was given to each participant at the conclusion of the recording of the autobiography. This reading was intended to help keep the participants informed as to the focus of data collection and analysis. Such knowledge allowed the participants to review their experiences through the study's lens of women's development.

I felt a conflict arise within me with the participant reading of the Voices paper. I felt the need to keep the women informed of what I would be thinking as I read through their stories and began my analysis. It seemed to me to be a deceptive move to choose not to share my analysis perspective with them. I felt, too, that they could provide some
rich insights regarding their development if they both understood the implications of the model and would direct their feedback to me in terms the model. They, in essence, would be participating in the analysis of their ways of knowing.

However, I was also concerned with the exposure of the women to the Voices paper. I worried that such an exposure would not merely help the participants direct responses to me in terms of the model, but would actually contribute to responses tailored to fit the model. I was less concerned with a contamination of the responses from participants, than with an unnatural, artificial structuring of the responses, a fitting of the responses into the model of the Voices paper.

I finally came to a resolution that was no more than an internal acceptance. The need for me to be open and honest with these women was greater than my concern about the potential for artificial structuring of responses. I would be able to work with what resulted as "contaminated", structured responses from the participants. I would not be able to work with my deception of them.

**Data Take Two**

The second step in the data collection was the focus group interview. I facilitated one focus group interview for each of two groups. The focus group interviews were chosen as part of the data collection process in the hopes that a group discussion would jog memories and therefore cause the participants to reveal more about their pasts than they had done in the autobiographical telling. I had also hoped that I would be able to focus in on common themes that emerged from the autobiographies for points of discussion in the groups. I wondered, too, about how the group discussion would turn with the opportunity for the participants to interact on topics like gender in the classrooms.
Placement in the focus groups was dependent on the common experience of the grade level taught by the teachers. Those in grades 1, 2, and 3 formed one group and those in grades 5 and 6 formed the second. The interview questions for each of the two groups were individualized for the particular groups (Appendix B) and were very open ended. I asked for elaboration on topics from the autobiographies, and in some cases asked women to share experiences with the group that they had already shared with me in the autobiography.

Although I felt that the experiences of the participants in each group, as well as their philosophies on teaching and learning mathematics, were as consistent as I could expect within each of the focus groups, I was troubled by the apparent chaos of each of the group interviews. I felt that I was prepared for the interviews because I had conducted group interviews with larger groups of people in the past. I was also prepared for my study's group interviews with questions that were grounded in and based on previously collected data about and from the participants. Still, all I could recognize coming from each of the group interviews was a sense of chaos and a question of whether or not there was anything of substance in the experience with respect to this study. As it turned out, there was, but that realization came to me only after I created a distance from the moment for myself, and after I completed the transcriptions.

At the conclusion of each group interview, participants were asked to complete a short open-ended questionnaire. The purpose of this questionnaire was to draw from the participants any information that they would like to share but felt they were unable to, for any reason, within the group interview (Appendix C). Field notes and researcher reflections were included in the collected data at that point as well.

45
Re-Analysis and Re-Interviewing

A second analysis resulted in the individualized protocols for each of the participants' follow-up individual interviews. The questioning in the last interview was intended to clarify and elaborate upon emergent themes and ways of knowing (Appendix B). Primarily, the questioning centered around the autobiography.

Synthesis

I wrote each participant's mathematical biography in an attempt to synthesize the individual data sets. The individual biographies provided a manageable document for each of the participants to review for the purpose of feedback, reaction, correction and any other responses they felt inclined to include. The biographies were written as a chronological retelling of the participant's math stories, with selected sections addressing themes that emerged in the women's stories. The pseudonyms used in the biographies were chosen by the participants. The source for their choices was not always made clear although some choices were either explicitly explained or became apparent in the women's stories. One participant chose a name she would have liked to use for a daughter, two chose the name of a daughter, and one chose her birth name.

Participant Re-Involvement

Once all of the mathematics biographies were written, I mailed or delivered each participant's biography to her. These draft biographies included occasions where questions arose in synthesis and clarification was necessary, so participant feedback was requested. Included with the biographies, each participant received requests for additional data in the form of a post interview demographic request (Appendix C) and a post interview individualized questionnaire (Appendix C).

The intent of this last data collection was to "level off" the data sets of the participants. As it was, the autobiographies were quite open ended. The women had the
opportunity to select the focus of their stories, as well as the content and structure. I did have the few questions following their stories that I asked of all participants, but the bulk of the autobiography was determined by the teller.

Some of the women chose to tell much about their families and others told more than most about their teaching experiences. I had not considered some of the topics they discussed, but did choose those I thought were particularly rich for this study and asked for more information. In that way, as I filled in parts of various stories, the sets of data became more equal, and thus leveled off.

I picked up six of the seven responses personally during the last week in February, 1996. The last of the biographies and questionnaires arrived in my mail on March 11, 1996. The data collection (other than the demographic data collected in the solicitation process) began with the first recording of an autobiography on October 12, 1995, and was concluded with the written responses to the biographies and individualized questionnaires, the last of which was received March 11, 1996.

Data Analysis

I began analyzing the data through a coding process (Lincoln and Guba, 1985) identifying experiences based on the perspectives of knowing defined in Women's Ways of Knowing. Statements suggesting participant positioning within any particular perspective were noted as were indications of movement between perspectives of knowing. I recorded incidences suggesting positioning of a participant in a particular perspective on a matrix which included the Women's Ways of Knowing perspectives and the seven women participants. A sample of the matrix is included in the audit trail discussion.
Following the initial analysis, a theming analysis was conducted. Themes based on topics such as teacher behaviors influencing participant-as-student movement between perspectives, and gender role influences were identified.

Audit Trail

The data used in the biography were identified within the text by a coding process as follows:

- D1: Demographic Request 1
- A#: Autobiography and page number
- MFG#: Morningview Focus Group and page number
- EFG#: Eveningside Focus Group and page number
- VR: Voices response
- PFGW: Post Focus Group Writing Request
- F#: Follow-up Interview and page number
- PIIQ: Post Interview Individualized Questionnaire
- PIDQ: Post interview Demographic Questionnaire
- BR: Biography Responses
- B#: Biography and page number.

For example, in the following excerpt from Amy's math biography, her discussion of factors relating to gender is constructed from statements made in her autobiography, the focus group interview, and Amy's follow-up interview.

She came to a belief that to be a mathematician, one would need be “resourceful” (MFG15) and “see that math is everywhere...that we use math everyday, and that it is a natural thing” (A9). Amy also came to the belief that even though mathematics is “male dominated” there is not “a reason that it shouldn’t be equitable” (A13). Still, Amy recognized that in society, “in the business world, and out in the beyond-school world, it’s going to be a slower process [than in the schools] to change that traditional ‘math isn’t for girls. It’s for the guys’” (F6).
During the coding and theming analyses, the data were again identified by location within the data set, and by page number where applicable. However, references were no longer made to the raw data sources at this stage. Citations for these analyses were drawn from the sets of the synthesized data, the biographies. For example, I made a matrix in the coding process where I identified moments of various ways of knowing as found in the biographies. A sample from the matrix is found in Table 1.

<table>
<thead>
<tr>
<th>Participants Perspectives</th>
<th>Carrie</th>
<th>Lindsay</th>
<th>Claudia</th>
<th>Claire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjective Knowing</td>
<td>MTL Workshop, no steps given, talking together (B6)</td>
<td>Independent classes, &quot;no one up front&quot;, had to do own thinking (B10)</td>
<td>change in teaching with only self as justification (B6)</td>
<td>taught self when teachers failed her (though not &quot;male&quot; authorities?) (B16)</td>
</tr>
</tbody>
</table>

Table 1: Sample of coding process matrix

Typically, an audit trail consists of levels, or categories, of auditing (Lincoln and Guba, 1985) and that aspect was present in my audit trail. However, the levels cited in my analysis were fewer than recommended by Lincoln and Guba. One of the categories suggested by Lincoln and Guba was the raw data source. I transcribed my audiotapes verbatim and found accessing the data easier from the transcripts than from the tapes. Therefore, although the tapes were available for review as a category within the audit trail, they were not cited directly as a source in my analysis.

Other categories expected in the audit trail included reflections, field notes, interpretations, intentions (proposal), and development of the project (including pilot study processes and findings). All of these suggested components of an audit trail were included in some way in the write up of my project. As such, all were and are open to
review. However, these categories were not necessarily a part of the coded audit trail of my analysis. I have limited the meaning of audit trail in this study to the tracing of the data sources directly generated by the participants of the study.

**Time Line**

The solicitation of participants for the study was completed in early October, 1995. The collection of the data began with project approval and, especially in terms of data generated in the form of my own reflections and interpretations, continued for the duration of the write up. The starting date for the collection of data from the participants was October 12, 1995. The data collection from the participants, including their review and response to the their mathematical biographies, was completed by March 11, 1996.

<table>
<thead>
<tr>
<th>Date Range</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 6, 1995</td>
<td>Solicitation completed</td>
</tr>
<tr>
<td>October 12-26, 1995</td>
<td>Recording and transcribing of autobiographies</td>
</tr>
<tr>
<td>October 12-November 1, 1995</td>
<td>Participant reading (Voices) MFG</td>
</tr>
<tr>
<td></td>
<td>Researcher preliminary analysis</td>
</tr>
<tr>
<td>October 26-November 28, 1995</td>
<td>Participant reading (Voices) EFG</td>
</tr>
<tr>
<td></td>
<td>Researcher re-analysis</td>
</tr>
<tr>
<td>November 1, 1995</td>
<td>Group interview, MFG</td>
</tr>
<tr>
<td></td>
<td>Writing request following group interview</td>
</tr>
<tr>
<td>November 28, 1995</td>
<td>Group interview, EFG</td>
</tr>
<tr>
<td></td>
<td>Writing request following group interview</td>
</tr>
<tr>
<td>November 1-December 6, 1995</td>
<td>Further transcription and analysis of data</td>
</tr>
<tr>
<td>December 6, 1996-January 10, 1996</td>
<td>Follow-up individual interviews and transcription</td>
</tr>
<tr>
<td>January 10 - February 15, 1996</td>
<td>Completion of transcription, writing of biographies</td>
</tr>
<tr>
<td>Date Range</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>February 28- March 11, 1996</td>
<td>Completed collection of responses and</td>
</tr>
<tr>
<td></td>
<td>individualized questionnaires; start of coding and</td>
</tr>
<tr>
<td></td>
<td>theming analyses</td>
</tr>
<tr>
<td>March 11, 1996 - April 22, 1996</td>
<td>Write-up of study - first draft</td>
</tr>
<tr>
<td>April 23, 1996 - May 20, 1996</td>
<td>Revisions</td>
</tr>
</tbody>
</table>
CHAPTER 4

THE MATHEMATICAL BIOGRAPHIES

I have included here the mathematical biographies of the seven women participating in this study. These biographies were written by me primarily for the purpose of synthesizing the data. The participants did not necessarily share their autobiographical information in any chronological or topical order. Additionally, the data were collected from a variety of sources. So that I might begin systematically to review and analyze the data, I used the writing of the biographies as an organizational tool.

Amy

I have been teaching teachers about math and people come to me now ...I know there is more out there all the time.... It sure has made me grasp at whatever I can to help them build confidence in what they are doing (A1).

Amy is a white 43 year old woman who grew up as the youngest of four children in a "typical middle class ethnic family" (BR1). Her mother had earned a college degree and was an insurance adjuster and secretary. Amy's father had not gone to college, but
had graduated from high school and worked in management in steel mills and car factories. Education was valued in Amy’s suburban home, and the children were all expected to work hard and go to college.

Amy believed that neither her race nor her class had any impact on her learning of mathematics. However, she believed her gender had an impact on her learning of mathematics. That impact was described by Amy as being the case that she “always felt inferior/less confident ... until adulthood!” (PIDQ).

Amy teaches in the same rural district in which she lives. The district is outside a major urban area in the midwest. Amy has been teaching for 23 years. She took five years off from full-time teaching to stay at home with her young twins, but did some substitute teaching during those years. She began her teaching career as a fifth grade teacher, has since taught seventh grade and third grade. Amy has been in her current teaching assignment in a first grade classroom for the past ten years.

From the Beginning

Amy had no recollection of mathematics learning prior to seventh grade. It was in that year that Amy first learned from her teacher that she was not a good math student. The first learning by Amy of her poor aptitude in mathematics occurred while she was at her teacher’s home. The math teacher’s daughter was a friend of Amy’s and the two girls had grown up together. This friend and her family lived next door to Amy’s uncle who was the principal at Amy’s school. Amy was studying math with her friend at her friend’s home, when the following incident occurred:

We had to memorize the squares of numbers to 25. That was our first quiz right off the bat...[W]e were studying this, and he [the teacher] came into the bedroom where we were and said, “You really need to go home and study this. You don’t know this.” I was crushed. I went home and cried. My mom tried to make me feel better about it...I was really crushed and he basically made me feel that I wasn’t very smart in math (A4).
Another seventh grade event which reinforced Amy’s belief that she was not a
good math student happened during a parent-teacher conference. While her mother was
in the classroom talking to the teacher, Amy was standing outside the classroom door
waiting. Her mother asked the teacher “how he thought [Amy] was as a math student.
He kind of wrinkled his nose up” and Amy found herself thinking “Oh, Yuck.... I’m not
very good at this”. She then “had that feeling all the time.” Her grades in the class were
not as good as her usual school performance, and a letter grade of C reified the message
to Amy that she was not good in math (A4).

It was not just what Amy received in this seventh grade class but what she didn’t
geret that contributed to her belief that she was not very smart in math. Amy did get that
grade of C, and because she and her friends were “highly grade oriented” and a C was
”like getting an F” for her, Amy was “just so disappointed.” What Amy did not get in that
seventh grade class was support from the teacher. Amy did not hear “Well, it’s okay.
We can get you to do this, or let’s go back and look” (F2).

Additionally, Amy was not pleased with the environment of the classroom that
seventh grade year. First, the style of the teacher “was that old very traditional” and
included a particular policy and method of teaching. Amy summed up the teacher’s
procedures and policies with the following example of his instructional method: “Here’s
how you do it. Now here’s the work. Now get going. No, you’re not allowed to get up
and ask a question.” In later years, Amy came to another conclusion regarding the
experience of that seventh grade classroom. Admitting that she “didn’t know this then,”
and now looking back on it all, Amy felt that the teacher “thought more of the boys in the
class.” In this general math class, the lower of the seventh grade math classes, there
weren’t very many boys and the teacher “doted on the guys” (A4).
Amy’s math experiences changed the following year. Entering eighth grade with the feeling that “I’m just not very good at this”, Amy found her eighth grade teacher to be “a wonderful teacher who changed that feeling a little bit.” The eighth grade class was a Pre-Algebra class. Amy’s grades were better and she earned all As. Although Amy was not certain what the difference was for her in this class, she did eventually conclude that “actually, it was probably just the teacher’s attitude” (A4).

The attitude of that eighth grade teacher contributed to the overall environment of the class and Amy’s memory of the experience as pleasant. “That pre-algebra teacher was fun, and he laughed a lot...He’d turn things around, and make jokes of everything... He enjoyed all the kids, and he gave you help.” When either the teacher or the students made mistakes, it was okay, and Amy thought about her own mistakes in terms of "Yeah. That's okay", too. The teacher even mocked himself in his own mistakes and Amy thought was “neat” (A4-5).

The High School Years

Amy studied Algebra I in ninth grade and then Geometry in tenth. Although she had little memory of the tenth grade class, she did recall much of the Geometry experience. Many students did not like the Geometry teacher, and he “was kind of old style.” Amy liked him, though, and learning Geometry from him.

He gave you his time. He always said, ‘Now if there’s anything you don’t understand, see me and we’ll find a time. I’ll be available whenever you want.’ He was good about that...He was rather strict, but you could argue a point with him. If you thought your answer was right, or if you found a better way, he would listen (A5).

Amy was a part of what she jokingly referred to as a “very athletic class” in her junior year Algebra II class. The teacher was the only Algebra II teacher in the school at that time. “He was also a coach and, of course, he’s going to suck in the sports, the
athletes.” Amy’s perspective on herself as a student of mathematics seemed to have changed by that time. At least in that particular class she “always felt that [she] was smarter than some of those nice little athletes” (A14).

In spite of feeling smarter than the athletes, it was not Amy who went on to senior Calculus, but, rather the boys. Amy voiced some regret and anger with herself over her choice not to continue into senior Calculus. As she put it, “I could kick myself now...If I had it to do over again, with the knowledge that I have now, I would have gone on”. However, back in high school, Amy’s thoughts on this were different. She believes that she chose not to go onto the senior mathematics because she “didn’t want to be up against the guys. They all appeared to be the top of the class kids.” So, even though Amy was feeling smarter, she still chose not to go on with more high school math because she just “didn’t have confidence” (A13-14).

**College Mathematics**

Amy went on to college where her math experiences included economics classes, as well as the methods and math content courses for her elementary education major. Of these, Amy enjoyed the economics classes for the mathematics and the methods course for it’s practicality. The math for elementary teachers was not a very pleasant experience for Amy and seemed to be more of the same of what Amy had learned that math was about. Amy explained why she so enjoyed the economics classes.

I understood it, for one. I thought it was interesting. It was something I had never thought about, with applying math to something. I always thought that history, government and stuff was here (motions to one side) and math was here (notions to the other side). Economics...pulled those things together, and I thought “Oh, they kind of relate.” I think that showing that relatedness was eye-opening (A5).

Yet, this first recognition of the connection between mathematics, government, and history was only part of the reason that Amy liked her economics classes. The
professor was interesting and helped develop the sense of relatedness with mathematics. The economics classes were also places where communication was a part of the environment. Since Amy "loved history...[and] you could talk about it and the other, together", she enjoyed the economics classes (A5-6).

Contrasting the economics experience with the math class that was especially for elementary teachers, Amy remembered that there was too much content in the math for elementary teachers. Not only did Amy wonder, as a pre-service teacher, "how this was going to relate" to what she was going to need to do as a teacher, but the presentation of the content was problematic for her as well. The content was presented as disconnected topics. Amy believed there needed to be an awareness of and some kind of knowledge of all that was presented. "But", she asked, "couldn't it have been presented some other way?" As it was, Amy described the class. There was no kind of project. Nothing but "Here's a concept. Here's how you do it. Here's another concept. Here's how you do it."...In one day, you could have talked about 10 topics. And nothing was connected. You might have found some Calculus to Geometry, but not showing any relatedness" (A6).

The combination of too much content and no connectedness among the topics led to some concern for Amy. Her frustration was revealed in her description of her learning strategies.

You just frantically took notes and "Oh my gosh, I've got to separate this from this. I've got to do this." And when I took the test, that's all it was, ... a bunch of these different kinds of problems...but there were hundreds of things to study from. You never knew what was the most important (A6).

The content of Amy's math methods class was focused on methods and management rather than on mathematics content. Amy learned practical tips on classroom and material management, and on discipline. As a pre-service teacher, she had
opportunities to use new ideas in classrooms, teaching math lessons. Amy was pleased with her learning in this class, since that practical component was not a part of some of her other methods classes (A7).

However, new math content learning did not seem to happen for Amy in her mathematics methods class. The math content of the methods course primarily was “basic topics of math that you might encounter in math as teachers... So, we were basically taking a K-8 math class during that time... Just going over finding averages and just making sure that you understood those concepts.” Amy felt she understood the math concepts of that methods class. Some of the work “reinforced” what she already knew; some simply jogged her memory. However, “because you could see the whole shebang” in this K-8 experience, the math content seemed more connected for Amy (F3) than her mathematics class for elementary teachers.

**Beyond Elementary Education**

Math learning continued for Amy after she began her teaching career. Amy learned through the interactions with students in her classroom, with peers in professional development programs and in graduate classes. She learned some about mathematics in these experiences. She was also able to develop her own levels of confidence in learning math.

The notion of connectedness between history and mathematics which Amy discovered in economics class, stayed with her. The idea of connection grew for Amy into a belief that “math is everywhere.” Amy learned some about the idea of mathematics being connected to other topics “just from teaching.” Her students recognized math concepts in different content areas and shared their discoveries with Amy and classmates. Amy talked about her students and said, “They pop up with things and the more you teach the more you hear those things” (F1).
More of Amy’s math learning occurred within professional development experiences. Amy identified a particular situation in her own professional development that “sparked [her] interest and made [her] want to go on.” She was in a class where she learned a way to teach place value with a conceptual, developmental approach. The method used to teach the teachers involved number systems with bases other than ten. Amy “could just feel [her] light bulb going on” as she participated in the class. She was also able to see “little light bulbs going on” in the other teachers as well. Amy remembered “seventh grade math and that dear teacher, and hating it, just hating it” when they studied place value. As an adult, it was especially satisfying for Amy to learn and watch other teachers learn a topic that had given her so much trouble. It was also good to know there was a better way (A11).

From such professional development experiences, Amy was able to identify the components of those classes and lessons that helped her learn, primarily, that mathematics is “a natural thing.” In the teacher workshops that had meaning for her, Amy had seen mathematics “in a context of where it was.” She had also “applied math to things that are relevant ... and done cooperative activities with...peers” (A9).

Amy took a graduate level statistics class, and later talked with other teachers, her peers, about overcoming some of her fears in that class. A colleague talking to Amy spoke of keeping silent in a statistics class. Amy then shared her statistics class experience along with her advice about how to overcome being silent.

I did that and I was so fearful, but, I just thought “I’m just going to do it, because it can’t hurt. All these people are in the same boat that I am, and they all have that same look on their face like I do”... So I just said, “Whatever happened, happened.” And ... there were some times when I probably should have turned three shades of red, saying something stupid. Afterward I’d think “Oh, how ... ?”. You need to just do it once, and then “No. It doesn’t matter anymore” (MFG11).
The Gender Thing

Amy concluded, after reflection, that the seventh grade teacher gave preferential treatment to the boys by “doting on the guys” (A4). She also commented on the Algebra II teacher’s attention to the athletes in class, who became the boys who went on to senior Calculus. As a teacher, Amy considered gender concerns in grouping her children for math activities. She didn’t want to group boys and boys, because she didn’t “want to make this a gender thing” where she might somehow seem to be contributing to the belief that boys are better in math (MFG24). Yet, Amy admitted that she might not be able to avoid the issues. She couldn’t help but wonder, as she looked down the rows of her students, or as she watched the children working in groups, “mathematically speaking...what each would do in a situation.” Amy recognized girls who were “meek and withdrawn” and boys who were "discipline problems", (MFG21) girls who seemed lost and girls who articulated “mature strategies” (MFG22) well. She noticed that a particular student who excelled in mathematics, who was identified as a mathematician by the other first graders because “He knew the answer, and he knew it fast” (MFG23), was a boy.

Amy believed that “we are gender conscious, whether we believe it or not” (MFG24). A heightened gender consciousness contributed to Amy’s observation of what seemed to be happening in her high school mathematics classes.

We were filtering out the girls as the years went on. The gals who were at the top of the class were more the English majors, and history...But the males were going on to the math...So, the gals were going the opposite way (A13). Most of the girls “took up to Algebra II...then we started. There were fewer in the Algebra II.” Although Amy was not in that senior Calculus class, observing the trend led
her to speculate that she would not be surprised if that senior math class was all male
(A13). After those observations, Amy developed some advice for girls who would aspire
to a career involving mathematics.

First of all...don’t let anyone tell you you can’t do it ... take every course that you
can take. Don’t be afraid to try...You’re going to come across stumbling blocks
in people, and probably in society as far as that goes, because it is basically male
dominated, math is. But there is no reason why you can’t continue. There’s no
reason why you can’t do the same job...You just have to keep at it (A 12-13).

Amy moved from seventh grade math feelings of inadequacy, to junior year
feelings of being smarter than the athletes, to adult moments of feeling “confident!” and
“validated!” (PFGW) She recognized that in math learning situations she had come to
where she would put her “2 cents worth in ...would never hold back in a situation...[and]
wouldn’t be afraid of saying ‘I have an alternate solution to that’” (MFG10). Amy came
from experiences where math knowledge “wasn’t natural” (A9), was disconnected and
“not necessarily in any kind of order” (MFG16).

She came to a belief that to be a mathematician, one would need be “resourceful”
(MFG15) and “see that math is everywhere...that we use math everyday, and that it is a
natural thing” (A9). Amy also came to the belief that even though mathematics is “male
dominated” (A13) there is not “a reason that it shouldn’t be equitable” (A13). Still, Amy
recognized that in society, “in the business world, and out in the beyond-school world,
it’s going to be a slower process [than in the schools] to change that traditional ‘math isn’t
for girls. It’s for the guys’” (F6).

Bridgett

Somebody ... said, "I can't believe you know so much about math."
I said to her, "I can't believe you think I know
so much about math" (F12).
Bridgett is a white, 36 year old woman who has taught first grade for 13 of the 15 years that she has been a teacher. She was raised on a farm, and now lives in a home that she and her husband built on two acres of her parents’ farm. Bridgett teaches in the same rural district in which she lives, a district which is near a large urban area in the midwest.

Bridgett sees herself both growing up and currently, as middle class. Both of her parents graduated from high school and valued education. Bridgett was the first in her immediate family to earn a college degree. Her parents wanted her to go back to college and get her master’s degree, and she is now the only person in her family to have a graduate degree. Bridgett says her parents now want her to get her doctorate.

Bridgett is not aware of any impact that her race has had on her experiences with mathematics. She believes that her social class gave her “more opportunities for growth” (PIDQ) than someone from a lower class would have had. Bridgett believes that her gender did indeed impact her experiences in mathematics in that “girls were not encouraged in the area of mathematics as much as boys. (PIDQ)”

**Early Mathematics**

In the lower grades, Bridgett, remembered that she "memorized everything" even though she "never understood anything". All of Bridgett's teachers were female up to junior high, and none, that Bridgett could remember, used any manipulatives to teach math (A1). Bridgett felt she was able to get by in those early grades by virtue of being able to memorize.

I faintly remember flashcards at home. They were not homemade. But, see, I was always ... good.... I never struggled with it. Not until I got to junior high and I really had to understand what I was doing. When you're in the lower grades, you can get by with memorization. Smart children - and I feel I am smart at memorizing.... So, I got by just fine. I think we all (those I associated with in general) did (A28).
Junior High

Bridgett was "scared to death of math" in junior high. She remembers first having an "overbearing" man as a math teacher. She didn’t like math or her teacher. Bridgett was "always angry [going] into math class" in junior high, for a number of reasons. One reason for her anger was she knew she wasn’t going to understand what he was doing. Another reason was his perception of who she was. "I just had a feeling that he just thought of me as a ditzy little blonde who was only into cheerleading ... I probably was a ditzy little blond into cheerleading 'cause I couldn't care less about math.... although I cared greatly about my grades" (A1-2).

Bridgett remembered another male junior high math teacher as a more pleasant person. Bridgett never remembered feeling badly about math in school once she had Mr. Day. She remembered him being "a sweet lovable teddy bear type of guy" (A2).

High School

Bridgett was in a college preparatory track in high school and studied both Algebra I and Geometry. Bridgett loved Algebra and her Algebra teacher. She loved Algebra because it was a formula, she could figure it out, and there was an answer. Bridgett explained further:

I could see why I was going to need Algebra.... There was a missing addend, or a missing problem that I could figure out and I could relate it to the world I was living in....I had the numbers to work with and I could manipulate the numbers as long as I had a formula. I could memorize any formula. I still remember formulas, but ...unless somebody tells me how to plug those in, I'm still scared to death of them (A3-4).

Bridgett's Algebra teacher was a woman and "was an extremely strict teacher". Bridgett felt she "started to learn math with her ... and really started to understand it". But
Bridgett added, "You know what I cared more about than the math was what she was wearing. She always wore color coordinated clothing and I thought she was so cool" (A2).

Bridgett was taught Geometry by Mr. Day, the teacher she liked from her junior high days. In Geometry, she was "totally lost" because of her lack of "mathematically inclined problem-solving skills". As Bridgett explained it,

Geometry takes problem-solving skills and I didn't have any. I didn't think I had any ... and when they put a theorem down in front of me, I couldn't get it. I couldn't do a theorem today if you set it down in front of me ... unless somebody sat down with me and went through the steps and used manipulatives (A2).

Bridgett saw the lack of a use of manipulatives in her high school Geometry class as problematic.

I think that's why I lost out on it was the [lack of] manipulatives.... Everybody always wanted me to do it symbolically and I wasn't ready for that. I had never gotten that manipulative stage and never understood it.... They expected me to go to abstract thought and I couldn't do it (A2-3).

It was during the year she was taking Geometry that Bridgett was captured in a candid photo for the yearbook. In the photo, she was being tutored in math by Mr. Day, and remembered, "they put me in the yearbook with my picture plastered all over the top of the yearbook 'Bridgett gets some necessary tutoring in mathematics" (A3). She said she "was mortified" (A20) and explained why.

I didn't let people know I feared math. When my picture was in the yearbook, I was mortified, I really was, because I thought that everybody thought I was so smart....and that was my senior yearbook... Where's my biggest picture? Being tutored in math class. I ... truly thought that I was fooling everybody. I knew people knew that I would go in and see Mr. Day, but I never really thought about it, that they really knew that I was having trouble with it. And then I was scared ... that everybody knew, that everybody was thinking about me in my high school "Oh, she needed tutored in math. Here I always thought she was so smart". Then I was scared that everyone was going to think I was dumb, because here I was being tutored in math and that worried me for a while. I'm sure that led to my apprehension my freshman year in college. So, I was definitely scared by math (A20).
Bridgett remembered considering different careers in her life, and filling in career forms in school. Bridgett always wanted to be a teacher or an airline stewardess, but her parents talked her out of the airline stewardess. Bridgett’s dad thought she had more skills and wanted her to work for the large auto company with whom he worked. Bridgett recalled, "And he said, 'Why don't you be an engineer?' Well, I, not knowing what an engineer really did or what an engineer really was, just said 'Well, sure. Where would I go for that?'". Bridgett’s father suggested she go to the institute run by his company.

The institute was "of course, loaded with brains" (A6).

Bridgett explained some about her choice of college.

Needless to say, my math scores were not high enough on my ACT to qualify. They were high enough to qualify for a scholarship to the state university ... but they were not a high enough score in the area of math to admit me into [the institute]. So that was nixed out before I got an opportunity. I never would have been happy, of course. Never, ever (A6).

Math At Home

Bridgett saw math in her upbringing on a farm. However, she never thought of those experiences as mathematical.

I saw a bushel basket. Never thought about the bushel basket. Never thought how much is in that bushel basket. Saw bales of straw and hay. I knew that hay was heavier than straw. I never thought of that as a mathematical problem, but it was. Never thought about the fact that when we were pulling the calf out of the mama, that you had to have a certain length of rope because the calf would sometimes pull back into its mama, and if the rope wasn’t long enough, the rope would go right back in also.... Just different things like that that you never thought about. When you show cattle, they need to be a certain height ...and if you go under a certain height, your steer or you bull or your calf isn’t going to show as well.... Those didn’t scare me, because they were familiar to me, if somebody would have said, “Well Bridgett, that’s math” then I would have said, "Well, then, I guess I do understand math." But nobody ever said that to me (A19).

As it was, Bridgett "never saw math in anything except math class" (A19).
Bridgett attended a "high profile school" when she went to college. She was "very intimidated and very scared" because the school accepted only students from the top ten percent of all the classes. This meant that Bridgett was "competing with some really intelligent kids". This was intimidating for Bridgett even though she, too, was in the top ten percent in her high school. She said, "In my school, I was fine. I could stay in the top ten percent and still not know how to do math 'cause I could get one-on-one help" (A4).

Bridgett had to take two classes in college which were general mathematics overviews. As a freshman she thought,

Oh my gosh. I'm never going to survive these math classes.... I immediately panicked, before I even went into the room. I panicked that this was even on my schedule.... Then I had to buy the book.... When I saw the book, I remember crying and saying, 'There's no way. I'm never going to be able to get this.... I can't do this. I can't do this. It's too hard (A4).

Bridgett's first college math teacher was a man who was "very good and very kind". Bridgett thought "it must have just been the look on my face" that prompted him to make himself available for extra assistance. He said, "A lot of the time I'll skim over things I think you've probably had in high school" and he was willing to help any who needed extra attention or felt uncomfortable with anything (A4).

Bridgett did meet with that understanding teacher on a regular basis and learned a lot from him. She learned a lot more than she thought she would, and understood a lot more than she thought she would. The experience helped convince her that she had learned more mathematics in high school than she thought she had.

Bridgett claimed that computers and calculators "never played a role" in her math learning prior to her college experience. She never touched a calculator in high school that she could remember, and was certain she never touched a computer before college.
Bridgett’s school had no computers for student use. Being in college with the top of the
class from affluent suburban districts around the state, Bridgett was aware of the
differences in their experience with technology.

They all had computer skills. They all had calculator skills. I had nothing. I had
never seen these calculators that they were putting in front of me with all these
things all over them . . . I had no idea what these things were . . . I was amazed. I
had never seen anything like that (A5).

Bridgett did end up learning to use the calculator, because she found she could "plug in
... memorized problem-solving skills". She did not use the computer very much in
college, though, because she was afraid of it (A5).

In addition to the math classes Bridgett was required to take in college, a math
methods class was also a part of her education program. The methods class was taught
by a man who was and has continued to be well known and respected statewide in
mathematics education. Bridgett remembered,

He was the best. . . . Immediately I felt like I could teach math . . . Everything was
manipulatives with him. . . . We were playing with things from day one, and he
made me feel much more at ease with math. . . . He told us, 'All of you out there
who think that you don't know enough about math to teach it are wrong. . . . I'm
going to teach you the tricks of the trade, so that you will be able to teach any
child anything that has to do with mathematics'. . . . After I had that class I felt
much better, but I still felt like 'yeah, right, as long as I stick with first or second
or third grade, I can do it (A6-7).

Even with the extensive use of manipulatives that Bridgett experienced in that
methods class, she sees the use as limited by today's standards. As a teacher, Bridgett
has learned about many different kinds of manipulative materials and varied contexts in
which to use them. Bridgett finds her use of manipulatives in her college methods class
to be minimal in that there was no variation in the kind of manipulatives used. Still, the
use of manipulatives was memorable for Bridgett because she didn't remember using
manipulatives at all before that class (A7).
Bridgett began her teaching experience without the manipulatives of her methods class. She simply followed instructions from the texts. In both her student teaching and early job experiences teaching second grade, Bridgett found that teaching math was easy. 

[It] was a piece of cake. I had a teacher’s manual. I just did everything the teacher’s manual told me to do... Everything was fine [in second grade]. The person I took over for said, ‘Just go by the math book.’ So, that’s what I did. Did everything the teacher’s manual told me to do. Never sought out too much more ... never used manipulatives (A7).

Bridgett then started teaching first grade. She began to realize that the students weren’t getting it because they weren’t getting to deal with it in a concrete way. Not at all. They never had punch-outs at the end of the book, unless it was for money and a clock....They never had any kits or things that you could buy to accessorize the math curriculum, that I knew of, that were available to me (A8).

Bridgett knew she wanted to be a different kind of math teacher than those she had experienced. She remembered,

I just knew the way I learned was not the way that I wanted to teach. I did not want children to be rote memorizers, especially when it came to math, because it didn’t work for me. It was so frustrating when I got to the college level and I knew that I didn’t want my students to feel like that (F1).

**Graduate School**

After Bridgett had been teaching for 1 year, she began to work on her masters degree. Bridgett took a required statistics class in which over 250 students were enrolled.

The class was held in an auditorium. Bridgett talked about being in that statistics class.

I thought I was going to die.... Everybody kept saying “Oh, it’s the worst, it’s the worst, it’s the worst”....[The teacher] had an overhead, and I always sat right up front. I knew that if I did not sit right up front, I was not going to get it. So I sat right up front and took notes on every single thing, ’cause I knew that that book was not going to help me to understand. I needed to hear. I’m definitely a visual and auditory learner. I am not a read it and get it type person (A8).

Bridgett talked more about what it did and did not mean for her to have the visual work for her in her statistics class.

I had to be up front.... He did everything on the overhead. I was constantly watching the overhead. But not only was I watching the overhead, I was
watching his hands, watching his gestures. I could tell what was most important and what was least important, just by watching his movements. If it wasn't very important he tended to walk away from the overhead. If it was really important, he stayed right at the overhead, and he would be pounding or pointing or circling or pointing up to the overhead. Otherwise, if it wasn't real important, he seemed like he was walking away. He'd walk away and kind of just talk to us. And then he gave specific directions about the test, and specific things we should be looking for. I was taking notes on every single thing he was saying (A30-31).

What visualizing did not mean for Bridgett was visualizing mathematics. She explained.

Oh, no. No. I didn't visualize mathematics. No, not in statistics. No. I couldn't visualize that....Perhaps I was visualizing when I thought I was memorizing. I was probably creating visual images in my head. But I couldn't tell you that I was doing that because nobody ever told me that I was doing that (A31-32).

Bridgett did fairly well in that statistics class as far as her grade was concerned, even though the grade of a B did not make her happy. She said, "I was crushed because I had a very solid A average and then I got a B in statistics (A8).

Developing Professionally

After Bridgett finished her Masters Degree she moved to a different building in her district, and started looking more at the teaching of mathematics. Bridgett talked about the beginning of her interest in teaching mathematics, before she began extensive professional development.

I became very interested in mathematics. I started buying more math manipulatives. I started using more math manipulatives in my classroom....I got to the point where I hated the teacher's manual. I was on the math curriculum... team... and... I would take all the old [books sent to the curriculum team]... and I tore them apart and I used everything in them. I started an idea book of math ideas (A9).

Bridgett then attended a workshop that demonstrated a hands-on, developmental approach for teaching children mathematics. Prior to the workshop, Bridgett had been buying and using manipulatives; in her college methods course she had already experienced some different ways that mathematics could be taught; and she had begun creating her own idea book. Still, this hands-on workshop had a further impact on her.
[It] really changed my way of looking at things. Then I started buying hordes of manipulatives and I wouldn't teach anything unless I had gone through every single stage. I became a little bit obsessive with it because I thought, 'I didn't learn it the right way when I was young, and by golly, you're going to learn it this way because I am just sure this is the right way' (A9).

Bridgett did say that this obsessive perspective on manipulatives has changed somewhat for her. "Now I know a little bit better than that. I know that kids do need concrete materials, but there are children who already had concrete opportunities, and already understand it and are ready for the abstract" (A9).

Bridgett continued her professional development through workshops and conferences in the state. When she became a Mathematics Teacher Leader (MTL) she had the opportunity for even more professional development. Through her teaching and professional development experiences, Bridgett felt she had learned much about mathematics.

I've learned more math - I can explain math to children who don't understand it, that's how much math I've learned. I can explain to them well enough that they can understand. Maybe that's why I can do that. I struggled with it so much that I know what they are thinking, I know why they are not getting something, and I know what they need to see in order to understand it. And, I feel comfortable teaching it because I've learned so much more about it. And I've learned different ways of approaching it. Instead of just approaching it one way - memorization - I've learned all different ways to teach the same skill....You become a better learner by being a teacher (A16).

However, depending on the situation, Bridgett does have variations in her comfort level with mathematics. She ranks herself in the middle of a low to high scale in her comfort level in learning mathematics, and moving higher all the time. She sees herself as very comfortable in both teaching mathematics and in teaching teachers about mathematics. However, both teaching experiences are only comfortable for her in the content of grades Kindergarten through 3 (DR). As she said, "I still do not feel
comfortable talking to fourth, fifth and sixth grade teachers. I did workshops for them, and I felt really stupid" (A16). Bridgett recalled an instance when she felt uncomfortable with being a MTL for the upper grades.

When I was doing workshops in our district, I just had a total mind block and forgot what a rhombus was. And I called it a trapezoid. And someone actually told our curriculum director that if I was planning on doing any other workshops I better learn my shapes. During that meeting I admitted to the fact, I said "You know what, I think I called this a rhombus, and I think it is a trapezoid"... Now, see, I was totally embarrassed because ... I feel that those couple of teachers were just ready to walk out on me then.... I was very apprehensive... I went to [the curriculum director] and said, "A couple of times I could tell that they just weren't getting anything out of this". And she had said that she had already talked to them and she had already laid down the law because she was embarrassed herself. She was embarrassed ... by them and the way they treated me, not by the fact that I didn't know a rhombus from a trapezoid. What she was more embarrassed by was their unwillingness to listen to someone else who was trying to give them some ideas (A20).

Bridgett felt uncomfortable with the upper grade teachers because they "have more content knowledge, and ... more ... mathematical knowledge than I do and they know the ins and outs.... They are experts because they've taught it" (A17). It was that discomfort with the intermediate grades teachers and content that caused Bridgett to ask her district to designate an additional MTL for the upper grades. She said, "I felt like I needed somebody that could relate to them better" (A20). She also said, "They didn't show me the kind of respect that I think I deserved" (F10).

The episode with the upper grades teachers taught Bridgett a "hard lesson" (F12). Even though she believed she was able to do mathematics at a high school level, she remained reluctant to go beyond third grade mathematics with teachers. Between third grade and twelfth grade is Bridgett's private math sphere, because of how she has to learn at those higher levels. Bridgett's private math sphere is the realm of mathematics that she is willing to struggle through privately, but where she is not willing to allow others to publicly, at least, observe or share in her struggles.
I know I can figure it out. But it might take me longer to understand it. I may have to go read. I may have to go study. I may have to go get out some balls or ... toothpicks or whatever I need to understand it. I probably will have to put it at a more concrete level than most people my age would have to. So, I may not want to do it as a public display. It's too scary for me (F12).

Bridgett was also afraid that she was "going to mess up ... and look stupid" (F12) if she did mathematics in front of teachers beyond the upper elementary grades.

**Learning By Teaching**

Bridgett felt that one becomes an expert in her content knowledge by teaching.

She believed

if everybody had an opportunity to teach something, then they would be able to learn it. That's how you learn, by teaching it. If you're not teaching someone else, you're teaching yourself. Because everything you learn, is, ultimately, you yourself as teacher. Someone might guide you, might give you activities, might help you to understand something, but in the end, you're the one that's really explaining it to yourself. You're the one that has to absorb it and really have to figure it out for yourself.... Where did I develop that belief? Because I did it. That's how I learned it (A17).

Bridgett's belief that we learn by teaching ourselves includes another component.

She explained, "I think we are all our own teachers, but somebody is there saying, This is what you're doing. Now just pay attention to it" (A32).

Bridgett did not learn mathematics by teaching herself mathematics through her school experiences as a student. However, she has learned math while having to teach math because she has had to figure things out. She explained that if she had a child who did not understand she would have to figure out another way to “teach him ... show him how to do it, come up with a new way. If you have a kid sitting beside you who isn't getting it the way you are trying to teach him, then you ... think of another way to do it" (A32-33).

It was only during the past 10 years that Bridgett has developed this philosophy and practice of figuring things out, and finding new ways. She said that before that
it was always memorization. But, I'd say in the last ten years, the reason I've come to understand math better, and feel that I am more competent in it and that I can do this is because I've read lots of things, I've listened to a lot of people, I've gone to a lot of workshops, I've seen all these things being done, and now I feel competent enough that I can go out and develop my own (A17).

As an example of something that Bridgett has develop to help students understand mathematics better, Bridgett explained her use of ten-frames.

When we first got the state math model, they talked of ten-frames. I had never, ever heard of a ten-frame, never knew what it was. Now I feel competent enough that I've developed my own. I don't like the ten-frame that they've developed with the five on the top and the five on the bottom. That's ludicrous. It's a five-frame. We need a ten-frame which is ten long, so that's what I give my children. I give them a ten-frame, and then they make a ten, so if it's $8 + 5$, they move two of those five up and they make their ten ... they can see they've got one ten and three ones (A17).

Bridgett believes that another reason she has learned is that she is a "very visual learner". "Now we've got all these concrete materials available and I can see it. So, if I can see it....then they can see it, too. I just know they can see it, because most children are visual learners, 70% of the American public are visual learners" (A18).

Being Recognized

Bridgett recently received the honor of being chosen teacher of the year at the elementary school level by the state Council of Teachers of Mathematics (CTM) and she was excited about receiving the recognition. However, in reaction to winning the award, Bridgett first thought that not many people must have turned in applications. "That was my first thing, cut yourself down, or this can't really be happening." Bridgett then called her high school Geometry teacher and shared the news with him.

I said "You're not going to believe this. I won a math award. I won a math award". He was just tickled ... and he said "I always knew you could do it. I always knew it". He said that he always knew that I would be a teacher of math. And I said "I don't know how you could have ever known that." And he said, "A lot of times those that have the most difficulty understanding are the best teachers." I think that's true sometimes (A22).
Receiving the state CTM award was problematic for Bridgett in some ways. First of all, few of her colleagues from her building knew of the award. Although the announcement was published in the state CTM newsletter, no one in Bridgett's building received the publication. Bridgett told a few close friends from her building; they were excited for her as was the administration (although the superintendent never directly responded to her award). The School Board recognized Bridgett's accomplishment with a commendation, which she only knew of because she attended the meeting for another purpose (A23-24). Bridgett also talked to her principal about sharing the news of her award.

I was just busting at the seams. I wanted to tell people because I was so excited because number one I never, ever thought I'd get it and number two, I've worked so darn hard on math in the last five years. I have busted my buns really doing what I think is best for children in mathematics, and really putting together what I feel someday I would like to have published.... I've created a bibliography that's over 62 pages long that correlates with the state Math Model. I've done a lot of work.... I've probably read every book there is that has ... to do with mathematics in the children's sense, in the children's literature sense. But I couldn't tell my colleagues that I got that award. And [the principal's] answer to me was "Why do you feel you need to?" And I was floored.... I realized that what she was saying was "Why do you feel like you have a need to justify yourself?" ... I shouldn't feel that, but, see, I still do.... It's not that I want to rub their noses in it. I want them to recognize I know more than first grade math.... I want them to know (A25).

Bridgett said she needed the "justification" for her mathematics teaching that the state CTM award gave her. This justification was for the benefit of parents and other teachers more than for herself. To her, it was so obvious the way kids learn best. However, Bridgett's own authority in mathematics did not seem to her to be sufficient for explaining to others why she teaches mathematics as she does. Because she was so different from the other teachers in the building she had to prove herself to other people. She said, "I feel like I need justification for what I do" (F1).
Self Esteem

Bridgett commented on the things that helped build her self esteem. The CTM Award along with recognition in the form of a national teaching award gave her a boost in her self esteem. Bridgett explained.

I knew I was doing the right things. That was justification. Doing these workshops has helped my self esteem a lot. I'm very different from the other teachers in my building....They're still very conservative and very traditional teachers. So, I was always the sore thumb, or the odd-man out. I was always doing these radical things that were so different from everyone else that I worried that sometimes I wasn't doing the right thing, although parents and administrators backed me up 100% and my kids' test scores were coming out phenomenal.... I was seeing my children walking away with a love of learning, in all aspects, every subject area. I was feeling that they were learning in an integrated fashion, so that they were learning in a fashion that they could go out and make sense of the world with what they'd gotten from me (A23).

At the first of the Mathematics Teacher Leader program sessions, Bridgett referred to herself as "tipsy". Three years later, after both presenting and receiving professional development and after receiving two teaching awards, Bridgett commented, "The award has done a lot for me as a math teacher leader." She also qualified her earlier identification as tipsy. She said, she is "still tipsy, but that's fun-loving. I'm a fun-loving tipsy kind of person....not a dumb blond" (A26).

Bridgett also feels she would now react differently to the teachers who criticized her for forgetting what a trapezoid was.

I feel now I could stand up for myself and say you know, kids make mistakes like that, too. And now I realize that that's embarrassing. I'm embarrassed standing up here getting mixed up on these shapes, but why should I be? For heaven's sakes, how can I be expected to know everything there is to know about math, and memorize every single thing there is to memorize about math? If you're not teaching it on a regular basis and you have no need to use it on a daily basis, then why should you be expected to have that memorized? We've got books, we've got calculators, we've got computers, we've got all sorts of things at our fingertips....You know the basics of those things and you know that a rhombus and a trapezoid are similar, they both have four sides. I could now stand up for myself and make some justifications for that error. But at that time all I could think about was "Oh my gosh, they must think I'm so stupid" (A26).
Being a Mathematician

Bridgett talked of the skills that one would and would not need to be a mathematician. First of all, mathematicians needed to be able to problem-solve. They have to be able to figure out a way.... They have to be able to know what to do when they don't know what to do.... If they are given a problem, they have to be able to draw a picture, manipulate concrete objects, or form a picture in their mind in order to solve that problem. (A8).

Bridgett recognized that mathematicians "don't necessarily have to remember all those formulas. They can create their own.... Just because one man figured out a formula to do a certain thing does not mean that is the only way to do the problem solving" (A29).

What Mathematics Is

Bridgett was certain that mathematics is everywhere but had difficulty defining mathematics without talking in terms of where it is. "It's hard to take the where is it out of it because it is everywhere you go and in whatever you do." Bridgett recognized the existence of mathematics "from the beginning" and that it came from people.

People had to figure a way to keep track of things, and in order to keep track of things, there would be the sun and the moon, they would have to keep track.... We had a need and math serves a need.... Yes, [somebody created it]. Somebody had to sit down and say "This is going to be our numerical system." Somebody had to come up with that (F11).

Since somebody had created our number system, Bridgett believed it could and indeed was created differently by others. "Well somebody did create it differently. We have all different kinds of bases. Yes, I think there were a lot of different creators of math and I think we continue to create math now. I don’t think it will ever be anything that will ever stop being created." Bridgett believes math is created "everyday, all the time" and that learning math is about learning what's already created, in order to have a basis for future mathematics learning (F11-12).
Understanding Mathematics

Bridgett said "I don't like to do things that I can't understand" (F2). Part of the reason understanding was so important to her was that it was necessary to understand in order to explain to someone else.

The biggie was not being able to explain it to somebody else. I was in the top ten in my class. People were coming to me to ask how to do something and I was feeling like a real idiot because I couldn't explain it to them. The only way I was able to do it was because I was able to memorize theorems better.... I couldn't understand those things. So, it was always more important to me to understand what I was doing and why I was doing it.

Here all this time I thought I had everybody buffalloed [in the case of the yearbook photo]. Obviously I didn’t. They just took the picture. I probably took the picture more personally than it was ever meant to be. But it was like a slap in the face for me. Oh my gosh. All this time people thought I as so smart and here they really didn’t.... At the same time I realize I have to put it in its place to a certain extent. I did get most things. But when I didn’t get something, I really let that take too much attention.... I’m a perfectionist and I think any perfectionist wants everything to be complete and if you can’t be complete in your understanding, then it’s really frustrating and irritating (F2-3).

Bridgett also talked of how this need to understand limits her in some ways.

I’ve got to be able to understand it. And if you can’t understand it, then I’d rather just not do it at all. Like Statistics. That’s why I don’t want to work on my dissertation, why I’m so afraid of the doctorate. I don’t understand it. I don’t get it. I get a lot of it. I understand mean, mode, median. I understand all those sorts of things. But it’s confusing to me for how to go about setting all that up. And I’ve been through a lot of classes that have gone through how to set all that up but I don’t understand it and it’s a scary issue for me. So, lots of times I try to talk myself out of something because I don’t get it. And when we would do activities for the MTL, if I didn’t understand it, I would find myself cheating just to get the end result, even if I wasn’t understanding so that I could have shown that I’m done. So it would look like I understood what I was doing and really I wasn’t (F3).

Learning Mathematics

Even though Bridgett said she had problems in Geometry because it was so abstract, the abstract nature of Algebra did not seem troublesome to her.

It’s abstract, but it’s numbers. I understand number. The concept of number I think is clearer to me than the concept of point A is over here and point C is over here. I understand that a straight line is the shortest distance between two points.
but that's about as far as it goes. I don't know if I'll ever have an aha moment in Geometry. I enjoy math now, at the primary level. I would not enjoy going back to college (F6).

Bridgett never needed to question deeply what was happening in Algebra I. She believed that her teacher "was very experienced and very wise and Algebra was just so easy." Bridgett said, too, "I just never thought it was hard, so I never needed to know more, ask more" (F7).

Bridgett did not question in Algebra I and believes she did not develop much of an abstract thinking ability as a student. She does believe she has developed more of an abstract thinking ability as a teacher experiencing professional development. Consequently, even though she may have struggled with an activity for fourth grade students, she can understand much more mathematics now than she did as a student. In fact, she decided, "I think I could understand any level of math now, but it would take a lot of effort on my part" (F6).

When asked if she would, as an adult, speak up and question in a college level math class, Bridgett replied,

No. No, no, no, no. No, because I would be scared that I would be giving the wrong answer and I always want to be right. I have a real problem. That's my perfectionism coming through... I wouldn't ask a question [because I would look stupid]... I wouldn't ask it in front of the whole class. I would either go to the professor afterwards, I wouldn't care if I looked stupid to the professor. I don't want to look stupid to all of the other people... [The professor's] the expert and he ought to be able to come up with a different way to show me how to do it (F6-7).

Bridgett also talked about pulling things together holistically in mathematics. She was able to do that and see connections between content strands in mathematics as a teacher of primary level mathematics. But as a student of mathematics, considering mathematics at what she described as at "her own level", she still had difficulty with seeing connections. Bridgett's "own level" includes mathematics she would study as a
graduate student, the Geometry she struggled with as a high school student, and the
Algebra she understood, but does not see connected to other areas of mathematics.

Bridgett did not think she necessarily saw the connections at her own level but
believed she was getting better at that (F13). She explained.

I think now I could make that relationship better, because I could think of it
concretely. Back then I couldn't think of it concretely. It was so abstract to me.
I wasn't able to relate to it at all. Maybe if I were able to ... interrelate the Algebra
and Geometry, perhaps that would have made it easier for me. I'd say, "Oh,
there is a relationship between these two things. I just have to figure out what it
is." Whereas before, it wasn't like that.... Maybe now I could. Maybe, maybe.
I don't know. You'd have to put me back into that area. I could probably go
back to high school and do geometry again and it would still be hard for me. I
probably would still have trouble relating it to other areas. But they still don't do
that. They connect the math to reading and language arts, but they still don't relate
it to other areas of math. Like Algebra and Geometry. They don't do that (F14).

Investing Time in Mathematics

Bridgett did not see herself as very capable in mathematics. Referring to being
smart in math, Bridgett said, "I don't think that I am. I think I'm probably above average
but I'm certainly not what I can consider math smart. I don't think I'm math smart. I
really have to think about math" (F5).

When Bridgett won the state mathematics teaching award, she talked to her former
Algebra II teacher about it. The teacher said, as had Bridgett's former Geometry teacher,
it was no surprise that Bridgett had excelled in teaching math. The Algebra II teacher
explained that her assumption was based on knowledge of Bridgett's personality.
Bridgett wondered what her personality had to do with learning math. The Algebra II
teacher explained she saw Bridgett as a "real go-getter" and Bridgett believed she knew
what that meant.

I think what it was that she knew that I have real stick-to-it-iveness. I will sit up
for hours trying to figure it out. It won't be fun for me, but I will be able to tell
you how to do it and how I did it and I think I can teach somebody else. But it
wouldn't be fun for me (F8).
For Bridgett, there was a problem with spending time on math and it was certainly related to whether you like it or not. She said, "I can work hours and hours on writing a paper and love every minute of it, or at reading and love every minute of it." She did not love every minute of doing math and explained this in terms of an example. The example Bridgett used was the "toothpick problem", a problem-solving activity from a MTL session.

I did not love every minute I was working on that toothpick problem. It was frustrating. Every minute was frustrating for me and I kept thinking, "If I can't get this - this is a fourth grade level activity - if I can't get this how am I going to go back and tell somebody else how to do it?"... That's our job as a Math Teacher Leader... to go back and tell the other people how to do it. I'm thinking, "If I can't do this, then how am I ever going to explain it to somebody else?" I don't want to go up and say, "Here's a really neat activity, and I'm sure you'll understand it but I don't get it.... If you are a mathematician and you work on math for hours, you do it because it's fun, too" (F5).

The Gender Connection

Bridgett talked of the gender connection in the math classes where she was a student. She had all female teachers until seventh grade, and two female teachers after that, for Algebra I and for Algebra II.

I understood what the women were teaching and I couldn't understand what the men were teaching. The women were teaching Algebra. I loved Algebra. But see, that's a formula, more than Geometry. Geometry was taught by a male and it was all theorems and trying to visualize and it was totally abstract. I think Geometry is so abstract when it comes to theorems. I couldn't get it. I'm not a very abstract thinker. I'm very concrete. (F6).

When Bridgett was talking of a hypothetical college math class and whether she would question in that class as an adult she attached the pronoun "he" to the professor, and commented on the use of that pronoun. "Isn't that funny?... I think [that's the stereotype]..., but you know, actually "she" could probably find a better way. "She",
not "he", could explain it to me differently." Still, Bridgett could identify no difference in style between her male and female high school teachers, leading her to believe her problems were related to the content (F7).

When considering the possibility of teaching an all-girl math class, Bridgett did not think she would do anything differently than she had been doing in her math teaching. She said, "I'd like to think that I am giving equal opportunity and that I wouldn't not do something if I just had girls, or that I would do something if I just had girls. I'd like to think I am doing everything I can now" (A33).

Bridgett believed that the role of gender in the classroom is not as great as it once was.

because of the mixed roles that we are trying to ... develop in children and ... because there are more working women, and children are having to fend for themselves, fathers are having to fend for themselves.... We still have those gender jobs, I think, but I think they are becoming more melded into society, as a job that has to be done.... I think that’s becoming more of a reality and I think we’re beginning to see that in children. I don’t notice that marked difference as much as I used to.... As a matter of fact, this year I have more boys who are well organized than I have girls. And more girls that would take a leadership role. Course, first grade girls are bossy.... I still think those roles are becoming a little more intermixed (A34).

However, Bridgett did feel "you still have children who are going to play predominantly male roles and predominantly female roles ... as seen in society, anyway" (A34).

If a former student came to her asking about becoming a mathematician, Bridgett would give the following advice:

Don't ever feel like you can't do it. Don't ever feel like just because you don't understand something you shouldn't ask questions, or you shouldn't ask someone else to try to figure it out with you. And, by all means, always consider another way to do something.... If you want to become a true mathematician, a mathematician is a problem solver.... Always be thinking of another way.... And when they go out in the world of work ... as a mathematician, they don't work by themselves as much as they used to. They have to work together (A35).
Although Bridgett would never consider telling a girl she couldn't do something because of her gender, Bridgett does believe that the message of girls' inability still exists.

I think that there are teachers out there who are saying "Well, they aren't doing as well in math as they should, but, you know, girls just never seem to do as well in math." There are a lot of people still saying that. I don't know that the kids hear them say that, but as adults, I bet, like us, they can think back on situations where they know, behind their back, the teacher was saying that. I'm sure, when I was in Mr. Sim's [seventh grade] class, he was saying "Well, Bridgett is never going to get math. She's the cheerleader, she's the majorette. She's the kind that's going to be fine in language arts, fine as a leader, but as far as mathematics, pfft. She's not going to get it." I'm sure that he said that to a certain extent. I could be totally off the mark, totally wrong. He might not have ever thought, but,... even at that time I thought he did. And looking back, I keep thinking, ugh. And I was flighty. I'm pretty sure I'm like A.D.D. or something. I'm very antsy, and I've always got my mind going in a million different directions. I don't think that's wrong. I don't think that is a bad thing.... I think we can all do anything.... I don't think there are any boundaries (A36-37).

Still Bridgett admits to some gender biases of her own. She believes that if she walked into a room with adults in it, both men and women, she would think that the men knew more about math. If they were children

that wouldn't play a role. But ... if I was with a group ... of three women and three men, I would probably think that those men knew more about math.... And they probably would.... I'm 36. I think, in general, men probably know more about math because they were taught more about math and they were given more opportunities to use math skills and ... to problem solve and ... to think, than I think we were" (A37).

Bridgett extended her hypothetical situation further. If in that room the three women were mathematics educators and the three men were in suits, Bridgett would make certain assumptions about them. Regardless of what the men did for a living, Bridgett would assume they would be just as intelligent in mathematics as the women mathematics educators, "just because they were in suits and they were men." Bridgett commented on her biases. "Is that ingrained or what?...That is really sad, but ... I do believe that I would think that way. I hate to admit that, but I think I would" (A38).
Even though Bridgett wanted to believe her opinions on men's intelligence in mathematics were changing, she knew the bias was indeed "ingrained".

I think there was an automatic authority because they were men. And I think that is because of the role that I grew up with. My father was very much the figurehead. My mother was a stay-at-home mom. My father was the breadwinner, and ... the one that made the decisions.... Still I go to my mom about cooking and cleaning and things like that, but when I have a problem to solve I'll call over to my house. My mom is very intelligent [and] can probably come up with the same answer my dad does, but I call and actually say to my mom "I have a question to ask dad". I never thought about that. I wonder if that ever hurts her feelings? But it's true. And most of the time, she would probably say "Let me go get your dad. I don't know" (A38).

Bridgett wanted to continue working on gender concerns in her classroom and worked to maintain a level of awareness of gender issues in her classroom.

I want to be aware that those gender differences are out there and that we need to not feed into them, not to play off of them.... I think kids now-a-days seem to be better about that.... I am becoming more aware of that ... I'm noticing that more and more now and I still have my kids sit boy, girl, boy, girl in the room because it cuts down on discipline and talking, both sides. Maybe I should be encouraging talking between the two sexes more, but instead, it's my method of discipline because it does cut down on the noise level. Girls are really chatterboxes, and boys seem to argue. I don't know. I guess I'm just going to try to continue my awareness of it and read more about it. I want to see what I really should be doing. Somebody in the group said something about boys taking on male roles in math and girls taking on female roles in math and maybe it's more important to put all girls in a group so they can take on those different roles. I have often times ... paired them up in the same sex.... I need to know more about what I should be doing (F9).

Bridgett was less certain of her ability to change her biases as far as adults being able in math. Referring again to the case of the three men in suits and the three women who were mathematics educators in a room, Bridgett talked of having her own perspectives change on that.

That's a big change, and after 36 years, I don't know.... It's going to take me a long time to change that although I said also that I think that now I'm not as buffafoed by people. They can't fool me as much.... I tend to pay more attention to a male in a suit than I do a female in a suit, [but] I guess I tend to be less buffafoed by that. If I'm just aware of that, maybe I can be. I don't want that for myself (F10).
Becoming Competent

Bridgett believed she had grown to a point as an awarded teacher where she could stay up trying to figure something out to teach someone else, although it wouldn't be fun. Bridgett was confident, however, that at least she was able.

As far as my level, skills are concerned, I think that it's fairly high. I think I'd probably take the twelfth grade proficiency and pass it. And I passed the NTE. I was one of the guinea pigs for that.... But I wasn't good enough to pass the test for [my father's company's institute], but that was a long time ago. That was really before I solved things with concrete things (F8).

Bridgett believes she has learned much more mathematics since her school math days. She felt she would have done better had she been able to use something concrete, even in Geometry, "straws or marshmallows or geoboards or anything." Bridgett recognizes her need to use manipulatives, and yet recalled, "I never remember seeing a manipulative, ever" in school (F8).

What Bridgett believed she needed as an adult if she were going to take a math class was an "attitude" (MFG11). A colleague talked of overcoming fear and speaking up in a math class, because she had decided that "it can't hurt" (Amy, MFG11). Bridgett listened to the story from her colleague and responded, "I need that. I need that attitude.... I really wish I was at that point" (FI 1).

Closing

Bridgett became angry after she had reflected upon her past mathematics life and first told her mathematics autobiography. She was particularly bothered about mathematics work at the elementary school level.

I was angry, because ... when I went home I'm thinking "You know, I've got this story that I wrote in fourth grade and I've got this and this that I did in this. What do I have to show for math? Nothing. Not a thing. And I went upstairs to my scrapbox from elementary all the way up through college, and I couldn't find anything, not one scrap. And then I put in my notes "But then, again, who saves a worksheet?" And that's all I ever did. And that frustrates me.... nothing to show for ... learning (MFG17).
Looking back, Bridgett knew that in math, the reason she was willing to struggle, willing to ask questions at all, willing to let herself be tutored was because she wanted to have good grades. She said, "I wanted As, and by golly, I was going to get them somehow" (MFG28).

Carrie

I never really thought that girls couldn't do math, or that girls couldn't do anything (A2).

Carrie is a white, 47 year old woman who has been teaching elementary school for the past 25 years. She was raised in a rural environment by blue collar, working middle class parents and describes her ethnicity as WASP. Carrie's family supported her desire to go to college, but did not require her to go to college. Both of Carrie's parents finished high school, but she was the first in her family to go to college. Carrie noted that her mother's parents had not even had the opportunity to finish high school. Carrie's mother received a partial scholarship for college, but the family could not afford to send her. Consequently, Carrie's mother married, Carrie was born and, as Carrie said, "The rest was history" (PIDQ).

Carrie teaches in a suburb of the large urban area in which she lives. Although born a "hillbilly" she is now an upper middle class professional. Carrie believes that neither her gender nor her race has had an impact on her experiences with mathematics. She does see her social class as impacting her experiences, however, in that she has had experiences and opportunities that lower classes may not have had (PIDQ).
Carrie has taught for 20 of her 25 years at her current grade level. Carrie is married and is the parent of one daughter. She had one break in her teaching career for the birth of her daughter.

Learning About Math

Carrie began her mathematical life without knowing that, as a female, she was not supposed to be saying "math has never really been hard for me. It has come easily for me" (A1). She experienced math with her family, in play, work and schooling, and knew her father, mother and self to be competent in mathematics. That girls were not supposed to be good at mathematics was something Carrie learned later in life.

Carrie learned to count at home, through what she described as her first pleasant memories of math, by playing card games with her father. Some games Carrie continued to play with her father well into adulthood, playing those same games later with her own daughter. Carrie’s childhood experiences led to her early acceptance of math as something that was "just there. It was always something we did" (A1).

Because Carrie's family lived on a farm, playmates were few at home. nearest neighbors were too far for friends to visit often. Carrie was also an only child for the first six years of her life. She felt that having a new sister at the age of six merely meant that she was "like an only kid for nine years or ten" (A11).

Even though playmates might have been few on the farm, "you could always have a deck of cards" (A11) and the games of Carrie’s early math experiences became a part of daily life. Since Carrie "always had this desire to win", she made certain that, when she played these games that had numbers in them, that she knew how to "add them up" (A1).

Carrie’s early acceptance of mathematics as a part of daily life was founded not only in playing games and learning about numbers from her father, but in experiences with her mother as well. Carrie remembered her mother helping her with "learning the
facts" by "drilling", her and remembers her mother's own skills in using mathematics with the family finances. Her mother did the records at home, and wrote the checks and kept the accounts. In fact, Carrie's mother maintained the role of family farm accountant until she reached her sixties, when she hired an outside accountant. With these early experiences behind her, Carrie "never really thought girls couldn't do math or that girls couldn't do anything" (A2).

Carrie did not have what she sees in others as a "negative female attitude about math." With this understanding of girls' abilities in mathematics, Carrie entered into her elementary school days and found that "the numbers just came" as she studied school math. She had some friends who seemed to be "on the same wavelength" and who also had no problems in mathematics (A2). Carrie and her friends challenged the boys. Together, they "were always out there doing it, and having competition with the boys and beating them out" (A3).

Carrie cited a particular experience as an example of her competitive spirit and her skill and sense of ease in performing mathematical tasks.

I remember one time we were doing fraction races at the board. We had to add fractions with different denominators. When I put it on the board, I put the first one down. Then the second one I knew I had to change the denominator, so I put it down as a changed form. The teacher said, "Well that's fine but we'll let him change his first and then you can add them up." And I thought "Well, that's not fair. I already changed mine. I'm ready to add them up and put the answer down." So, as I said it wasn't ever really hard (A11).

**Junior And Senior High School Mathematics**

Junior high school and high school mathematics again was easy for Carrie. While in junior high, and in preparing for choices for high school coursework, Carrie decided to become an accountant. This decision determined the mathematics coursework she studied
in the first years of high school. Since she needed both business and college preparation to become an accountant, she was "kind of in the business and college section, doing bookkeeping things which were no problem" (A2).

Carrie found pleasure in those bookkeeping experiences for a number of reasons. First of all, as with her other math experiences, it was easy and "things that aren't hard you want to do again" (A11). Additionally, Carrie liked the bookkeeping work because "everything balanced out and it was real orderly, except for when you missed a penny and had to find the stinking penny" (A2). That concern for pennies changed and Carrie found herself as an adult whose checkbook never balances. "I know how much is in there. I don't want to know how many pennies are in there. I don't need that. I don't care" (A5). However, it was more than the search for missing pennies that pulled Carrie away from mathematics in her career preparation.

Carrie had the opportunity to do some teaching and working with small children when she was in high school. She enjoyed that and started to think about going into teaching. When she switched from a business track in high school, she hoped to "make a difference" as a teacher in that, for her students, "they won't do it the way I did it." Carrie also began to question a life doing mathematics. She found herself thinking that working with children "was more interesting than just working with numbers the rest of your life" (A2-3).

Even though Carrie was first drawn to accounting because of the order and balance, she began to find bookkeeping "too routine, and, at that time, the computers weren't there... and it was just very routine, very mathematical and not a lot of thinking into it." Carrie thought, "Doing the same thing day in and day out would get awfully boring, and I didn't think teaching would be boring" (F2-3).
The switch in high school from a preparation for business to a preparation for elementary education became problematic for Carrie with respect to required coursework. Carrie's high school mathematics experiences were limited because she had taken time to study business math. She had three or four bookkeeping classes before changing to a college preparatory program, and it was only then that she could study Algebra I and Geometry. Because she also had to take Chemistry and other courses necessary for the college preparatory program, Carrie never had time to take Algebra II or any other math. Because she didn't have "advanced math knowledge" Carrie felt as though she "was kind of behind with that kind of math" (A3) and did not feel prepared for mathematics going into college (F3).

**College Mathematics**

Being ill-prepared for mathematics in college turned out not to be troublesome for Carrie once she was there. She had few required mathematics courses to take and did well in those. She took a course that was the required mathematics for elementary teachers, as well as a mathematics methods course. Although Carrie felt she understood the content of these mathematics classes, she found the content excessive in some ways and deficient in others. The content of her college mathematics classes was excessive in its emphasis on theory and on proof, and in its repetition of the basic number operations. What was missing in her college mathematics classes was any sense of connectedness between the mathematics content of the classes and what Carrie would be doing with mathematics as a teacher. Consequently, the courses left Carrie less than satisfied with her preparation to teach mathematics (A3).

Carrie's mathematics class for elementary teachers was taught from what Carrie described as a philosophical perspective. Carrie explained her perspective on the content:
It was the time of the new math. . . . [The professor's] big thing was "you are going to learn why associative and commutative and all this stuff exists and we are going to prove it" . . . And we're going into all this stuff and . . . I can understand it. Now what are we going to do with it?" (A3)

Carrie was ready, after spending hours on the associative property in class, to "get on with something else." She agreed with the overall philosophy of teaching children to "figure out why things happen, and not just saying this is how it is and this how you are going to do it." However, the course requiring Carrie to sit through chalkboard after chalkboard of proof did not help her learn how to do that. As Carrie commented, "I just felt like we weren't given the kind of ammunition to teach it with" (A3-4).

Carrie did take some positive experiences with her from her college math classes. Because of some program and college policies, Carrie was able to substitute logic classes for some others, and consequently studied three different logic courses. She enjoyed those that involved proof, "getting from here to here to here to here, and the if-thens." An understanding of proof led to pleasant math learning in this class, as well as in learning proof in her elementary teachers' math class. Carrie was clear, though, in her dislike of some other topics in her logic classes. She commented on how it was "the philosophical logic" she couldn't stand (F7). Carrie, then and now, prefers a more pragmatic approach in her learning, especially in learning to teach mathematics. "If it's practical, I'll take it and I'll use it. I don't like philosophy things. I guess I have my own philosophy" (A4).

Carrie did wonder for a moment about what might have been if she had stayed in the field of accounting. Even though the bookkeeping math was routine, Carrie's concern for that was pushed aside as she contemplated other opportunities for further study in college. As she commented, "Maybe if I had gotten into college and had done
some finance courses, or investments or something like that I might have found it more interesting" (F2), it seemed as though these possibilities were not clear to her whenever she was making the decisions to become a teacher.

From Sponge To Taking and Reasoning

Carrie's school mathematics experiences involved a process of having the teacher begin with a statement that "this is the way you do it." Then, as Carrie described the experiences "you stare and work and do it... You just didn't say 'Well, can't we do it another way?' or 'Isn't there another way?' or 'Can't I do it this way?'" In fact, Carrie remembered no one asking questions in the mathematics classes she took. She described herself as a "sponge" when she learned math, and, as mentioned earlier, math was easy for her. Being a sponge worked for her (EFG2).

Yet, Carrie's success as a student of mathematics, for whom the numbers just came, and math was easy, came into question as Carrie talked of her professional development as a mathematics teacher. She talked of finally understanding concepts that she never really understood as a student of mathematics. In learning more about how to teach mathematics, Carrie came to a realization. "I guess I really never saw it, understood it. You just did it" (EFG25). In fact, Carrie admitted that "there were a lot of things that I never really understood. There's still a lot I don't understand. I could do the problem, but I didn't really think about it or know it" (F11). Carrie explained that once she learned more about mathematics through learning to teach mathematics, "it made more sense to me and it was easier, and it was easier to teach" (EFG25).

Over the years, Carrie learned more than content in mathematics. She developed her own ideas about what mathematics is and how best to do mathematics. From her childhood, Carrie saw mathematics as whatever one does with "digits in it" (A9). In particular, "math was just computation. Just adding subtracting, multiplying and
dividing" (A8). Doing mathematics was an individual endeavor, which began with a "show and tell" (EFG11) from the teacher, followed by student tries and practices.

As Carrie explained, "My way of thinking about math has really changed to include not just number things [but] number things as a process to do something" (A9). A particularly pivotal moment in Carrie's development of this perspective occurred at a teacher workshop in her fifteenth year of teaching. She was amazed at the technique where the teachers, as students in the class, were given a problem, with no steps to follow, and no expected answer to find. They were just "talking and working together ... and it changed me" (EFG4).

Eventually, for Carrie, math became synonymous with problem solving, and doing math became a collaborative, "very social learning thing" (A6). Carrie learned that to problem solve you "need to talk it out." She decided, "When I’m problem solving, I don’t want to sit there by myself and do it. I want to talk it over with somebody" (A6).

Carrie continued to find some pleasure in moments of problem solving in isolation, though, especially when she approached a mathematical task as a puzzle. An event in one of the logic classes that Carrie enjoyed in college was such a pleasant and successful puzzling experience. Carrie's description of the event revealed not only her method, but an explanation of why she needed to take such an approach at reasoning.

I'm sitting here and I get the steps this far and I couldn't get the rest of the steps. And I'm sitting there. So, then I start backwards and see if I can work up.... I'd done the problem twice....I needed to get the whole thing together before the parts made any sense. (EFG22)

From all of this, Carrie decided that to learn mathematics she would need some specific circumstances, such as "someone not telling you how to do it, but you figuring out how you did it. Then you’ve come up with your rule and your way of doing it . . . and not giving us the answers." Carrie wanted to be able "to do the manipulatives to
explore" and to have "a lot of time" (A10). However, Carrie mentioned that she had
"changed over a lifetime, too" in that she no longer wanted "to take the time to do it now"
(F6). She believed, "I am old enough now that I want the answer eventually" (A11).
Carrie went on to say that she has "too many other things" she is doing (F6).

Even though Carrie had no problems in math, she recognized what might have been troubling for her if she had problems in math. Carrie explained,

To think just abstract everything would have been really difficult... I can see, as a learner, if it had really been hard, and frustrating, I wouldn't have wanted to do it, and I would have tried to do anything to get out of it" (A12).

Additionally, math "was competitive, a lot." The competition was not uncomfortable for Carrie, as she was competitive herself. But then, as she pointed out, she always won (A12).

Getting Math Knowledge

Carrie believes that "knowledge is always out there." She believes that it was not knowledge that was created, but the process to get the knowledge. For Carrie to get math knowledge in a classroom, she wanted an environment to be set up by the teacher so that the students "work things out" and so they "discover the information, or... patterns that lead to information." Carrie also saw her role as a teacher change with respect to this perspective on knowledge (F8-9).

In a discussion group, Carrie and Lindsay, a sixth grade teacher, discussed math knowledge and their roles as teachers with respect to that knowledge.

Carrie: Math was given to you. The teacher was the font of all knowledge. You had a question, go ask her. She'll answer it.
Lindsay: They knew it all. They were going to share all their knowledge.
Carrie: They are going to share it with us. I am going to sponge it up, and I'll be able to recite it back for the test. And now, I don't want that at all to be the way I'm looked at. You come ask me question and I'll probably take you to a book and you'll go find the answer. I'm not the font of all information. There's just too much information out there... I'm going
to teach you how to go find it, how to figure it out, and how to get an answer. Maybe how to be a problem solver so you can figure it out (EFG8).

**Girls Going Into Mathematics**

Carrie has specific advice for girls who want to become that problem solver, to figure things out, to major in mathematics. Carrie saw females being successful in mathematics in her childhood, both in her home and among her friends at school. She commented about how she “never really thought that girls couldn’t do math, or girls couldn’t do anything.” Yet, for a former student who might choose to become a mathematician and seek Carrie’s advice, Carrie had this to say:

> I would turn handstands and say “Great! Way to go. Show up those guys and don’t let them put you down.” What should she do? Hmm. Make sure she has a good strong foundation in the arithmetic... Use your problem solving. Think about classes... you know when you get into high school you’re going to have to get into those math courses. And get the skills that they are teaching there. I know they are supposedly changing to more problem solving and not just the formulas and the calculations and things. So, she’s going to have to do all of that. And you’re going to have to compete in the guy’s world, and beat them at their own game. They will [give her a hard time]. . . If she’s good enough, like I tell the kids, hey they can give you a hard time, but if you prove by the way you do it that you belong there, then they don’t have a leg to stand on (A16).

What happened to Carrie in between the not knowing about girls having trouble in math and the advice to a former student to not “let them put you down”? In Carrie’s words, it was life. Being there. I guess it is competing in a guys’ world. You see all this, the good old boys’ network. It’s still there, even though, as I’ve told the girls [in my classroom], we’ve come a long way, but we still have a long way to go. We are allowed to vote and hold these jobs and be in professions where we were not allowed to be before...we are doing things that were not traditional roles for women before. But, men are still in control, and they, I don’t know if they feel threatened, if a woman can do the same thing that they can. I don’t know. Some do and some don’t. But it’s still, academia, I think is still a lot of men in control, and they feel threatened, maybe, by women coming in and seeing a change (Fl).
As far as what actually happens in mathematics classes that contributed to Carrie’s advice for girls who want to become mathematicians, Carrie has formed opinions based on her experience as a teacher and as a student. Carrie commented on this.

I’ve seen a lot of math classes where boys dominate. The few girls that are in there don’t speak up and you don’t know if they are doing as well as the boys or not. The boys are more aggressive and more verbal about what they are doing. You just see them taking charge, where the girls aren’t, as much (F2).

So, Carrie moved from counting and numbers and card games in the home life of her childhood, to competitive victories in elementary school math, and on to understanding philosophy and logic as a young adult. She learned further about understanding mathematics as she learned more about teaching mathematics and developed her own perspective on what math knowledge is, and how best she would gain such knowledge. Carrie explored a professional life focused on mathematics before choosing a professional life focused on children. And finally, Carrie defined, for herself, a position on women learning mathematics.

Claire

"I’ve been in hiding all these years" (A6)

Claire is a white 31 year old woman who has been teaching elementary school children for seven years. She earned her degree from a teacher's college in an eastern state, and teaches in a small rural district near a major urban area of the midwest. She lives in a suburb of that urban area. Claire began her teaching career as a first grade teacher and three years ago “graduated to third grade” (A7).

Claire was raised in a lower middle class, blue collar, ethnic, Catholic family. Her family lived in a very small town, and Claire did not realize until she was an adult
how low her family's socioeconomic status actually was (PIDQ). She currently identifies herself as a struggling middle class professional, who is married and has a newborn daughter.

Both of Claire's parents graduated from high school. It was a given in Claire's family that she and her siblings (a twin brother and two older sisters) would go to college. There was no pressure to go; it was "just matter of fact" (PIDQ). Claire described her family's expectations as far as education was concerned. There were never any conflicts or pressures. They knew our potential and we worked to that as best we could. Education was viewed as a privilege, joy; excitement of books and knowledge in general [was prevalent] (PIDQ).

Claire knew of no impact that her race had on her experiences with mathematics. Nor did she find her social class to impact her experiences in mathematics. However, she did believe that her gender had "tons!" of impact. That gender impact came in the form of low self-expectations in mathematics, and Claire attributed this low self-expectation to low confidence in mathematics (PIDQ).

**Elementary School**

Claire told the story of her math experiences in a sequential fashion. "That's just how I am going to do it" she said, as her past came to her "in little bits and pieces" of memory. She was able to go through the grades and tell her memories from each class, including the names of most teachers as she had progressed through school. Claire noted that at each grade she had "one horrifying memory of math" (A1). From first grade with Mrs. Blair, Claire remembered,

The problem was 7 + 3. I remember counting the ceiling tiles. The only way I could do it was to count the tiles. She made me stay after school for doing that ... I can remember crying and I can feel a lump in my throat now. Seven plus three.... It was unfair (A1).
Claire felt that the consequence of having to stay after school for "cheating" and counting the ceiling tiles, was something that she "knew at 5 and a half years old was wrong", and Claire, even as a small child was vocal about that unfairness (A1).

From second grade Claire’s significant memory was of a struggle over vocabulary. Again Claire remembered, the word digit was on a test and I didn't understand what digit was - Mrs. Bauer didn't understand what digit was. My cousin Liz was in class with me and Liz knew it ... I cheated and had to stay after school again" (A1).

Claire explained that she cheated in second grade because she was "so desperate. Math was desperation. It was always desperation" for Claire (A1).

In third grade Claire encountered multiplication. She began her recollection with the statement “Oh, god, third grade, multiplication” (A1). Claire described her third grade experience.

We had little booklets to do our times tables - Mrs. Cleary - these teachers just stick in your head.... We had to go up to her desk and do our tables. I think I got to a certain one, you know you go 1’s, 2’s, 3’s, 4’s, 5’s.... I don’t know that she really set us apart. But I guess I remember the anxiety of having to go up and it just not clicking (A2).

In third grade Claire tried to "do it all by memory, all by rote." She believed that the problem with that was that "a third grade brain is only so big." Claire "couldn’t really get it and ... never really got the hang of it, ever." She never understood multiplication ... until she was older. Claire commented, too, that such a lack of understanding was present "with a lot of concepts in math, a lot of concepts" (A2).

Fourth grade seems “like a blur” (A2) to Claire. She has no specific memories from that year, but does remember some from her following fifth grade year. Two topics stood out for Claire from that fifth grade year. One was her success in reading. The other was her experience with division. Claire, contrasted her success in reading with her lack of success in mathematics:
All I remember is getting all the reading awards, and them not really mentioning my name in math at all. I got every reading award you could get in Seventh Street Elementary, but nothing for math (A2).

Claire’s lack of success in mathematics in fifth grade was connected to learning division. She remembered "trying to do division, and just trying." Claire tried to do more than learn division. As she explained. "I don’t know. When you’re like me you try to disappear during math. I remember trying to disappear all the time" (A2).

Junior High

In Junior High I got the idea that I was never going to get it. I was pretty much convinced that my goal was to hide from math and excel in everything else, which I did in all the languages and all the reading... But in math I just wished it was gone. I pretended it didn’t exist. I tried my hardest to get around it and get through it, and took the easiest things you could do (A2).

Claire again remembered a particular experience in school math in Mr. Hill’s seventh grade math class. She described the moment as follows:

I remember in seventh grade it finally dawning on me, as a math concept, the concept of time, finally dawning on me at 2:40 in the afternoon. I could figure out what timing was, what the increments on the clock were.... I knew how to tell time. I knew the overall concepts, but it finally dawned on me, the digital and the analog numbers and what they meant (A2).

Claire questioned "Why didn’t anyone teach me time? (A2) and she believed that time was not the only math concept she was not taught. She had an explanation for why she did not learn math concepts in school math.

In essence, I taught myself everything I think I know about math. Because I had to reteach myself... It always was just up to the board and show you how and then do it. That never really cut it for me, ever. Never really cut it (A3).

High School

For Claire "high school was just getting through ... take every academic language and language arts course you could...every college prep course" (A3). In Claire’s high
school curriculum "everything was available" as far as mathematics courses were concerned. Claire remembered "We had it all, but I didn’t take it. I did anything but take math in high school. I watched my girlfriend take it" (A5).

Claire maintained what she called both a "very symbiotic relationship" (A3) and a "co-dependent relationship" (F3) through high school with her best friend, Loni. Loni stayed with studying mathematics all the way to Trig and Calculus. For those high school years, Claire explained "I would write all the English Comp papers and [Loni] would do my math" (A3). Claire decided that "symbiotic is better" in describing this relationship than "co-dependent" (F3).

Even though Claire had already decided to "get around it and get through it" (A2) as far as math was concerned, she did study some mathematics in high school. In Algebra I with Mr. Cook, Claire experienced more of the teaching style that she had described from junior high school, along with the ineffectiveness of the style for her. Claire talked about Mr. Cook's methods. He would

stand at the board all day long ... He would just show the problem. I guess in his off-beat way he would be trying to show us a pattern, but he never showed it clearly enough that I could see it, ever. He would put two problems up, and even when I got extra help from him, he would say "See how these two problems are alike, Claire? See how they are alike?" No, I don't see how they are like! No, I don't! (A6).

In trying to get through Mr. Cook's Algebra I class, Claire would

sit there and go "Uh huh, uh huh, uh huh"... and go home and sit at the dining room table again and cry all night, because I couldn't get it done ... and call whoever could help me get it done. I tried. I'm a great student. I put everything I could into it and it never clicked (A6).

Claire never realized that doing Algebra "was a process". She "thought it was always something that worked itself and you put numbers into it ... You either got it or you didn’t get it." Claire wasn't getting it. Other kids got it (F5).
Claire also took Geometry in high school. As she remembered it, "Geometry was a joke". Her particular course was dubbed "geometry for idiots" by Claire. She believed that the course was designed for her group of students because the district had to get the students through the SATs (A4).

To offer this particular Geometry class, the district "brought some real strange guy in" (A5-6). Claire jokingly claimed that he was "probably an insurance salesman somewhere". However, on reflection, Claire believed that she is sure he had to be a teacher. Claire commented further on her Geometry experience. The teacher "pretty well messed us all up. Maybe that's why I feel a little more competent in Geometry, because everybody didn't get it that year" (F7).

In her Geometry class, Claire and her classmates "just had a ball" even though they "didn't learn anything". Claire felt she could "probably set up a proof of something somewhere, but it wouldn't make any sense" (A6). The district did create another Geometry class for Claire's group during the following year "because ...[the first course] was so lousy ... They had to create another one the next year with a different teacher ... Just to get us through the SATs". Claire did not know why she did not take the second Geometry course, but her study of high school mathematics ended. Then it was "off to college". Claire commented that she wondered why they took her (A6).

Pausing To Reflect

For Claire, "there were no gold stars ... never" in math. Claire's reflection on her school math days led her to say "It was always a joy, like a big book burning at the end of the year, to get rid of the math. It was always a joy, it was always a relief.... God, I got to erase the marks out of the math book. That was the happiest day of your life, because you didn't have to do any more, didn't have to do any more" (A13).
Claire’s "rational side... knew" she was "very smart and there’s no reason ... [she] shouldn’t get" (A4) the math. She remembered, "I knew always that I should have been getting it" (F6). However, she said her "irrational side wouldn’t let [her] do it" (A4). Claire described the irrational side as an "irrational fear" (F6). Claire recalled,

It was a fear that wouldn’t let me , compounded by daily episodes of not getting it, not knowing it.... Once in a while a glimmer. I could probably count on one hand ...the number of glimmers in twelve years and then an extra four years of college....Day after day (F7).

Claire wondered about her self esteem during these times as she said, “I don’t know how my self esteem stayed high all around math, all around it, because it did" (F6). Claire found she would "take authority everywhere else" (F13) except in math. Claire continued to limit her taking of authority in mathematics into her teaching years so completely that she was "shocked" to hear that she did take authority in a particular mathematics situation ,without even knowing it (F13). One of her friends recognized it happening and brought it to her attention. Claire was not certain how she would feel as an authority in a mathematics because, as she said, "I never have. I don’t know that I could" (MFG9).

Claire did speculate about authority and power if she were to try again some of her college math classes.

If I had to take those college math courses that I would drop out of after the second day again, now, after I’ve come to know what I know now about math, I would walk in there the first day and I would say “listen, you need to teach me the way I need to learn, because I know how I need to learn”. So, I feel like I have more power and more authority over that authority figure, because I know what he, what he or she - Isn’t that terrible? I said he. - I know how the professor, how he or she should be teaching me. ... She should be teaching me any way until I know it.... So, that’s where I am the authority. Where I have power (MFG10).

As it was, Claire did not enter into her college years with this knowledge of her self or with this sense of power.
College Math

If you look at my college transcript, there’s nothing there, no math, nothing substantial. If anyone ever really pegged me on it - It was enough to graduate, obviously, and get a diploma and a certificate, but definitely not enough, I don’t think, to be at all well rounded (A6).

Claire remembered "breaking into a sweat every time" she started a new math class in college. She wrote "these long letters to these professors the first day of every college math class", even though she didn’t try many classes. Claire’s college math experience was "minimal" as "this was before 1986, before you had to take a lot of math courses for an education degree". She remembered only three or four math or math methods courses in college (A4).

Claire referred to her college math courses as "stupid teacher courses" that were "geared ... for dumb elementary teachers" (A4). The designation of "stupid teacher courses" was one that Claire gave the classes, although she "would never call it that" to anyone else. She did "remember thinking it, but ... no one in authority ever really came out and said it". As students in college Claire knew she and her friends were not "idiots". When an advisor said "this course was created for you guys because we saw a need for it" Claire "could figure out what the special course for ... the teachers" was about. She believes that she and her classmates all were "actively reading between the lines" because, after all, "elementary teachers tend not to have strong math skills" (F5). Claire remembered that Statistics for Elementary Teachers "was crazy. It was doing percentages and it was a ready-made course". It was a course to teach about grading (A4). Claire did make an effort in those teacher math classes. She described her efforts.

I remember trying at least. Every time, I would sign up for one and I would write the professor this long letter, the first day of the class, saying “I have an irrational fear of math. You’re going to have to hold my hand through this class. Please make sure I am able ... I will work extra hard.” By the second class I was running out of there, usually in tears, and dropped it. So, it wasn’t ever a good experience (A4).
The Teaching Years

"I don't consider myself a mathematician or a math teacher. I am teacher of third grade. God bless all the math teachers" (A24).

That math was never a good experience continued for Claire even when she taught. She "just pretended it didn’t exist. [She] could get through the daily math, the checkbooks and stuff like that". When Claire moved from a teaching job in the south to her position in the midwest, she started taking classes and workshops "just to learn more about it" (A4). Claire described what she learned.

(1) just really found out that it wasn’t me all these years. It was the way I was being taught, or not taught ... I remember coming home from a workshop, a manipulative workshop, and calling my mother and crying and saying "I finally know. I’m 28 years old. I finally know what a base is." I was taught in a math workshop. How sad is that? (A5).

The class, "a turning point", was taught by Claire’s friend Amy. Claire thought “It was just amazing that math could actually be like that, something that Claire could understand. For goodness sakes. That was unheard of” (A8). Claire felt "elation ... It was like the Fourth of July. It really was". As Claire put it: "It was just, oh, damn. Everything ... I knew about my abilities was validated ... I was doing it ... I was understanding concepts that I had never understood before" (F8). Claire remembered more about what it was like learning in Amy’s class.

The years of self-doubt just fell off me. From then on, I could have taken math, I could do anything. It didn’t matter anymore. I knew I could learn and it wasn’t me. Even thought I had known all those years that it wasn’t me. That ... cemented it. And from then on, I’ve just been a different person as far as math is concerned ... When I was talking to another teacher at home about being a math rep from my district, they kind of looked at me like “You? Of all people, you Claire? Are you sure about that?” ... That’s the reputation I ... always had, but now I know it’s different. I’m not saying that I know it all, the math, because I don’t. I still have never taken the higher math, the Trig and the Calculus, and probably never will, but at least now I know I can, if I want to. I could go back. I’d have to start, I think, way back, to get to that level. And if I want to I will. There’s no reason I can’t (A5).
Claire talked about the qualities of Amy’s workshop that made the learning experience so memorable for her.

The whole idea of the workshop was to bring every concept down to a concrete level, and she did that beautifully. And once I got the idea that there are three levels... of learning math which are concrete, symbolic and abstract, once I understood that as an adult, well that was a triumphant day... She was able to teach me bases through bingo chips that day, or whatever we used... I understood as an adult that anything could be taught like that, most everything could be brought down to that level. So that was definitely a triumph. Definitely (A10).

After Amy’s class, Claire "was ready to call up every math teacher that [she’d] ever had and say 'See'" (F8).

As a teacher, once Claire learned about how she learns math, that recognition influenced the way she taught math. She always started with the a concrete approach to concepts, and avoided abstract paper and pencil beginnings. With respect to teaching mathematics with a paper and pencil start, Claire commented:

There has to be a lot of paper and pencil in math.... I don't play with m&m's every day. There's a lot of paper and pencil but it's never started that way, ever. I refuse. I can't do it. I couldn’t teach it that way, because I don’t know it that way (A22).

The Teachers

Claire talked about her teachers and how even though their “intentions ... were good ... they could have done a lot better" (A8). She talked about what her teachers did do to teach math.

They said I’m going to show it to you one more time, this then this. I remember the word “t-h-e-n”, then you do this, then you do this, then you do this. They did not explain, that I can remember ... they just kept saying we do this then this then this, that’s two “th” words that I kept hearing over and over. And I should be able to get that process and plug my own numbers in, but could never do it ... it never made any sense to me. It was always a procedure this then this then this and you’ll end up with this - ta da. (F9).

Claire silently ‘described’ what math class was. Claire looked up to the chalkboard, silently watching, then looked down at the her paper and hurriedly scratched
notes, then looked up at the chalkboard again, then back to the paper and notes ... no
discussion or questions, no speaking, only listening or ... in this case at least, watching."
Claire described this way of learning mathematics as "Look up. Look down. Look up.
Look down". Claire then stated "That was math class, and the whole class did it. It's
kind of like we were bound (praying) to Allah or something" (MFG14).

Claire saw herself "just emerging out of silence after 31 years" (MFG4). She also
talked about being silent as a young child in math class. Even though she would never
question it out loud, Claire questioned in her own mind whether or not what the teachers
were presenting was the way to do it. Claire recalled thinking, as a child "they don’t
know what they are talking about. They’re not teaching me" (MFG7).

Claire did not remember a successful teacher-student math relationship, ever. She
became her own teacher, "because [she] wasn’t able to rely on any teacher". Claire’s
most pleasant memories were drawn from her own personal triumphs, when she got it
herself, when she would finally get it on her own, teaching herself, like "time, in seventh
grade" (A9-10). It was from teaching herself that Claire eventually "learned that it’s not
just doing the things on the board. It’s the process of it. Just plugging numbers in
doesn’t work" (F5).

Claire saw her daily experience in math class as "just repeated, repeated abuse"
(F6) and "public humiliation" (A14). She remembered "year after year, week after week,
day after day, being up there, standing or sweating until somehow I was helped through
it". She noted that the teachers "at least ... had the grace, the mercy to help me through
it" (F6).

Claire believed that learning mathematics just came down to what the teachers told
you. She said "You’re told in first grade that you’re doing it wrong. You’re using the
skills you know are right to get through a 7+3 problem, and you have to stay after school

105
for it because you were 'cheating'... You know in your head you were not, as a 5 year old, and if someone for 12 years is telling you you are, you are going to shy away from it" (A3).

Claire believes she "faked through" her math classes. She believes that her teachers "probably didn’t know and maybe ... weren’t strong enough to own up to it, that their student didn’t know it. So, maybe they didn’t call on [her] as much" (F3). Claire discussed blame in her math experience, too. She said, "I’m tired of blaming myself, I guess. I’m not going to anymore. I can’t. I know now, as a teacher, that I wasn’t taught right. I was simply to memorize and copy and do it, but it’s never made any sense" (A8).

To have it make sense, to learn mathematics, Claire came to know what she needed. "If I wanted to do that, I’d have to go back and ... make sure that, as a knowing adult, [I would] choose people to teach me that I know will teach me the way I need to learn." Claire learned that she needed activities that were "definitely concrete and hands-on - kinesthetic or touchy-feely." Additionally, Claire would "have to see it ... to write it." She learned that she couldn’t "do anything just by listening to it or watching it. [She had] to do it again, repetitively, a couple of times ... to see the logic in everything ... to find that pattern." Without those experiences, Claire commented, "you can show me ‘till the cows come home" (A12).

**Claire’s Math World**

Claire talked about her place in mathematics. "How tragic, knowing, for 12 years, that you don’t fit in anybody’s math world. And I didn’t. Probably still don’t. But it was tragic to live that way." Claire clarified that she "didn’t fit into their math world." She believed that she "probably could make a world now, a math world" where she did fit in (A21).
When asked what she would like that math world to be like, Claire had the following response:

It would be real. It wouldn’t be chalk and assignments. It would be real. You have more than thirty minutes to explain a concept, and then leave an assignment on the board to do. You’d be able to go back and say for the sixteenth time, show it to me a different way - not just "again". Show it to me differently (A21).

Needs

Claire felt her needs were not ever met in elementary school, but thought that "obviously, they were", because she got the basics. What her needs were, then, Claire decided, were to get the basics. As she reflected on her needs as a math student, Claire knew she wasn’t being taught the way that she came to know she needed to be, "which is concrete, concrete. Something in front of me. Showing it to me" (A10).

Claire also determined that her needs were not of her own choosing. Claire explained "probably at that point my needs were just formed by the teacher ... being the perfect little student I was in every other respect in everything else except math" (A10).

Claire described what those formed-by-the-teacher needs were.

To fit the mold that they said we needed, this mold that you needed to get to junior high, then to high school, ... then to get to college. There was a specific mold that they kept telling us we needed. You’ll need this, you’ll need this. So it’s them telling us what we need in order to get to the next step of education. Little by little I think you just learn not to question it. As little kids you question, and, I guess disagree a little bit freer than you would as a teenager because you know that society expects certain things, and ... you wanted to do the right thing and the right thing was learn this specific thing because you are going to need it, for the next step (F1).

Claire felt that being told to do something because it was preparation for the next step was "threatening" (MFG18). As Claire remembered it,

God help you, if you didn’t get that, didn’t get this. You’re never going to get that. You’re never going to get the next step. And we were warned of that for so many years that you’ll never get the next step if you don’t get this. Well, I gave up after the first step because I didn’t get the first step. I knew I wasn’t going to get steps 2 through 7. Forget it. Forget it (MFG7).
What all of this meant for Claire was clear to her as she discussed her experiences.

It was a defeat. It was them beating me down, beating the questioning, the problem solving or them beating my way to find the answer. Not beating physically, but mentally, emotionally. Time after time letting me know that my way was not the correct way. If left to my means, I probably could have always found the answer, even in those higher courses, but it was always them telling me that wasn't the right way, so, time after time, so I guess I learned to respond (F2).

Because they were telling Claire her abilities weren't good enough, she learned how to behave. She was learning "all of the time ... on every test" that she was "the great, fantastic reader, crummy math student". The only thing Claire learned to question was herself. She remembered "not questioning what they were doing but ... questioning my ability. That's what I questioned, strongly, and did for many years". She believed them that she "wasn't going to get the right way", and Claire became "an exceptionally well behaved student" (F3).

Claire remembered "doing literally ... everything ... to look like the correct student, but not knowing a darn thing". To do this she just "faded away" in math class. Claire thought it was "horrible", how much she missed. She explained, "Then it was survival. It was truly survival. As a teenager, you'd rather not be different, or not good enough. So, I just tried to fade away, or be invisible" (F3).

Claire talked about her memorable math experiences and the role of the teacher.

How do I remember every stinking teacher and an incident from each one? ... It seemed to burn in pretty deep ... they're so etched, so burned. They're never going to leave me. I hope Sarah (her newborn daughter) doesn't have to go through it ... And I would say, "I hope she gets her father's math brain", but I know better than that, because my brain is just as good.... So, I hope she gets better math teachers (A20).

Mathematicians

Claire: Where do mathematicians live? Is there a little burg somewhere? Interviewer: What do they do? Claire: You got me... What do they do? Interviewer:: What kinds of skills do they have to have?
Claire: I guess all the ones that have eluded me all these years. All the higher math...the pages of long problems, the two page problems, the problems I watch my husband struggle with, but get, in college...and notebooks full of proving this and proving that (sound of disgust), stuff that I would never touch (A11).

Claire struggled with describing what mathematics is and how a mathematician does mathematics. She watched her husband do mathematics from his work and school. The problem solving he did at home with measurement and equations amazed her. She described how she thought he must do his mathematics.

I don't think he memorized it. I think he was able to pull it out of the right file in his brain and use it again. He knew where to go in his brain, knew what area to go to, what file to go to, file to pull out. And that's what I was so impressed with. I think he built... the equations himself (F9).

Claire continued with her thoughts on how one, other than herself, did mathematics.

You work through it. This brings that, and that brings the next step, and you go through it step by step by step. But how do know what to do? What do you do? What is that stuff? How do you you know? To me each step is a new experience. For some reason, these mathematicians have seen it before. I've never seen it. Each time I look at it's a new thing. They've seen it before. I guess I always figured they had this extra chip in their brain that allowed them to see it. At some point, they probably do... aptitude, but they just know what to do next. Which is a mystery to me. Definitely. God bless the mathematicians. I know it's not me. (A12)

The sense of logic that Claire found she needed in order to understand math was one of the things she believed that mathematicians needed as well. The mathematicians "need to, since it's always been a mystery to me, they need to know what to do next. It's all steps, isn't it? You're the mathematician. Isn't it? One step after another and knowing where to go next?" When Claire did mathematics she "never knew where to go next." She wondered, "How to get through a line of it?... They were all disjointed. They were all separate. They were all separate to me" (A12). Claire described what knowledge was to her in the past.
Coins in the bank. The things that you mastered, the little blocks that you got, the
stars that you got on the chart, for this, this, this, and this specifically is
knowledge. Coins in the bank...with no rhyme or reason (MFG16).

As Claire participated in professional development she changed her notion of why
some people were able to do mathematics. She "thought it was something other people
did, at first." She also "thought it was just something inborn you had to have and [she]
didn't have it." Eventually, Claire was able to say "After those classes got me started on
it, I knew that it was something that everyone should be able to learn if it was taught in
certain ways, at levels that they can understand" (A17).

Ultimately, Claire believed that there was a way to get to be a mathematician. She
explained that "in this world, [the mathematics students] need to be able to have the gift of
being able to understand what the teacher is doing, whether or not the teacher is doing it
correctly.... Play the game. Play the game" (A11).

Playing The Game

Playing the game was advice Claire remembered getting from her mother. Claire
recalled her mother's advice and the shared experience of working on homework
problems.

I remember her taking them apart.... She was able to look at things a little bit
differently, from an outsider perspective, and she helped me take things apart.... I
could take it apart and understand it, but ... I could never get it back together,
how they wanted it.... That's probably where the failure was. I wasn't playing
the game. I remember sitting at the dining room table and her saying "Play their
game. Play their game. Just do it, because that's how they want it to be done."
Like I said, I could still feel the... lump in my throat, swallowing, swallowing,
swallowing, trying to get it down (A23).

Claire commented on her mother's part in playing the game. For Claire's mother,
it was "sad...because she had to" play the game, just to get by. She had to play the game
more than Claire did. Still Claire's mother, though playing the game, never actually got
to be a part of it in Claire's eyes. Claire benefited in playing the game by managing to

110
get in the game. Claire still believes that it was good advice from her mother. After all, Claire “had success” even if “not the success [she] could have had”. Even though Claire believed that playing the game was probably still good advice, she was not certain that it was advice she would pass along. As Claire said “With her (referring to new born daughter), this four month old here, I probably won’t tell her to play the game. I’ll give her the ammunition to do it... somehow, somehow. Come hell or high water” (F10).

Claire would not advise a young woman just entering mathematics to play the game, either. Claire decided that she would not give herself “permission to advise” (A18) an aspiring female mathematics student as far as mathematics was concerned. Claire reasoned "I’m not where I’d like to be" (F10). However, Claire was willing to give the following advice, focusing on what she learned about studying math.

If it ever doesn’t turn out right, or if ever isn’t working for you, find a better way, find a better teacher, find a better explanation. There’s not only one explanation for everything. There’s not only one way to do everything. Maybe that’s where I would go with my advice. To give her the ability to question the authority a little bit more and demand (F10).

Masculine And Feminine

I don’t see it at all as masculine and feminine. I see it more just gray matter, what your brain is doing ... That it could be perceived as definitely not masculine or feminine (F12).

Claire wondered about the connection between gender and teaching style with the teachers she experienced as a student.

My experiences weren’t with a lot of males, I guess because I never went that high.... I’m still wondering. Is it male-female, or were those female teachers taught that male way 30 odd years ago, so they were passing on how they were taught to me (MFG 5)?

Claire remembered a particular troublesome gender connection in her math classes. She said,

It always bugged me when they would do “Okay, boys, lets do this problem with measuring the boxing ring” and “Okay, girls, lets do this problem with the
recipes"....I thought "That's so stupid". Or "let's do the digging of the ditch story problem for the boys" and again, "measuring the curtains for the girls" (A18).

Claire decided, "I'm pretty much for all-girl math classes", and advised teachers of mathematics to "make sure you don't pigeon-hole them into girl problems, and not-girl problems". She further advised teachers to "watch ... confidence levels ... because the confidence can go in an instant". Claire believed that "if you can't see that in your students, you have no business being there...If you see them faltering in confidence, you better go catch up ... They're not going to get themselves out of it. It's only going to get worse" (A18). Claire described the advantage of an all-girl math class.

There is an innate ... self-imposed ... pressure that we put, a lot of women, or girls put on themselves around math. And if there are boys or men in class I think we tend to ... give the limelight to them, or let them take over, take the lead.... It's a learned reaction. But I think they do. We just bow, and I hate to use that word, but we bow to the old ways of them, of the men doing it, of the men with the white coats and the glasses and the clipboards, and the calculators and slide rules, and the computers. And if you're going to be a mathematician, it's still considered - it's not considered, but in a corner of everyone's mind it's still considered off the beaten path, and unorthodox. It's great, everyone loves it. Everyone admires it, but it's still considered, I'd say, not the norm (A19).

Claire felt that if she had to go back to being 15 or 16, she'd probably let the self-imposed pressures get to her. However, she also noted that if she were a 31 year old student in a class now she probably would not let the pressures get to her (F11). Claire cited the following reason for the difference between the expectations for the 31 year old and the 16 year old.

**Might have Been**

At 15 or 16 you need to be accepted, you need for boys to like you, you need to be popular, you need acceptance by your peers. At 31, you could care less. You can go out and find friends somewhere else. You're not bound to this group of friends that's going to be judge and jury for you. I'm sure you will be able to find 15 and 16 year olds that don't care. But I know myself, at that age, I cared, a lot (F11).
I think I would have chosen careers differently if math would have been better for me. If it would have been ... not easier, but less frightening, less daunting, less of a monster. I know I would have chosen careers differently. Not that I wouldn’t become a teacher. To tell you the truth I can’t believe I did become a teacher because of math. I know that’s one of the reasons I didn’t go to secondary, because I wasn’t going to teach secondary math. I could do elementary math - who couldn’t? But I think I would have ended up in something in the medical field if I would have been more in tune, more confident in math (A3).

When discussing what might have been, Claire talked of what she might have had as a career.

I wish I would have been able to channel it or do what I need to get to be a physician. I think different people have different careers and different callings that they just naturally take to. For some reason, I seem to understand the systems of the body and things seem to make sense medically to me.... I guess it's just what I know, what I can do. It's too bad that I didn't. It's not a strong, strong feeling because for sure there are other reasons that I didn’t. Never mind. Someday. It’s never too late, I guess (F4).

Claire also tried to find a word to describe her feelings about the lost opportunity.

I want to say angry, although I shouldn’t say angry. Just, like “Ugh”, damn it. I could have done it. Could have, should have, would have. And I feel that now that I probably could get through it and do a great job, it’s not the right time in my life to go back and do it. So ... it’s a quiet regret. I’m not going to go running to a therapist for it, but it’s just a quiet regret (F3).

To Learn Math Now

Claire did talk of what she would like to do in mathematics. She described her skill level in mathematics.

I can do ... basic, beginning, first month of school, September Algebra, beginning Algebra. That's about it. Geometry ... I could probably go a half of the year, doing the proofs, or whatever they're called. That's about what I'd be comfortable with, I'd say. (F5).

If Claire were going to study math, she felt she would “want to start from scratch, as a beginning math student. Almost like a first grader, a counter” (F4). Claire also talked about what she thought it would be like to do mathematics and what she would like to be able to do, even though she “doubt[s] that she’ll ever get to that now” (A7).
I would like to be able to take a class or do what my husband did in college. I would see what he did and I would just be in awe.... I was in awe of anyone, of you, as a person who was a math major. Wow. That to me is the greatest thing in the world, if you could be a math major. I know, that's what all the math majors do. But to me, it was "God, you can do that? You can really stand up there and do that?" It's amazing to me. I don't think I'll ever get to that, and that's okay. I don't think that's why I was put on this earth, to do that, but it would have been nice if I would have been able to learn that when I was supposed to. I think it would have been a lot different, my schooling. My schooling would have been much, much different (A7).

Claire thought that she would be a different kind of learner than she had been when she was younger. For one thing, she would demand more.

I think I would. I would like to think that I would. I'd probably start by flapping my mouth and saying hey listen, I've been - for 4 years now ... I would probably spill everything in the beginning, and probably make that teacher very aware that I am watching him or her, as much as they are watching me (F11).

Claire also "wouldn't be afraid now" (MFG10).

Closing The Story

Claire talked about her teachers, and at one point recalled by name all of her teachers from first through eighth grade. She remembered and told stories, talked of feelings, failures and "triumphs and pleasant memories", even though there were "not too many, at all" (A9) of those happy times. She talked of how different she would be in a math class as an adult, and what she wished she could do in the future. Still, Claire stayed away from mathematics as an adult. She said "Simple math, even, I shy away from. Everyday math, as we call it now. I do it, but if there is someone else to rely on, namely my husband, I'll let him do it" (A7). Even with her openness in interviews Claire recognized a barrier.

It's true.... Once the conversation goes to a higher level when it comes to mathematics, I do shy away, shut down, turn off, and just try and get through it. I want no part of it, still. I'll get there someday. I think I will. I will. But not yet. I'm not ready (A20).
Claudia

[I had] self-satisfying moments [in math]...when things started to make sense for me (A6). I consider pleasurable more temporary and self satisfying is something that is more deep.... It was more like total involvement for me (F7).

Claudia is a white 44 year old woman who teaches first grade in a small rural district in the midwest. She has taught elementary school for 17 of the past 22 years, taking a 5 year break to raise her two daughters. She lives in the same district in which she teaches. Claudia taught fifth grade, second grade, and third grade before coming to her first grade teaching assignment.

Claudia and her two brothers grew up on a farm in a lower middle class, German-Dutch family. Both of her parents had graduated from high school and her mother earned a nurse's degree when Claudia was a teen. Claudia's parents valued education and wanted her to go to college. They wanted her to do more with an education than they had done; she became the first in her family to earn a four year degree (PIDQ).

Claudia paid for her college education with scholarships and by doing factory work. She believes that neither her race nor her class has had any impact on her learning of mathematics. Claudia also believes that gender only has influenced her mathematics learning in terms of her own self-imposed beliefs and behaviors (PIDQ). She has chosen to accept behavioral expectations of her gender; and she has chosen to be the kind of person that she believes women are expected to be, such as being a good student, and being there to help others. Accepting the behavioral expectations of her gender then became a part of Claudia's mathematics learning as she tried to be the good student she was expected to be.
The Elementary Years

Claudia had no recollection of anything that she did very early that would have been mathematical. She did remember playing with dolls, stores, and having money hidden away. Claudia's elementary school memories consisted of "a lot of worksheets and a lot of pages in the book,... tons of 'let's do 1 to 10'". She remembered herself as a "typical child in elementary school" where she really didn't have very fond memories of math. She experienced math instruction as seeing "how ... you do this", after which the students simply would do the problems. Claudia remembered, "I'd do them and if I didn't know how to do them, I always looked at my neighbor " (A1).

Claudia discussed her elementary experiences with colleagues, talking about experiences where the style was paper and pencil oriented. A colleague wondered if her female elementary school teachers taught as they did as a part of a "male-female" way or if they were "passing on how they were taught" (Claire MFG 5). Claudia commented, "I don't know that I consider that a male way versus a female way. I think it was more of an instructional level, of where everybody was at that period of time" (MFG5).

Beyond Elementary School

Claudia remembered that moving on to the junior high meant more of the same type of thing in math as she had experienced in elementary school. However, in high school, Claudia "hated math". She took math courses "only because [she] was forced to." That is, she knew she so needed many of certain credits to get to college (A1). Claudia studied Algebra I, Geometry, and Algebra II in the first three years of high school (F8). She thought she came to a point in high school where she "felt better about math because [she] had become a better student". Claudia worked hard at mathematics in high school, earning mostly As and Bs (A1).
Claudia’s high school math experiences became less pleasant for her when she came to the senior math class, which was "advanced trig and that kind of stuff" (A1). Claudia recalled:

It just blew me away. I had no concept of any of that kind of stuff. It was a horrendously awkward experience because everybody around me knew what they were doing, of course, but me. And I put on this really good show at being able to do this....It was just awful (A2).

Further reflection upon the senior advanced math experience led Claudia to feel she probably was not the only person who didn’t understand, but she knew that as a student, she felt she was (A6). Because of these experiences, math was not Claudia’s favorite subject (A2).

Claudia had never been singled out in a math class other than by her "own personal feelings" (A6). Claudia believed that it was she who was to blame for her feelings in mathematics classes. In her senior advanced class in particular, Claudia remembered that it was not the teacher who caused her to feel as she did.

In fact, she was very kind to me, because she knew I was having a heck of a time, and it was my senior year. I was definitely in over my head, and I should have been advised not to take it. But all my friends were taking it (A6).

Even though Claudia’s senior year math teacher was very helpful, Claudia "ended up having a tutor.... It was that difficult." Math differed for Claudia from the languages, reading, and writing. The language arts classes “came very easily” and Claudia “always did well in those kinds of things” (A6). Claudia believed if someone were a "math major, everything should come easy.... That’s just an ingrained thing [she’d] always felt” (F7-8). Claudia believed that since she had to work so hard at mathematics, she must not be good at doing mathematics.

Previous to the senior mathematics class, Claudia had been able to maintain pretty good grades in mathematics. Claudia believed she earned the grades she did “just
because [she] worked ... hard at it.... [She] can remember doing just hours and hours of theorems and always practicing and memorizing" (A6). Both the difficulty Claudia experienced in understanding the mathematics, and the need to have a tutor verified for Claudia that she was earning good grades because of her work, not because of her ability.

Claudia believed she had troubles in senior math because she did not know what she needed to know from the previous classes. Her tutor helped her go back over those past experiences, questioning her about how she got to the senior mathematics, and what to do next (F8). Each week her friend reviewed topics from the previous week. Then he and Claudia talked about topics for the coming week. Claudia believed her tutor "really got [her] through .. just because he spent extra time with [her]" (F8-9).

Still, math itself truly "was really hard, too" (F7). Even though Claudia only took mathematics because she was "forced" to do so, she still selected difficult mathematics classes. Claudia described her choices in studying mathematics and other subjects.

I was always trying to make sure I was in the best math class... even if I was in the bottom of it. I wanted to be in that best math class or that best language arts class or Shakespearean Literature class or whatever it was. I always wanted to be in it. It was ... important for me to be there (F7).

Claudia considered the notion that difficulty and a large investment of time in learning to understand mathematics simply were a part of what mathematics is about. If this were true, Claudia decided, it probably wouldn't change how she thought about her own ability in math. She said, "After feeling for 30 years that you were not good at it, I don't know that it would make that big a difference in the way I feel. I'm not sure I could convince myself...because...I really have to work at understanding the concepts sometimes still" (F7).

Claudia also thought she “maybe ... just ... didn't enjoy [mathematics] as a student”. Although she was putting in the same amount of time in her reading and
writing as she was in mathematics, she was enjoying the non-math subjects and not the mathematics. Additionally, regarding both the reading/writing and the math, Claudia said,

The benefits were similar. I could get an A or a B in math, usually a B. I had a couple of Ds and a C here and there, but [in] language, or Latin or whatever I took, I always had an A.... The time I spent ... seemed lots less. I'm sure I studied for all of those. I know I did (F8).

College Mathematics

Since Claudia had four years of "pretty solid, hard math" in high school, she felt her college math classes were not that difficult. The only math Claudia took in college was what was required. The courses "were entry level and weren't too difficult" (A7). Still, Claudia recalled, things did not change for her in studying mathematics when she was in college, and she consequently believed she had "no good math background through college" (A2).

Claudia had three math courses in college. One was a beginning entry level math where she had to work with general, across the board topics - a "little bit of everything". Claudia didn't remember "having tons of homework" in this mathematics class. Much of the work was done in class. Claudia recalled, "The professor said 'we're going to do this', he showed us how to do it and we sat there and did it." If Claudia had a question, she would go up to the professor in class, or ask another student in the class (A8).

Claudia helped a lot of girls in her entry level course, a behavior she found to be "amazing" in retrospect. What Claudia found amazing was that others were having more trouble than she. In any case, they worked together a lot which Claudia believed was "probably ... good for [her] ego at the time" (A7).

A second math class Claudia had in college was a "class about teaching math. It was a little bit more like strategies, but it wasn't a methods class" (A7). Claudia
remembered the class as "a beginning skills thing on how to teach ... It wasn't really done very well." The course required "a lot of base work" and Claudia remembered, "In that era, the early 70's, we spent all this time trying to figure out how to work with different bases." Claudia's third math class was a math methods course. She remembered they "did no methods, just structure...That's all it was" (A2).

Claudia also had math experiences in college as a student teacher. When she taught math, Claudia taught "strictly page by page, the beginning of the book to the end of the book." Overall, reflecting upon the math classroom, student teaching experiences in math, and math classes from those college years, Claudia commented, "It took me a long time to get that out of the way and get it behind me” (A2).

Developing and Teaching

Claudia's own beginning teaching "was strictly page by page, the beginning of the book to the end of the book” as it was in her student teaching experience. Claudia described those early years with respect to teaching math.

When I look back on some of the things I used to do ... it scares me. Hopefully, [the children] came out all right. I was just strictly by the book. Do page one. Do page two, three and four, one to ten, one to twenty-five, do the odd numbers. That was my big variety for the week ... lots of coloring. Let's color by number (A2).

Even though Claudia described her 'big variety of the week" as assigning the odd numbers, she did also mention other changes from the routine of those first teaching years. She would 'help kids individually, or once in a while ... think 'Oh, yeah, this might work' and ... try this idea." At one point, Claudia started some centers, and they were probably the most manipulative oriented she had ever gotten in her instructional practices. Looking back, Claudia wondered, “I don’t know how those kids ever learned” (A2-3).
When Claudia began to teach first grade, after teaching fifth, second, and third grades, she "was finally able to see how the kids were developing for the first time ... in math" and she "was really upset." Claudia wasn't getting through to her students, and felt there was a reason for that. She started doing some different things with her students and lot more hands-on activities. In her math teaching, Claudia had been "doing things with no understanding as to why [she] was doing them.... If someone came in and said 'Why are you doing this?' it was ... 'Well, I think it will work.'" Claudia felt she "couldn't justify anything [she] was doing at all." Claudia was certain, however, that "there had to be something better out there" for her students and for her, too (A3).

Four years after she started teaching first grade, Claudia had her first experiences with the state's regional professional development center. She was “intrigued” by what she saw and heard and recalled,

So, the center came along and they gave me a lot of ... good guidance, and ... more, the freedom to experiment and the confidence ... to experiment and try things with the kids, as well as a knowledge base that I did not have before (A3).

The knowledge base that Claudia was developing within herself was in math. She believed "the strategies and things were there ... [She] just never felt comfortable playing with them before" (A3). Claudia explained further about what it meant to her to have a more developed math knowledge base as a teacher.

It's like something was okay now. I could be a little different, and try these things and people weren't going to say 'Oh geeze. What's she doing in there?' because I could justify.... I know this is going to work. I know this is important (A3).

Claudia talked of her need for ways to justify decisions in teaching math.

I guess the only reason I needed the justification was for my own peace of mind more than to go ahead with the kids ... and my administrator's peace of mind.... Also,... so I could go to parents.... It gave me some ammunition.... I think it was more just confidence that it was okay (F3).
Regarding whether she continues to need that voice of authority saying she is right, Claudia said, "I think I would... I often have to stand up for... my opinions.... I would probably never have done that several years ago and I would now". If she were in a "totally new system", Claudia was pretty sure she would stand up in support of how she feels. However, she remains cautious, uncertain as to just how quickly she would "jump in" with new ideas (F4).

Claudia referred to moments of gaining her new knowledge as her "Aha moments" in math, where "all of a sudden, things started making sense, and[she] could really see that 'Gee, there's a progression here I need to be a part of'". She noted that these aha math moments did not occur to her when she "was 10, but when [she] was 40" (A3-4).

It was important to Claudia to "be a part of" the progression in math. As had been true previously, Claudia had "never really put those pieces together.... That's why [she] always had so much trouble in math" (A4). Claudia explained.

I could never see a connection. They were all... just little, tiny units of things.... I could never see crossovers of how measurement can be affected by number, or how data analysis is a part of number, and it's a part of this and it's a part of that.... All these things are connected. I could never see those connections.... There was no progression. We just did it (A4).

These connections in mathematics were important to Claudia as she felt more comfortable trying new teaching methods in math. The comfort level "was a big thing" especially in the building where Claudia taught. Claudia's was "a very traditional-based building" where "it was real hard to be different." Claudia's improved knowledge base in math became a "confidence boost" (A4) for her in teaching math. However, the changes also "made [her] be a loner all of the time" (A12).

Part of the new knowledge base that Claudia developed in math included the realization that there were different ways to reach the same answer in math. She found
that "it was okay that [her] answer wasn’t the same as somebody else’s." Claudia commented, "That doesn’t mean that someone hadn’t told me that all along the way.... I just never let it click" (A9).

**Graduate Study**

Claudia studied statistics while earning her Masters Degree, and described the experience.

When I took statistics for my Master’s Degree, the professor was the worst one I’ve ever had in my entire life.... He just had us read chapters and he had us answer every question in the back and we turned them in.... It was awful (MFG 11).

Claudia also remembered working her way through that statistics class.

A high school guy, Rob, sat beside me and he was wonderful.... He was totally hands-on and he and I worked together for the entire semester.... If it hadn’t been for him working with me, I’d probably have flunked. He was just really in tune to what was going on.... He could bring it down to my level, so I could understand it.... Even then it was hard (MFG12).

Claudia thought "it was really funny" that the professor depended on her and Rob for explanations for the class. As she recalled, "the professor would come back and ... say, ‘Okay, how would you explain this?’ ... He knew [Rob] was working through me as an elementary person.... There was a ton of elementary people in there." The professor asked for help in explanations, because, as Claudia said, “He knew Rob had already worked through it with me” (MFG12).

**Questioning**

Claudia talked about times when she was willing to ask questions to learn more about her mathematics. In her senior year in high school, Claudia was in an honors study hall with classmates from her advanced math class. They did homework together, and Claudia also asked for help from peers. Questioning at that time was a request to be walked through procedures (F10). Claudia did not ask questions expecting different
explanations, nor would she in any way question the authority of the teachers or others teaching her. Rather, she "would just ask, 'Show me how to do this ... and I can do it. Walk me through it.'" Questioning became something Claudia saw as a "just-to-get-me by" strategy (F15). Claudia again asked questions of friends rather than of the teacher when she was in her college statistics, because the teacher was so "awful" (MFG12).

Claudia did not attribute her questioning strategy in high school to any particular behaviors or attitudes of her teacher. She remembered that her high school teacher (who taught all four years of Claudia's high school math) was a woman who "was very open, as far as communicating with the kids." Claudia recalled, "She never intimidated me, really, that I remember." When Claudia would ask questions of other students rather then of the teacher in her classes it was because of her "own inferior feeling" (F9).

Claudia talked about silence as it was connected to her questioning in mathematics. In a discussion with colleagues, one colleague explained her silent role as being different as an adult from what it had been as an student in a math class. Claudia said of herself,

I viewed myself as the silent majority that was always quiet and sat there and listened all the time... I probably asked for a while and I'm sure I gave up.... I didn't always understand it, I know (MFG6).

The questioning behaviors that Claudia moved toward and from were specific to learning how to do the mathematics the teacher's way. "Through elementary or even through college" (MFG7), Claudia recalled,

I would never have questioned .. that what they were presenting wasn't the way to do it. I never would do that. I wouldn't have gone so far as to question [that authority]. I just thought [to myself], "Boy, are you stupid. You can't get this. Go sit down".... That's what I said here. I just questioned until I gave up (MFG7).
Claudia discussed the skills she felt mathematicians needed. They “need to be able to understand number sense, have some basic understanding of the patterns and relationships between numbers, how they function, how they work” (A8). Claudia believed that mathematicians also need to be able to come down to someone’s level and explain... There’d have to be a lot of communication skills developed, listening type things. Being able to take some risks, and move down a level or up a level. Understanding how people learn in general... [They would have to] accept the fact that we don’t all learn the same (A8-9).

One additional realization the mathematicians would have to make is that their way is not the only right way (A9). Overall, Claudia felt mathematicians might be “tremendous” but she just might not understand a word they say. Claudia was “looking for a more functional type of person” (A8).

Claudia felt she probably viewed this as a case where mathematicians were people who don’t relate to other people. She believed her view on mathematicians came from her elementary and junior high years and speculated on those origins.

I think [it came from] the teachers. It would have to be... I don’t know that it would necessarily come from the math concepts... It could be though... since I look at it as a dysfunctional type of subject... Other subjects were always related, and you could see those relationships,... always make connections (F11).

Claudia thought about mathematics and struggled to verbalize her definition of it.

A definition for math? Math is - I want to use connected. This is harder than you think. I would want to include something about problem solving. Math is not just numbers. Math is... being able to... Math is developing sets of strategies to solve problems and make connections in the real world, using numerals or other abstract things (F6).

Claudia was taught mathematics as “separate entities” and came to believe that mathematics itself was a collection of separate entities. She assumed that whatever the teachers told her was true. Claudia explained:
[I] just assumed math was that way - little disjointed units. You learn Geometry and when you were done with Geometry you forgot about it and you did your Algebra I. When you were done with your Algebra you did ... whatever was next ... I never remember connections, or that there was anything similar about any of those classes (F5-6).

While struggling with her definition of mathematics, describing it as a sort of dysfunctional subject, and perceiving mathematicians as people who were not very functional themselves, Claudia also determined who was an authority in mathematics.

Until around the time Claudia was beginning to teach first grade, she saw an authority figure in math to be "anybody who said they were a math teacher.... If he said, ... 'I teach math', I’d say, ‘Okay, you know it'" (MFG8).

How Claudia's perspective on authorities in mathematics changed for her was revealed in a group discussion with colleagues. Others involved in the discussion had described a math authority as “a person who is able to come to a solution, an adequate solution” (Amy, MFG8) or “a user of the knowledge” (Bridgett, MFG8). Claudia agreed and expanded her definition of a mathematics authority to be

someone who can take that knowledge and impart it, give it to others, give it back ... empowering others ... having the ability to make the little lights go on.... To me, that’s a quality of authority that we don’t often recognize, being able to empower others with their own self-confidence (MFG8).

Gender In Mathematics

I think gender is really important.... Sometimes I think that it is not quite as major today as it was a few years ago, but it is important. How I deal with it in my classroom is not a major thing for me (F16)

Gender surfaced in Claudia's talk before she began to address issues of gender directly. When Claudia was talking of her ideas of what it meant to be an authority in mathematics, she spoke of the mathematics teacher as an authority. She also referred to such an authority or mathematics teacher as "he".

126
Whether Claudia recognized her gendering of the mathematics authority is not clear, but she did recognize the existence of gender related issues when discussing an interaction she had with her daughter’s male high school math teacher at a parent conference. When Claudia questioned him about how he was preparing students, the high school teacher "started spouting all these things off and talking down" to Claudia (MFG1). Claudia recalled her responses and feelings regarding the event.

I felt very comfortable in just saying, "Well, you know, the NCTM Standards say...." It’s the first time I’ve really been able to put a man in his place. I just felt so good.... I don’t like being talked down to. I just decided I wasn’t going to put up with that as another adult who had some self-confidence. I wasn’t going to let him do that to me anymore. So, I just spoke right up and he just backed right down.... I think in a way he was just trying to impress the parent ... I happened to just not fall for it (MFG2-3).

Claudia understood why she reacted as she did to the male math teacher, believing that a gender connection “was there, somewhat” for her in mathematics. First of all, Claudia knew the teacher to be "very biased ... and very male oriented. He’ll let the boys do a lot and the girls can’t do anything." However, Claudia’s gender connection had something to do with her own feelings of intimidation in mathematics. Claudia’s feelings of intimidation are changing, but she still felt them as apart of her reaction to her daughter’s teacher. She commented:

He really did talk down to me.... I felt very defensive with that. That’s why I tried to nail him immediately with some terms and information, so he would know that I knew some things, too."

At a later conference, Claudia noticed the same teacher didn’t do that to her again. She said “He was more talking to me than at me” (F16) at the next conference.

Girls In Mathematics

Although Claudia said she had never really given it a thought, she didn’t think she would do anything differently teaching an all-girl math class as opposed to a class of both boys and girls. She said, “I can’t imagine doing things differently just because they’re all
girls. I might have at one time said 'I won’t do insects or I won’t do -' but I don’t feel that way anymore” (A11). After talking with her colleagues, she did decide “it might be a little easier in some ways” to have an all-girl class, at least at the first grade level. Claudia believed “it’s easier not to make those differentiations [in teaching strategies] like it would be in an older age” (F12).

Beyond the issues of her own first grade classroom, Claudia had further thoughts on girls and mathematics. As a girl would reach an older age and seek advice on becoming a mathematician Claudia would advise her to “go for it..... If you really feel strongly that you like numbers that much and you really feel like you’ve got a niche for that, that’s great.... There’s all kinds of possibilities out there.... If it involves number, go for it” (A11).

Claudia certainly wouldn’t tell the young student not to aspire to become a mathematician. However, she would have some difficulty responding to the girl’s question of “What can I do with it?” because Claudia’s not certain of what all is out there for a mathematician. Still, Claudia would “encourage her as much as possible” (A11).

Niches

Claudia spoke of first learning through professional development experiences that there were different ways to solve math problems. She also talked of possibly being told, but not remembering hearing, that there were different ways to solve math problems. She commented that one of the reasons she had “never let it click” was that she “still had to be fit in a little niche” (A9).

For Claudia, her niches and her need to do math the same way as everyone else were connected because she’s “one of those people who has to be okay with everything.” Claudia explained.
I'm awful, you know ... I've got to be what everybody expects me to be, for everybody. I'm not so bad anymore. I'm matured some, but I used to like 'Well, if this person expects me to do this, or be this I will be this for this person, regardless' (F11).

Claudia felt that not making the realization of her need to fit into niches until a few years ago was "scary when you think about it." As she said, "You're thinking about a 35 to 40 year old woman who is still trying to fit into all these little niches that everybody says she's supposed to be in. It's not just that we're all going to get there no matter what" (A9).

Claudia believed this need to fit expectations came from being female and "having the need to be everybody's okay thing. Being the okay leveler for everybody." Claudia discussed this further.

I'm one ... who wants everything to be okay and I'll do the best I can to get it there for everybody. It's one of those burdens that I think women carry much more than men. Being the stabilizer and the "okay, I'll make it better for you and I'll fix it for you" (F12).

However, Claudia also commented on having this skill as a part of who she is. "I don't think it's all I am now, I hope."

Needs Being Met

Claudia said, "Personal needs in school were probably not met as much as the teachers could by just working with me in small groups or one to one" (A7). Classes "were just so structured" and about the only thing Claudia would keep from her math learning experiences was the "patience" of the teacher. Claudia remembered her teachers' patience and how it helped her as far as getting her to where the teachers wanted her (A9-10).

Claudia didn't remember her teachers "trying a lot of strategies ... [or] trying to tell [her] it's okay to get there ... Especially in the early years, it was 'you will remember
5+5 is 10, or you will sit here and write it 50 times until you can get it” (A10). Looking back on it, Claudia believed her teachers had been “just leading [her] along” (F13).

Memorizing that 5+5 is 10 is not what Claudia felt she needed to do to learn math. She felt she had a “need to make ... connections of topics in math ... Math was separate entities, always ... Without [connections] it’s like isolated learning and you forget it.” She said, ”I forget isolated learning...and I needed to make those connections for me personally to understand and remember” (F5).

Pleasant Memories

Claudia discussed what she considered “pleasant memories” for herself in math. She said, “I really don’t have any of my own that are just of me in math, truly. I think the most pleasant memories I have are when I see my kids making sense of things” (A5). Claudia was “sure there probably were some like when [she] got an answer right at the board or something.” However, these moments “just don’t stick out “ (A6) for Claudia since she “never really excelled in math or was singled out for math things she did.”

When recalling her aha moments in math from her professional development experiences, Claudia determined they probably were examples of pleasant memories. However, she “hadn’t considered them pleasant memories” because she preferred to think of them less as pleasant and more as “satisfying things. Self-satisfying things. Self gratification. Self-satisfying moments. More that just pleasurable moments when things started to make sense for me” (A6). Claudia made the distinction between pleasurable and self satisfying in her math learning.

I guess I consider pleasurable more temporary, and self satisfying is something that is more deep ... It is for me.... It was more like a total involvement for me.... Which was ...a weird thing because I never considered myself as math oriented at all (F7).
Leigh

I remember those story problems. I could read when I was 4 or 5, so it shouldn't have been a problem. The understanding of it shouldn't have been that difficult (A7).

Leigh is a 49 year old white woman has taught elementary school for 18 of the past 27 years, taking a “nine-year hiatus” when her three children were young. Leigh teaches second grade in the same rural district in which she lives, a district which is located near a major urban area in the midwest.

Leigh grew up in an urban environment in the midwest, after some early traveling with her family. Hoping to become missionaries to China, her parents had left home in the midwest for two years to study Chinese at Yale. As the family was about to receive their shots to travel abroad, China was closed, and Leigh’s parents’ plans for missionary work ended. The family then traveled back to the midwest when Leigh was five years old.

Leigh’s Scotch-Irish, white collar, middle class family valued education. Her father, a minister, earned a Ph. D. in Old Testament Interpretation, and taught at a seminary from the time the family left Yale until his retirement. Leigh’s mother was also a teacher, first certified in Physical Education. She later earned a master’s degree and extended her certification to secondary English. Leigh’s brother majored in mathematics in college, traveled to Europe for a year, and then returned to the United States to attend Harvard Business School. He is now an investment banker. There was no question in Leigh’s family about whether she would go to college; the only question was where.
Early Math

Leigh's earliest math memories were not pleasant ones. She remembers second grade, taking timed tests and never being able to finish, because she couldn't do the problems quickly enough. Leigh remembers that the students "didn't ever use anything to help" with the learning, as they "were supposed to memorize all the facts" (A1).

Leigh went on to say:

I don't know whether I just couldn't memorize them quickly enough, or just couldn't get them down on paper fast enough, but I can remember feeling a lot of pressure. The other kids would get done - I suppose not everybody, but, you know, you felt like that - and I was still working on my problems (A1).

Not being able to finish timed tests was not the only reason Leigh remembers that "second grade was just god-awful". It was during that year that Leigh's vision problem was discovered. The teacher would put problems on the board and Leigh couldn't see. Leigh explained:

For a long time we didn't know that was the problem and one time everybody was supposed to finish their math problems to be able to go outside and I turned in my paper and told her I was done. She, in front of the whole class, called me a liar... Then I ended up getting glasses ..., but it was all associated with math" (A6).

From second grade, "it just kind of continued that way" through elementary school, until eighth grade. Leigh's eighth grade experience was a little different for her. For some reason, she was more interested in math that year and got straight A's in math. Leigh thought she "still didn't probably really understand the basic principles but ... was able to do everything" (A1).

Leigh felt she remembers her eighth grade year for a number of reasons. One reason was her 4.0 grade point average. A second reason was because eighth grade was the top level at their K-8 school (F8). Leigh also found the year memorable for another reason.
If you did really well ... in English or in math, or both, you could go to a high school in the summer and take Latin or you could take Algebra ... I didn't feel like I could take Algebra, even though I had done this well in math all year (F2). Leigh ended up being eligible for, but turning down, the opportunity for summer study that year.

High School

For Leigh "the breakdown came, really, in ninth grade, but it must have led up to that" (F2). Because she was "able to do everything" in eighth grade math, she was placed in an advanced Algebra I class in high school. It was in that advanced ninth grade Algebra class that Leigh "had no clue what [she] was doing" (A1). Leigh experienced the combination of having an eighth grade teacher who "didn't really teach [them] anything" (F2) and having the realization that she herself "never really understood" (F1) anything. At that point Leigh "knew [she] couldn't go on" (F2) with studying math. Consequently, in high school, she just "took the basics that [she] needed to get into college, in math, and that was it" (A1).

Leigh looked back and commented on her lack of understanding in math. "I don't know why I feel that way. I can manipulate numbers. I could do the calculations ... Certainly, I had Pre Algebra things in eighth grade and seventh grade." She knew how much she hadn't understood in Algebra, that she didn't know how to do it and that it didn't "make sense" (F3). She did not know why.

Leigh went on from Algebra to study Geometry. She "liked geometry a little bit better" and felt she "had a little better understanding of Geometry " than Algebra. Leigh attributed her understanding in geometry to the belief that Geometry "was kind of related to art" (A2, F14). Leigh had an interest in the visual arts and that art interest added enjoyment to her high school Geometry class. Leigh's art interest became a part of her college program when Leigh included an art major in her elementary education program.
Leigh did not understand all that was involved in Geometry, however. Her understanding included "maybe not all the proofs and theorems, but just the angles" (A2). Geometry was the end of Leigh's high school math study, because of Leigh's limited understanding. "Not having understanding to go on" was a recurring concern for Leigh through much of her school math experience. After Algebra I and Geometry, Leigh again felt this inadequacy. She knew she couldn't go on to Algebra II (A6).

Leigh talked about how she made it through her high school math courses. She did not ask friends for help and felt she could not get help from her teachers. The teachers, Leigh remembered, "would put something on the board and they would expect you to know it" (A8). Leigh did not remember her teachers ever going back and helping people, and saying, "Well, there's maybe a different approach here," or "Let me explain that again for you. Let me give you some help after school. Let me ... "None of that. Nope. Either you get it or you don't (F8).

Leigh was "just one of the ones that sat there and acted like [she] understood it and didn't question" (F8). So, when the teachers would "put something up there [on the chalkboard] and ... say 'Well read the book'" (A8) to learn it, that was what Leigh tried to do. She tried to learn the mathematics on her own and she "would read the book and then ... try to figure it out" (A6). Where that did not work, she turned to her father for help.

Leigh's father was "really good in math" (A5,2) and "really helped [her] a lot in high school" (F3). "He was always really willing to listen to us and help us" (A7). She remembers "sitting at the kitchen table for hours and hours ... He was extremely patient" (A2). Every night they would sit and go over these things (F3). Leigh's dad "made it more understandable. He was a good teacher." These were the times Leigh remembered as "pleasant" (A8) math experiences.
Leigh managed to get good grades in math despite the fact that she never really did understand it. She knew that her father, even though very patient, at times "would get frustrated" with her. He could not understand why she didn't get it (A2). Still, her father "never got angry or upset" (A8) and Leigh made it through. However, it was still short term learning as far as math was concerned. Leigh commented that even in her father's teaching "I don't think there was that much" (F7).

College

In college, as in high school, Leigh took just what she needed in mathematics, and no more. Leigh remembered "I knew I wanted to go into el. ed.. I didn't have much [mathematics] background when I went to college. There wasn't much else I could take" (A6).

Leigh's math experience in her college years included a math methods course and a math course designed for elementary teachers. The mathematics class emphasized the content of the elementary school with the New Math perspective. Leigh recalled that her New Math learning experience was "changing the bases and all that ...No understanding of the process." She thought the whole thing was "stupid" (A2) and commented, "We had to take it ...but, geeze, base four? I don't think so. I never got base ten" (F8). Leigh's math methods class was quite different. In that class, Leigh "was actually preparing lessons to teach" and since she "enjoyed teaching math" (A2) this course seemed to be more useful.

After College

As a teacher, Leigh learned more about math through professional development. As she stated, it "has helped me not only in my teaching but in my own understanding of math concepts " (A13). Leigh attended a particular workshop taught by her friend, Amy.
The class was the first in a sequence of "eye opening" (A3) professional development and curriculum work opportunities for Leigh. Regarding that first workshop, Leigh recalls:

It was so much fun ... I thought "If I had had math this way when I was growing up I would have loved it" because we did all hands-on things ... it's like that thing 'I hear and I forget. I see and I remember. I do and I understand.' That was really true and ... that's how it is for my kids that I teach. Unless they do it, unless they put their hands on things and really understand through working with things ... they would have the same kind of experience that I had ... in math (A3).

Leigh continued to experience "eye opening" (A3) in professional development. She and others in the Mathematics Teacher Leader program developed friendships and experienced many workshops and classes together. As Leigh put it, for "every one that we've taken ... it's like 'Wow. This is understandable. I can do this. If I'd been taught this way, I might have loved this'" (A11).

Through her professional development experiences, Leigh's definition of math changed. Her definition was once that math is "numbers. Just procedures. Something you use on a daily basis" (A13), and that "there was only one way to do it in math" (A11). According to Leigh, this notion grew to a "much broader view of what math is, it's relation to other areas of life, other subject areas" (A13).

Although Leigh did not describe what more that "broader view" included, she did describe what one should be able to do to be a mathematician. For Leigh, a mathematician still needed "to be good with numbers" but to also "have an understanding of math concepts." Mathematicians needed to be able to "think logically ... develop strategies" (A11).

The need to develop strategies was important to Leigh because it helped to minimize the panic she felt in doing mathematics. When Leigh took the SAT in high school, she "tried to figure it out from clues, from the process of elimination" and even though she said she did not know how she did as well as she did, she "didn't do too
bad". What was problematic for Leigh was that she believes she "probably did" think that there was something wrong with figuring out the problems, that she couldn't just "sit down and work right through it". Leigh revealed her changed outlook when she stated, "But I don't feel that way anymore. That's how I do a lot of things" (F5).

**Panic**

Leigh remembers always having "that panicky feeling" (A2) about math. She did not remember exactly when it started, only that "it just got worse" over time. She felt this panic mostly when she encountered story problems. She thought this may have started about fourth grade "whenever you really start to do those things" (F4). Leigh did not know why this feeling started. She "could read when [she] was four or five" and "the understanding of it shouldn't have been that difficult" (A7). Leigh assumed that the reason for the panic was that she "must not have been successful" (F4) with story problems at some point. When she encountered a story problem, Leigh didn't "know where to start" (F5).

Even though Leigh grew to "feel a lot more comfortable with it" (A4), her story-problem panic continued to surface in adulthood. Leigh remembered a particular day when she was helping her son with his fifth grade math homework and the panic returned.

Because they were story problems ... I still have this block and it's immediate. As soon as I read a story problem, I'm thinking "Geeze, I don't know how ... " I'm just in a panic. It just takes me right back to fifth or sixth grade, or seventh grade, whenever we did all of those, and I can't think through it (A4).

Leigh also had that "panicky feeling" whenever she took a math test. She explained, "I didn't think I would do well on it. I always got A's and B's in math. I got the grade, but I never understood anything." Leigh took the SAT in high school after
only taking Algebra and Geometry, and there were ... terms [she] had no clue about.

She did not explain how she "came out okay on it". She just didn't know how (A2).

Leigh learned from her own math experiences that it was important to develop different strategies in solving math problems "because there is no one way, most of the time ... So you need to be able ... if you come to a dead end, or you feel panic, ... to be able to say, 'I can do it this way. I might be able to try something else.'" Leigh found this belief to be "less restrictive", and felt there "was comfort in that." For Leigh, knowing that "there's not just one right way to do something" helped because it "minimized" (F6) the panic.

Leigh wondered about her mother's influence in such matters as her panic about story problems. Leigh's parents both always encouraged her to do what she wanted to do (A4). However, even though education was valued in their family, and Leigh's father (who had at one time had been a math major himself) helped Leigh with her math homework, Leigh did not receive positive messages about math from her mother.

Leigh saw her mother as "very, very bright" (A7). Leigh went on to describe her mother further:

She has a master's degree. She's an English teacher ... She was in speech and theater ... She did plays in dramatics ... very intelligent person, but she always said she was terrible in math. From the time I can remember. That was a role model, a female role model that was reinforcing how I felt about it (A8).

Consequently, throughout her childhood Leigh knew "it was okay if girls " did not do well in math. She remembers her mother saying "Oh well, I'm not good in math either" (A5). Her "mother always said 'Oh, I can't do this, I can't do this. Thought problems I can't do'" and Leigh "heard that all the time" (F1).

Leigh has two daughters, both of whom do well in mathematics. Leigh remembers her mother's messages "which is why Leigh never says the same things to
her children" (A8). Leigh told her children that math was "something you need to be
good at" (A5). One daughter hoped to become an architect, and Leigh had some
thoughts on having her daughter in a mathematical career.

I would make the same kind of comments that these other people make. Go for it.
Don't let the guys get you down. Don't take anything from them. Do the best
...But they haven't had to deal with a lot of that ... and it's important for them to
do well (F10).

Because of their desire and ability, Leigh assumed her daughters would be successful.
Leigh also wondered " Doesn't it all go back ... to your own self concept, how you feel
about everything, how you feel about yourself? ... If you feel good enough about
yourself to overcome the adversity, then you could do it " (F10).

Tuning Out

There were times in her efforts to learn math that Leigh simply chose not to work.
When Leigh worked with her father on her math, she sometimes "would tune him out"
because she "just didn't want to think about it anymore" (A8). Leigh suggested, "Part of
it probably was just my mind set. I'm really stubborn and got to the point where I just
don't want to do it" (F3). A lack of interest was also a part of Leigh's choice not to do
math. She described an example as follows:

Like if a train goes this many miles an hour for two hours, how - I don't care.
What difference does this make? Maybe it was the real application. I don't
know. But it didn't make any difference to me. I didn't see any sense in doing it
( F5).

For Leigh, math "just wasn't important" to her, at least "not as much as other
subjects" (F3). Leigh talked about those other subjects, too.

I liked science ...I loved Biology. I liked Chemistry pretty well except for the gas
law problems. I liked English and reading. I loved to read. I read from the time
I was little. I loved books. So, I would choose to do that (F3).
Teachers

Leigh attributed some of her lack of success in math to herself, her tuning out of her father, her not wanting to do it any more, her not caring about it. She does, however, attribute some of her failure to her teachers. There was no one who stands out in her mind (F8) as a particularly good teacher. When asked what she has taken from her teachers to use in her own classroom, she responded "nothing" (A12). From what she remembers, "it was problems on the board. Copy these. Do them. Do your homework. No real explanation" (F8).

Good teachers in other subjects differed from math teachers in Leigh's experiences. The good teachers she had in other classes were teachers who "really understood and loved their subject." Of the teachers Leigh enjoyed, she cited characteristics like "sense of humor" as important along with the impression that "they loved what they taught or they at least were excited about it" (F8).

What Leigh experienced in math teachers was an Algebra teacher on whom the students played tricks daily, and a college instructor who got his foot stuck in the trash can. Overall, Leigh had this to say about her math teachers: "I don't think I ever had a math teacher that really, even in high school, understood it that well ... or who was able to get it across to us " and there was "no excitement" (F8) from the teachers.

Learning Cycles

Leigh talked about what she would need to develop the skills that she had determined would be necessary to become a mathematician, to develop reasoning, understanding of concepts, and problem solving skills.

What I saw as an adult that was effective was actually using the materials where I could put my hands on them and manipulate them ...Then there was a connection between that and the math concept. It made it understandable to me. And
working with other people and talking about things and working in small groups, or even with just one other person ... Just being able to ask questions and having it be reiterated (A11-12).

Given an opportunity to learn that included the environment and materials described above, Leigh would need more from herself. She knew that moving into a new learning situation she wanted to first "observe, listen" (MFG 9). Leigh explained why she had this need for quiet observation. "So I make sure I'm understanding what you are saying ... That's just my approach. I don't just jump right in. I want to make sure I understand" (F13).

What Leigh would need to do next would depend on what she was listening to. If she didn't understand something, she would question it (F12). However, this has not been easy for Leigh in mathematics. In her school math experiences Leigh did not think she could question in math. For Leigh "it was ... pretty much .. what the teacher said. That must be it. I don't even think I got to that point where I had questions but didn't ask them. I don't think it was like that. I think it was just that I accepted it " (F11).

Even as an adult, Leigh struggles with the idea of questioning in a math class, as she explained:

I don't know if I would, in a completely different situation, particularly in math, because that's where I'm the most intimidated, whether I would say anything or not. I'm also at the point where I don't get too embarrassed anymore ... It doesn't matter anymore. I know what's important and what's not ... If I have a question and it's a really stupid question, if other people perceive it as a really stupid question, if it's something I want to know, then, I figure ... (MFG11).

Leigh had no problem questioning when she was in her friend Amy's math workshop or in the MTL sessions. As far as Amy's workshop was concerned, Leigh remarked,

"I didn't feel threatened by Amy. Maybe I was just at a different place in my life. I felt like I could question, or ask, or it was explained better ... She made it understandable for all of us. She took the time to explain it ... The same way with ... the Math Teacher Leader workshop (MFG4-5).
Once she understood, Leigh would then work on trying to "internalize it ... and use the information." To internalize it, Leigh wanted to "participate in a discussion." Leigh also used her participation in discussion to let others know she understood the content (F12). After understanding and discussion and internalization, Leigh felt she could then "show somebody else." However, in new situations, Leigh often took time listening and didn't "participate for a long time, even in small group" (F13). For one particular non-mathematics class Leigh described what typically happened.

> I listen to what other people have to say. Then, if I feel strongly, if I don't agree with them or if I - I'm not afraid to say what I think, but I always kind of listen first ... kind of observe what's going on around me (F13).

The cycle described above did not happen only once for Leigh. She entered new situations always as the observer, questioning when necessary for understanding. She participated in the discussion to heighten her understanding, but only after feeling comfortable enough with the topic and what was going on around her. As Leigh said "I always start the same way. I always listen first" (F13).

### Knowledge

Leigh believes that knowledge is something that is "out there" (F9). A friend of hers describes knowledge as "coins in a bank" (Claire, MFG 16) and Leigh added the description of "just bits and pieces" (MFG16). School math knowledge was about bits and pieces of information that didn't seem to have much relevance to each other ... To me, it was like everything was individually taught and you learned that and then you forgot it. Then you went on to the next thing. But there wasn't a real pattern ... I didn't feel that anything was connected (F14).

As a teacher, Leigh was a "facilitator", giving her students "a starting off point" (F9) for their math learning. She was beginning to "feel a lot more comfortable" (A4) with math herself, and was more comfortable "teaching kids than ... teaching adults" (F9, D). Leigh was interested in "different kinds of opportunities to develop strategies,
to explore ... in math, to ask about things ... see how math relates to other areas" (A5).
She wanted her students to have a better math experience than she did.

Lindsay

I did okay in math, although I didn't like it (A1).
I didn't like ...knowing what to do ... but not understanding why I was doing it (F1).

Lindsay is a 38 year old, white woman who teaches sixth grade in a 5-6 middle school. The district in which she works is a middle class suburb of a large urban area in the midwest. Lindsay has been teaching for 17 years. Her teaching career began with an assignment in a Learning Disabled classroom. After 4 years she began teaching sixth grade children in a regular education classroom, and has been teaching sixth grade ever since.

Lindsay was raised in an upper middle class family and lived in a suburb of an urban area. Education was valued in her family and both of Lindsay's parents had masters degrees. Lindsay particularly remembers her mother studying for school when Lindsay was in junior High school.

Both of Lindsay's parents were educators. Her father started his career in education as a high school social studies teacher. He later became a high school principal when Lindsay was in upper elementary school. Lindsay's mother was a third grade teacher until she, too, became a principal. Lindsay's mom was an elementary school principal from the time Lindsay was in late junior high.

Parental expectations for both Lindsay and her brother were high. She remembers that her brother struggled more than she in school, but for both of them the parental message was a consistent "do your best" (PIDQ). Lindsay feels that she didn't
need the expectations of her parents or any other outside pressure to do well in school. She just always wanted to do her best. She does remember, though, her parents asking her about her choice to major in education in college. Their question was, "Are you sure you want to teach for the rest of your life?" (PIDQ).

**Elementary School**

Lindsay's earliest memories of mathematics included an episode in first grade where she "was traumatized" (F6). Lindsay had a paper returned to her on which the teacher had written a note which said that Lindsay had copied from her neighbor. Lindsay remember that she felt "just heart broken." She thought to herself "I didn't copy." Later in the year, Lindsay was again accused of cheating from the same boy as in the first episode. She remembers how she felt when she "just broke down in tears" (A3).

Lindsay did not know if the boy from whom she was said to have copied was similarly accused, or how it was determined that she should be. She remembered "people saying 'did he look at your paper or did you look at his paper?'" Lindsay also remembered there was only one problem wrong on the paper, an observation commented on by her parents (A3, PIDQ). Although Lindsay threw the first paper down the sewer, the second, with "copied again" written on it (A3) had to be signed by her parents.

Other than the first grade copying episode, Lindsay did not really remember the primary grades (A1). She did remember a time in fifth grade when everyone had turned their tests in and were leaving for the next class. Lindsay couldn't figure out an answer and started to get tears. She was just told the time was up and to turn in her paper (PABN).

Lindsay'e memories from sixth grade include recollections of decisions about who would go on to honors classes in junior high and who would not (A1). She remembered what those decisions meant to her.
They were going to put me in honors math, just to see how I would do.... We
decided to go ahead and do that. That was really the first recognition that I was
either really good in math or not so good in math, although I know I didn't like it
(A1).

Concerning the comment from Lindsay that she didn't like math, she further
explained that she "hated math in school.... It didn't make a lot of sense." Math was just
doing problems. Lindsay didn't remember special things they might have done "along
the way. It was just math homework and so many problems and so many pages to do"
(A3).

Even though Lindsay said that she "can't remember stuff [they] did in math,
besides just the worksheets, and things in the books" (A8), she does remember she
"hated story problems" (A5). She believes she probably hated them because she got the
ones wrong that didn't follow the pattern. As she remembers it, "If we were multiplying,
I just multiplied on them" (A8). Lindsay mentioned other things she disliked about math.
"If you put the comma in the wrong place, it was wrong. You didn't have the label, it
was wrong." (A8).

Even though Lindsay recalled little from elementary school math, she did
remember other subjects.

Especially in elementary school, ... I can tell you specific things that we did ... in
science and social studies, different projects that we did, and books ... read. I
don't remember anything about math besides you just did problems (A2).

Junior High

In junior high, while in the honors track, Lindsay had "regular math" in seventh
grade and Algebra I in eighth grade. Lindsay described her feelings about going to math
class in those years. "I looked forward to the other classes and didn't look forward to
going to math. I don't know if it was because we weren't doing anything exciting or
because I wasn't as good in math as I was in other areas" (A8).
Lindsay was an athlete, participating in sports the entire school year in every grade from junior high through high school (F4). In eighth grade, when scheduling for ninth grade, Lindsay had the opportunity to become a Girls Gym Leader. There wasn't enough time in her schedule with band for Lindsay to be a Gym Leader (A1). Gym Leader was a five day a week commitment, and with all of her other courses, Lindsay decided to decline the opportunity.

When Lindsay then decided to take Algebra II ... the Gym teacher asked "Why aren't you trying out for Gym Leader" (F4)? As Lindsay recalls, "It was almost like it gave me permission. Oh well, maybe I don't need to do this then. Maybe there's a way to get out of this" (F4). Lindsay had not discussed any of this with her parents before making her initial decision to decline the gym leader position. When they found out about Lindsay's decision, and were sensitive to her struggle over it, they suggested Algebra II for summer school (PIDQ).

Lindsay finally switched from her ninth grade Algebra II class, and became a Girls Gym Leader. She took her Algebra II course in summer school between ninth and tenth grade. Lindsay discussed the rationale behind her choices.

I think, looking back on it now, my parents knew that I didn't enjoy math a whole lot and that it wasn't a strength and I think without saying it, they probably realized that I wasn't going to go into an area that was going to do math and science. Right or wrong, now that I look at that. But at the time, looking where my interests were and the things I was involved in ... and saying that, and knowing how involved I was in sports, and looking at the option of that - You could do it in summer school. That seemed to be the most logical. You couldn't take English in summer school. They didn't have science. Again I was in honors English, and those things at that time. It just was an okay thing to do....I don't even remember when I signed up for the classes any counselors saying well what about math? Again that may have been because knowing a family of educators ... that had already talked.... But it's almost at that point I would have thought "no that's okay" (F4-5).

Lindsay recalled another factor that may have had an influence on her choice to opt out of Algebra II in ninth grade. Lindsay received a "C" on her grade card in eighth
grade math, in the middle of the year. She did question her teacher about her grade because she knew her scores to be similar to a friend's. That friend received an A. As it turned out, Lindsay had a 79.9 and they gave her a "C" (F5). She remembers, "That was the only 'C' in my life. My parents knew that was traumatic for me...So, probably when that [dropping Algebra II] came up as an option it was ... "She doesn't like ... math" anyway (F5).

High School

"I took only what I had to" (A24).

Lindsay did take Algebra II in summer school after ninth grade. The course was offered in "just a short amount of time and it was self-paced. You did your own stuff" (A1). The class was taught through a short six week program, and Lindsay believes she didn't get out of it what she would have had she taken the year long version of Algebra II. Lindsay felt that she got a lot done, but didn't have the struggles that she would have had in a regular classroom. She believes that in some ways, though, she did a lot better (A2) and further explained:

I still think it was easier for me ... I don't think it was nearly as much work as it would have been throughout the school year. It was easy.... I think if I would have taken it during the school year I would have struggled with it more (F6).

To Lindsay, another advantage of taking Algebra II in summer school was she had to really push herself and not get stuck on stuff. Lindsay described herself as a student in that summer class as one who "sits and does her work" (A10) and remembers:

I was the shining star of everybody. I was a fast worker and I got a bunch of stuff done....There were a lot of kids in there who had failed Algebra II that year before. I was with older kids that failed it ... so I probably was good ...but I didn't like it (A10).
Lindsay was one of only two females in that summer Algebra II class and remembered that she and the other young woman didn't even know each other. Lindsay did know some of the ... guys in there (F16).

In fact, there were couple of other kids who weren't my real close friends but who had been in honors classes with me, too. I don't know why they didn't take it during school. They wouldn't have been people who would have failed it. Somehow they were in there, so we hung out together (F16).

For some reason, the sequencing of her math classes was different than it was for some others at that time. "The other kids took Algebra II in eleventh grade after Geometry. Everybody took Geometry in tenth grade and then most people took Algebra II in eleventh grade" (F5). Lindsay considered the possibility that she did not receive good advice on dropping the ninth grade Algebra II because others thought she was a year ahead anyway. "It would have fit in that [they] would think that" (F5).

After studying Algebra II in summer school, Lindsay went on to study Geometry in tenth grade. The Geometry teacher was the same teacher who taught Lindsay's summer school course. Lindsay remembered, from Geometry, that when they were doing all the proofs and things, she could never get those on her own. She recalled, "When I was in class and followed through it step by step, they always made sense to me, and I thought 'I can so this' ... I'd go home, and I couldn't figure it out" (A3).

Lindsay had depended upon her ability to "follow the procedure" throughout her math experience. What she "didn't like about it ... was just having to do problems ... of knowing what to do but not understanding why [she] was doing it". Lindsay also stated "I knew the procedure to follow but it made no sense to me ... Then I got ... frustrated, because it was no longer 'do these same things and you can find-'.... It was the proof stuff" (F1), and finding patterns (BR1). Geometry came to be a place where Lindsay learned "there wasn't a set procedure to follow" (F1) anymore.

148
Tenth grade Geometry was the last of the school math that Lindsay took. About this Lindsay said, "I took what I needed ... and did all right in it, but didn't excel....As soon as I had the opportunity not to do anymore I stopped" (A1). Lindsay talked more about stopping math study in high school. "All my friends took that kind of stuff. I didn't miss it. I didn't care that I wasn't in math. I was happy with the other classes I was taking" (A9).

Had Lindsay "gone through Trigonometry, Calculus, that kind of stuff", she believed she wouldn't know it today, anyway, because she would never have used it (A13). After further thought on her use of mathematics, Lindsay continued talking about how she knew she wouldn't have used the higher math. "I guess I don't. I'm assuming I never would have used it because I'd never used any other math ... besides grocery shopping and that kind of stuff" (F10). Once Lindsay talked about these things and reflected even more she commented "Well, now, see. You got me all involved here because I guess I really did use math but ... it wasn't the math we were doing. It wasn't school math" (F10).

Lindsay considered how the role of her not wanting to proceed in mathematics may have been yet another factor in parental and teacher support for dropping her ninth grade Algebra II class. "Even if I had taken Algebra II at that point, I wouldn't have taken Trigonometry and all that stuff. I think they knew that at the time" (F6).

**College**

In college, Lindsay took two math classes. Of those two classes, Lindsay recalled:

[We] had to take a teaching math class and ... one math class that elementary teachers had to take....It was through the math department and that was okay.... It didn't have anything to do with the teaching of the math class. It was just math concepts and things...Again, I did all right in it, but I didn't like it (A2).
Lindsay "really enjoyed" her mathematics methods class, which was called a teaching math class, for a number of reasons. First of all, they "did a lot with manipulatives. That was the first time she had done anything with those (A4).

Additionally, Lindsay enjoyed the style of the class.

It was ... a self-paced class. It was done a lot with computers. We took computer tests. When you got done with one you went on to the next (A4). People would work in a certain area, and had all the manipulatives out that you had to use. We had class time where we could do that stuff and we took the tests during class time, but you could also do the stuff on your own. We went through the different modules....It was the first time I actually used manipulatives, and I was doing basic adding and subtracting things and I thought, "Wow. This is why you're borrowing and this is why you carry over" and what it all meant. I had never known any of that before. I think that's when that clicked (F3).

Lindsay talked more about how she felt in that college class.

I think that was probably the first time I felt confident in math and knew what I was doing.... That was probably a turning point for me in terms of the math ... I could see why I was doing certain things, or was remembering things that I had just known rules for in the past, without knowing why I had to do them. All of a sudden I was thinking "Oh, that's why we were doing this." It was just all clicking for me ... as I was going back through these math modules (A4-5).

Lindsay did comment, however, that even though she enjoyed the class she still felt differently about it than she did about other, non-math classes. "Even at that point I still liked the other areas better, because I felt more comfortable with them" (A4-5).

Although Lindsay liked the teaching math class, she had a problem with anxiety "with the computer tests" (F3).

I am a person who skips over questions I'm not sure of and goes back to them later or gets information later in the test and goes back and uses it...[With these computer tests] you put your answer in and it told you right then and there if you were right or wrong and you couldn't skip it. So all of a sudden you got one wrong and - (F3).

Professional Development

Professional development experiences helped Lindsay enjoy mathematics. In one experience Lindsay learned about doing some things differently, and starting to question
and starting to see that there are different ways to do the same thing. That particular program was, to Lindsay, another turning point. Lindsay described what the program did for her as a person learning math.

It made it fun. That's the first time I enjoyed math.... It became real. It became meaningful....There was a reason for doing the stuff and I could see the reason we were doing things... and having fun with it (EFG3).

Professional development also helped Lindsay learn differently what math is. "Math isn't boring", she learned. Lindsay also learned "It isn't just repetitive stuff. It isn't just memorizing things. It's not just moving on ... math is useful. There's a reason why we are doing it which wasn't there before. Just to do it because you had to" (A18). Lindsay also learned to see patterns in mathematics (BR). Lindsay talked about learning about how she could learn math.

I don't think I knew that I wanted to see it, or could see math in a different way until it was presented in a different way. I thought math was always just... rules to do, and things to remember, and order to do things in, and all the practice with it. I think at that point [I] saw there was a need, but I didn't know that was a part of math (EFG3).

Lindsay continued to learn new ideas about math through professional development. She learned "there are steps involved" (EFG4). When given a problem without a procedure to follow, she and her colleagues were expected to "come up with something, or make sense out of it ... We were able to do that among ourselves" (EFG4).

Silent And Active Learning

Lindsay had seen herself as a silent learner in math because, as she explained it, "I didn't say anything, just did what I needed to do and went along with it" (EFG1). Lindsay also saw herself as a silent learner because she "never asked questions in class" (EFG3). Lindsay observed that in her classroom there are a lot of kids like herself, who will never raise their hand because the don't want to be wrong (A19). If Lindsay did have questions, she "would ask friends or talk with parents at home" (EFG2). Lindsay's
professional development experiences helped her change. She commented "I would not say now that I'm a silent learner, because I'm active now" (EFG5).

Lindsay talked about the difference between silent and active learning for her. She knew in her mind that it had to be different but defining that difference was difficult.

While you're doing anything ... Your mind's got to be actively doing something ... If I'm following the steps of a problem it's being active, but it's got to be completely different when you have a chance to think.... My mind's going to be thinking of different things and starting to associate different things when I'm ... able to try out something to see what you're going to have to do (F16).

Passive learning, in Lindsay's eyes, is "just sitting and listening. Kind of like a robot just going through the motions, doing what the teacher was doing, not really thinking, but just doing (BR)

Lindsay used the example of working with decimal blocks and a problem situation that required regrouping.

Well, my mind, if I had just been sitting there, would think, "Well, you just borrow." But all of a sudden, I had to see the need and said "What am I going to do if I don't have enough of the tenths? ... I guess I'm thinking of a different thing and thinking association and probably thinking that I've done that.... I'm sure I'm hearing and I'm sharing my ideas ... It's more involved. There's a lot more to the thinking and to the learning ... than if you are just sitting there following along with the instructions at the board or the way to do the problem (F17).

Communication

Lindsay talked about communication and how it was related to her study of mathematics. She remembers the lack of communication being common in math class. You didn't talk to anybody ... We were all in rows back at that time.... I don't even remember sharing ideas about math problems and answers you got. It would be homework and ... go through the answers. "Who's got a question about it?" Of course, no one is going to say that they have a question about what they got wrong (A14).

Even though communication was not an option in math class in school, Lindsay did use communication to help her with her math outside of class. Sometimes she talked with
friends later on and got help. She would call friends a lot on the phone to do math homework (A18). Lindsay's friends played a role in her math learning into high school.

Probably it was my friends that I got more information from and help. We would often, later in junior high and in high school, meet at the public library and work together and that kind of stuff. That's probably how it made more sense to me.... Then you take a test and you get back the test and, of course, no one has questions about it.... And you go on.... it was just the same thing over and over again (A15).

Lindsay believed that without contact with her friends she would not have known what to do (F13). Lindsay also described what was so beneficial for her in her contacts with friends when studying math.

I think a major thing was that it was being explained and we were talking about the ideas. We were saying this is what we should do or this is not what we should do.... It was coming from both sides of the conversation. It wasn't just me giving it. I was ... able to offer some things there. I think without that time to talk and to share, find out how to do the problems, I wouldn't have been as successful as I was (F12).

**Isolation**

I remember other classes where we got to do different things together and talk with other people. That wasn't something you did in math... math is an isolated kind of thing (F2).

Lindsay didn't like that isolation component of math. However, when she studied Algebra II in her self-paced summer class and math in her self-paced college class, Lindsay found that experience of isolation enjoyable. She did well in those independent classes, too, learning on her own. Lindsay distinguished between the experiences of isolation in her self-paced classes and the traditional math classroom.

I guess in the traditional classroom I was isolated but I had to do what everybody else was doing ... You went at their speed.... When I was in the summer Algebra II class I was on my own but I could progress and I was done ...(F2). The same way with the college class. I was able to go at my own rate, at my own speed, and when I wanted to do more, I could do that. That made more sense to me as a learner (F3).
There was no one "up front" (BR) and Lindsay had to do the thinking for herself. No one was showing her how to do it.

**Other Classes**

The isolation among students in math was not the only thing that Lindsay recognized as a difference between math and other subjects she studied. She continued to see math as isolated, but isolated in that she never used it any other time besides math class (F2). This was not true for other classes. Another difference between math and other subjects involved right and wrong answers. Lindsay remembered that, in math, when you went through school you were either right or ... wrong.... We would always talk the social studies teachers into accepting other answers.... We would always fight for things and try to explain it from our point of view. You couldn't do that in math (F13).

Lindsay didn't like that about math. Another concern for Lindsay was that she and her classmates were "creative in the other classes in trying to say why something should have been right.... It was really using a lot more thinking than it was in just having the problem right or wrong" (F13). They did not have that opportunity for reasoning in math. In fact, it seemed that math offered little opportunity for thinking, not even for exams. During her school days Lindsay "was under the impression that you couldn't study for a math test anyway.... You either know it or you don't" (EFG13).

**Understanding**

I guess I really didn't understand. I was doing math but I wasn't understanding it. I guess there's a difference between doing and understanding. So, why should we understand (F7)?

Lindsay believed that understanding would "certainly" (F7) help one remember.

In the primary grades, remembering is easier ... without as many things to remember.... In the primary grades, there's only so many things to remember.... You get introduced to something new and
you're still practicing that other stuff ... but when you are moving on and you get the upper elementary and middle school and high school stuff ... there's just too many new things thrown in (F8).

Once the list of rules to remember gets long "it gets hard to sort them out, when you use which rule" (F8). Lindsay did not feel it was less important to have understanding in the beginning, when there were fewer rules to remember, and admitted that she probably liked the idea that she had a way to remember; when there was no set way anymore she didn't like it. If she didn't understand it, at least she knew what to do (F7). Still, eventually "there were so many 'how-to's' and so many formulas and so many rules ... I just got all confused. You couldn't remember the order ... or ... what to do at which time" (EFG14).

Being a Mathematician

Determining what one needs to be able to do to be a mathematician was difficult for Lindsay because she wouldn't see herself as being a mathematician (All). Lindsay said, "I don't see myself as a ... mathematician ... but I'm mathy.... I don't view myself in that way as a learner, though" (F15) only as a teacher.

To be "mathy" as a learner Lindsay thought she would have to be "strong in math and gone through and done all the math ... you can ... If you've gone though and done everything that you can mathematically, and you've succeeded at it ... that's being a mathematician". Later, Lindsay's perspective changed. Eventually being a mathematician came to be "more reasoning ability" (A11) and having your brain think about things in different ways (A12).

Lindsay believed that for her students, mathematical knowledge came "from the students' experiences in things. They have to talk to each other and see that there are different ways to accomplish the same task" (EFG9). Lindsay also believed that when
we are gaining mathematical knowledge "we are creating it ... finding guides along the way to help get the math out of things that happen" (EFG10).

Women Going Into Math

Lindsay shared various thoughts on how to advise a female who was a former student and who now wanted to become a mathematician. If that student came to her Lindsay's initial reaction would be "Why do you want to become a mathematician?" (A19). Another response that Lindsay shared was "Why are they coming to me? ... There's all kind of people who you could go to for that kind of information. Why me? What do I have to offer" (F14)?

Lindsay did decide that even though she didn't know what she would tell her aspiring student, she might just tell the girl to work hard. Lindsay assumed this student "obviously likes what she's doing or she wouldn't want to do that.... She's probably been successful at it or wouldn't want to be doing it" (A19). She was willing, however, "to encourage her ... to continue ... in the sciences ... because so much of the math is related to science" (A20).

Lindsay did have some advice for teachers of high school girls who wanted to become mathematicians. She recommended "somehow to continue the encouraging to go beyond, to be able to take ... obscure things ... and make sense of them" (A21), and certain tasks were recommended by Lindsay to develop skills. Those tasks included working with "practical stuff ... something open-ended ... where it's going to require thinking and taking from a lot of different math areas in order to put it all together ... [and be] able to ... explain her reasoning" (A21).

Needs

Lindsay did not think much about her own needs as a student of math but talked a little about her needs being met. "When I was going through school, I didn't know any
different. It was just math.... My needs were probably met because I learned what I
needed to learn." Lindsay agreed that the teachers' needs to have her learn certain things
were met. "Yes, their needs" were met, "but those were my needs at the time. I did what
I needed to get the grades I wanted to get ... on my report card" (A10).

Lindsay described what she would need to be able to learn math. "I would want
to be able to talk to other people about it. I'd want to be able to ask questions and see if
we were thinking about things in the same way. I would have to do diagrams or to move
things". Lindsay determined that she would have liked to do some projects in math, tie in
other areas that she felt confident in.

Lindsay discussed more what she would need to learn math in terms of what she
did not have as a student. "Sometimes at home I would make stuff so I could move
things around, but wouldn't dare do that during school.... A concrete representation ...
that made it meaningful". Lindsay would also like to be able to have fun while in math.
Lindsay wanted to be able to say "'we were in math today' and not 'we had to do math'"
(A11).

Summing It All

Lindsay always did fairly well in math but never understood it. She didn't like
math, and even as a teacher who enjoyed teaching math, was careful to distinguish
between being "mathy" as a learner and as a teacher. She saw her teachers as typical
math teachers and as something very different from what she was and what she wanted to
be. "They were all men teachers ... in junior high ... high school ... Everybody wore the
same type of clothes. I'm sure everyone wore ties back then ... They always had glasses
... always had their piles of papers. The books were always ... fat "(A14).
Only after reflection on her math past, Lindsay thought she “probably was good in math” (A10). Even though Lindsay did not talk of regrets or loss, she did talk of might-have-beens. Lindsay commented on what might have happened if she "had taken more math." She said "I guess I wonder ... if I could have been more successful or felt more confident in my abilities.... I don't think it would have happened.... but I guess a part of me wants to know if I could do it, if I had to" (A9).
CHAPTER 5

DISPLAYS OF DATA

Artistic (re)forms

While exploring the experiences of the women of this study as they negotiate the Space/Barrier, I have considered the dominant forms of research methodology, perspective, analysis, and data display to be as much a part of the Space/Barrier for me as societal influences of gender role expectations, and traditional mathematics teaching. Methodolatry separates experience from knowing (Janesick, 1994). Nonfeminist perspectives disallow the hearing of women's voices; (en)framing limits the emergence of new and not yet expected directions for data. These three issues have already been discussed in this dissertation, and because of the elemental boundaries they strengthen around research for women in mathematics, have a place within the Space/Barrier. These elemental boundaries hinder both the women and the researchers working with them, and restrict efforts to learn about and dissipate elements in the Space/Barrier.

A fourth elemental boundary mentioned above is that of a dominant form of data display. I find this element in the Space/Barrier maintaining the role of a policing agent. Data-display police, those accepting only the dominant and traditional forms of data
display as appropriate and telling, can stop the researcher-warriors and Amazon-warriors from dissipating elements of the Space/Barrier. Should an inquiry begin, by its resistance to methodolatry, feminist perspective, or dis-(en)framing analysis to dissipate some element of the Space/Barrier, the data-display police will become yet another boundary to be breached.

In an effort to work towards a follow-through of research efforts, towards a movement forward through all boundaries, some researchers have sought techniques to help better present findings. Much that researchers have found valuable was being lost in the modes of representation.

Donmoyer and Yennie-Donmoyer (1995) discussed an inadequacy in traditional answers found by empirical researchers. In their discussion they refer to the example of an increased interest in qualitative methods in part as a response to the inadequacies traditional research. An awareness of the losses resulting from statistical languages, general categories, and ideal types in describing human experiences led to the support for more qualitative methods, and the drive to find alternative modes of encoding human experiences.

As qualitative researchers have begun to explore alternatives to the traditional ways of displaying data, some have turned to the arts. For example, Eisner (1979) argues for the use of literature and poetry to describe experiences in research. These nondiscursive forms of language would replace the discursive language of science. They would allow the writer and reader to participate in experiences that would otherwise be reported merely as factual descriptions. It is the factual description that creates the feeling of inadequacy, that makes the researcher acutely aware of "what gets lost".

160
Critiques of more artistic forms suggest that researchers will never really be able to "keep the experience". Rather, the artistic form reconstructs the experiences. In doing this reconstructing, the literary piece smoothes over contradictions, develops steadily, and aims for an unrealistic idealization. The preservation of the artistic form and its stylistic preferences risks taking precedence over the presentation of the experience and a tension sometimes arises between norms of the research field and artistic needs (Donmoyer & Yennie-Donmoyer, 1995).

While research boundaries are being stretched, more means of stretching emerge. Considering these modal boundaries, explorations and criticisms from all sides, we hope for the, for a variety of modes representing experience and a recognition and appreciation of the imposed biases of each. With such appreciation of systemic biases, artistic educational research has begun to find support and publication, and researchers have begun to employ even more diverse modes of representation (Donmoyer & Yennie-Donmoyer, 1995).

One particular mode of representation currently being explored by educational researchers is that of drama, in particular, a form of drama known as readers theater. Readers theater is a scripted presentation with minimal staging, props, and lighting. Scripts are held while being read to the audience, and acting is highly stylized. When used as a form of data display, readers theater sends its messages not through lighting or props or elaborate staging. Rather, readers theater sends its messages through the voices of the data comprising the script.

It is readers theater that I propose as an introduction to the women participating in this study. These women are as complex as one would expect any human to be. Because of their complexity and their diversity I found myself unable to satisfactorily and interestingly describe who they are. I can describe neither them nor their
experiences in any orderly fashion without losing much of what I have heard about what they know, believe, and feel about mathematics, themselves, and the Space/Barrier. Therefore, I choose to be Dis-orderly, "breaking through the tidy orders of Boredom" (Daly, 1987, p.118), of discursive text, and to resist the data-display police.

I have not attempted to present all of the findings of my inquiry in a readers theater format. Rather, I have selected to use the presentation as an introduction to the women participating in this dissertation. By means of my script, I have attempted to present a view of these women that will help the reader understand more about who these women are, and how and why they negotiated the Space/Barrier as they did. I have used only direct quotes from the women as their own voices, and I chose themes that emerged in the data to structure the parts and acts of my readers theater script. I have named this particular readers theater script Theming Theater in the Space/Barrier

Theming Theater In The Space/Barrier

Introduction

In this performance of Theming Theater in the Space/Barrier, we hear the voices of seven women. These women have opened their mathematical lives and personal selves to us through an exploration of the Space/Barrier. In Part 1, some contexts and beliefs that distinguish each woman from the others serves to introduce each woman. Following the initial introduction is a theming of some of the women's experiences and learnings which have emerged from their negotiations of the Space/Barrier. The descriptions and experiences as staged here are brief. The adequacy
of the Theater's words rests in part upon how much we each believe we can learn about people through a few, brief voicings.

The setting or stage for this performance is the Space/Barrier, and all that it encompasses. The players move from one location to another within the place we define for this performance, and they become a part of the moving and evolving Space/Barrier. Although the positioning of the group at any particular point is random, they may select positions within a theme/act to best suit the moment.

Part I: Introducing the Players

Staging: Players are lined one behind the other, in alphabetical order. As they introduce themselves, they step out to one side or the other, presenting themselves. They step back into the line after speaking completing their sections.

Claire: I'm just starting in math....Just emerging out of silence after 31 years (MFG4).

Carrie: Math wasn't hard. The numbers just came (A2). I'm like a sponge. But I guess I never really saw it, understood it (EFG25).

Claire: When you're like me you try to disappear during math. I remember trying to disappear all the time (A2). I've been hiding all these years (A6).

Carrie: I thought maybe I wanted to be an accountant. I enjoyed doing that because everything balanced out and it was orderly (A2). [But I thought that] teaching would be more interesting than just working with numbers the rest of your life (A2).

Claire: There were never any gold stars - ever (A13).
Carrie: My mom was the one who always did the records at home. We lived on a farm and she was keeping all the farm records straight (A2).

Claire: I am 31 years old. I have a newborn daughter. I hope my daughter doesn't have to go through it (A20).

Carrie: I'm told that mom got a partial scholarship [for college] but the family couldn't afford to send her. Then she got married, I was born and the rest was history (PIDQ).

Lindsay: [My father] was a high school social studies teacher and then a high school principal. Mom was a third grade teacher and then an elementary principal (PIDQ).

Bridgett: I am 36 years old; I have been teaching for 15 years; [I am] the first in my family to receive a college degree; the only [one] to receive a masters (PIDQ).

Amy: We were always encouraged to work hard, were read to, and expected to go to college.

Lindsay: [In math] I took only what I had to [in high school and college] (A24). I didn't enjoy math a whole lot (F4).

Bridgett: I have papers I wrote in fourth grade. What do I have to show for math? Nothing. Not a thing (MFG 17).

Amy: I am 43 years old. I was never told that I knew anything [in math] (A1).

Bridgett: All this time people thought I was so smart (F3).

Lindsay: I'm assuming I never would have used [trigonometry] because I'd never used any other math ... beside grocery shopping and that kind of stuff....Well,... I guess I really did use math but ... it wasn't the math we were doing. It wasn't school math (F10).
Amy: I have been teaching teachers about math and people come to me now ... like I am an authority; but, I don't feel like I am an authority.

Bridgett: Somebody ... said, "I can't believe you know so much about math." I said to her, "I can't believe you think I know so much about math" (F12).

Leigh: My mother has a master degree, and my father has a Ph.D. in Old Testament Interpretation. There was no question of whether we would go to college, only where we would go to college (A1).

Claudia: I was always trying to make sure I was in the best math class...even if I was in the bottom of it....It was ... important for me to be there (F7).

Leigh: I always had that panicky feeling whenever I took a math test, because I didn't think I would do well on it. I always got As and Bs in math. I got the grades, but I never understood anything (A2).

Claudia: I really have to work hard at understanding the concepts sometimes still (F7).

Leigh: I don't know whether I just couldn't memorize them quickly enough, or just couldn't get them down on paper fast enough, but I can remember feeling a lot of pressure. The other kids would get it done - I suppose not everybody, but, you know, you felt like that (A1).

Claudia: [I had] self-satisfying moments, more than just pleasurable moments, when things started to make sense for me (A6). I guess I consider pleasurable more temporary, and self-satisfying is something that is more deep ... It was more like total involvement for me (F7).
Part II: Movements of Meaning

Act I: Gender In The Space/Barrier

Staging: The players have moved as a group from their previous position to a corner of the room. They are no longer in a line, but are gathered in a group. They are talking to each other. They partially face each other and partially face the audience for their conversation.

Leigh: My dad has a Ph.D......and he's really good in math. It was just different then. That was in the fifties and sixties, you know, and it was okay if girls - ... It was like "Oh well, I'm not good in math either"... That's what my mom said (A5).

Carrie: I never really thought that girls couldn't do math, or that girls couldn't do anything (A2).

Bridgett: If you were in a room and several other math educators that I know were in a room and then there were several ... men ... I would think that they were just as intelligent as you were in math, just because they were in suits and they were men (A38).

Claire: I remember sitting at the dining room table and [my mother] saying "Play their game, Claire. Play their game. Just do it, because that's how they want it to be done" (A23).

Bridgett: I don't notice that marked a difference as much as I used to ... As a matter of fact, this year, I have more boys who are well organized than I have girls. And more girls that would take a leadership role. Course, first grade girls are bossy (A34).

Carrie: I've seen a lot of math classes where boys dominate....The boys are more aggressive and more verbal about what they are doing (B9).
Claire: There is an innate ... self-imposed ... pressure that ... a lot of women or girls put on themselves around math. And if there are boys or men in the class I think we tend to ... let them take over, take the lead. It's a learned reaction (A19).

Claudia: I've got to be what everybody expects me to be. It's scary when you think about it, ... a 35 to 40 year old woman who is still trying to fit into all these little niches everybody says she's supposed to be in. It's one of those burdens that I think women carry much more than men (F11).

Amy: [In high school] we were filtering out the girls as the years went on (B8).

Bridgett: I understood what the women were teaching and I couldn't understand what the men were teaching (F6).

Claire: Learn to play the game (A23).

Carrie: You're going to have to compete in the guy's world and beat them at their own game. They will ... give you a hard time, but if you prove by the way you do it that you belong there, then they don't have a leg to stand on (A16).

Amy: You're going to come across stumbling blocks in people, and probably in society as far as that goes, because it's basically male dominated, math is (A13).

Leigh: Don't let the guys get you down. Don't take anything from them (F10).

Claire: I don't see it at all as masculine or feminine. I see it more as just gray matter, what your brain is doing (F12).

Amy: We are gender conscious, whether we believe it or not (B8).

Bridgett: If I was with a group ... of three women and three men, I would probably think that those men knew more about math ... And they probably would (A37).
Part II

Act II: Math And Mathematicians In The Space/Barrier

Staging: The players face the audience here in a semicircle, front and center. They are talking to the audience and describing what mathematics is to them.

Carrie: My way of thinking about math has really changed to include not just number things [but] number things as a process to do something (A9).

Claudia: Math is - I want to say connected. This is harder than you think. I would want to include something about problem solving. Math is not just numbers. Math is -... being able to - ... Math is developing sets of strategies to solve problems and make connections in the real world, using numerals or other abstract things (F6).

Leigh: [Math is] bits and pieces of information that didn't seem to have much relevance to each other (F14).

Claudia: I look at it as a dysfunctional type of subject. [Other subjects were] always related, and you could see those relationships ... always make connections (F10).

Lindsay: I remember other classes where we got to do different things together and talk with other people. That wasn't something you did in math ... math is an isolated kind of thing (F2).

Carrie: I think it's a very social learning thing (A6).

Lindsay: The teachers were all men teachers ... in junior high ... high school ... Everybody wore the same type of clothes....They always had glasses ... always had their pile of papers. The books were always ... fat (A14).
Claire: What do mathematicians do?... I guess they have all the skills that have eluded me all these years. All the higher math... the page of long problems, the two page problems, the problems I watch my husband struggle with, but get, in college... and notebooks full of proving this and proving that (sound of disgust), stuff that I would never touch (A11).

Claudia: I know a lot of mathematicians are just tremendous, ... but I'm looking for a more functional type of person, one that I can talk to (A8).

Leigh: Like if a train goes this many miles an hour for two hours how ...? I don't care. What difference does this make (F5)?

Claire: I probably could make a world now, a math world where I fit in....It would be real. It wouldn't be chalk and assignments. It would be real.... (source 21).

Amy: [Math] is a part of life. You use it all the time. It's a part of the environment,... a natural thing. It's everywhere (A9).

Bridgett: It's hard to take the "where it is" out of it because it is everywhere you go and in whatever you do (F11).

Part III: Negotiating The Space/Barrier

Act I: Getting Through It All

Staging: The Players gather in a group and face the audience. They are talking to the audience, but are talking as though they are in a crowd; they are arranged behind each other and must sometimes step out slightly to read their parts.

Lindsay: When I was going through school, I didn't know any different. It was just math....I did what I needed to get the grades I wanted to get (A10)....although I know I didn't like it (A1).
Claudia: You will remember $5 + 5 = 10$ or you will sit here and write it 50 times until you get it (A10).

Lindsay: I learned what I needed to learn .... [The teachers'] needs were met (A10).

Bridgett: I don't like to do things I can't understand (F2).

Lindsay: In the traditional classroom I was isolated but had to do what everybody else was doing ... you went at their speed.... When I was in the summer ... class I was on my own.... I was able to go at my own rate, at my own speed, and when I wanted to do more I could do that. That made sense to me as a learner (F3).

Carrie: It was competitive, a lot....I always won....I was competitive (A12).

Leigh: I would try to figure it out just from the clues, from the process of elimination (F5).

Claudia: I could never see the connection. They were all ... just little tiny units of things....there was no progression. We just did it (A4).

Amy: There were hundreds of things to study from. You never knew what was the most important (B5).

Claudia: It was important for me to finally see how everything really worked together as a unit (F5).

Amy: [To see] math in a context (B7).

Bridgett: [To] inter-relate things (F14).

Amy: [To see] connectedness (B5).

Claire: I just pretended it didn't exist (A4).

Lindsay: It was my friends that I got more information from, and help. We would often ... meet at the public library and work together. Sometimes we would talk on the phone. That's probably how it made more sense to me (A15).
Bridgett: In my school, I was fine. I could stay in the top ten percent and still not know how to do any math, 'cause I could get one-on-one help (A4).

Leigh: My dad made it more understandable. He was a good teacher.... He would get frustrated with me, because I would tune him out, too (A8).

Bridgett: I'm not a very abstract thinker. I'm very concrete (F6), but ... I never remember seeing a manipulative, ever (F8).

Carrie: If I had had problems, those manipulatives would have really been a help (A12).

Amy: There were some times when I probably should have turned three shades of red, saying something stupid.... You need to just do it once, and then,... it doesn't matter anymore (B7).

Claire: It was a fear that wouldn't let me, compounded by daily episodes of not getting it, not knowing it ... day after day (F7).

Bridgett: I wouldn't ask ... in front of the class. I would ... go to the professor afterwards. I wouldn't care if I looked stupid to the professor. I don't want to look stupid to all of the other people (F6).

Claire: [Now] I'd probably start by flapping my mouth and saying hey, listen (F11)... I wouldn't be afraid now (MFG10).

Amy: Don't be afraid to try (A23)...Never hold back (B8). There's no reason you can't continue (A13).

Amy: Don't let anyone tell you you can't do it (A13)

Carrie: I don't want to sit there by myself and do it. I want to talk it over with somebody (A6).

Leigh: [To] develop strategies (A11).

Amy: [To be] cooperative (B7).
Part III

Act II: Might-Have-Beens

Staging: The players are seated, and standing around the room, casually. They speak softly now, and address no one in particular. They speak out into the Space/Barrier, over the heads of the audience, up and out.

Leigh: If I had math this way when I was growing up I would have loved it,... all hands-on things (A3).

Claudia: I really don't have any of my own [pleasant memories] that are just of me in math (A5).

Amy: I could kick myself now ... If I had it to do over again, with the knowledge that I have now, I would have gone on (B4).

Claire: I think I would have ended up in the medical field (A3). I seem to understand the systems of the body and things seem to make sense medically to me (F4).

Bridgett: I enjoy math now, at the primary level....I would not enjoy going back to college (F6).

Carrie: Maybe if I had gotten into college and done some finance courses, or investments or something like ... I might have found it more interesting (F2).

Claire: I want to say [I'm] angry, although I shouldn't say angry. Just, "Ugh." Damn it. I could have done it. Could have, should have, would have....it's a quiet regret (F3).

Lindsay: I guess I wonder ... if I could have been more successful or felt more confident in my abilities ... I don't think it would have happened ... but I guess a part of me wants to know if I could do it, if I had to (A9).

Staging: The players now move from the stage and the theater ends.
Amazon-Warriors Find Ways

The Amazon-warriors who participated in this study came to know mathematics in varying ways and in different circumstances throughout their mathematical lives. They confronted elements and Elements. They experienced moments of movement and Amazonian action. The Amazon-warriors found ways to negotiate the Space/Barrier, and a discussion of those ways follows.

Moments Of Knowing

Moments/Movements of be-ing: Acts that propel Journeys into Realms of Metabeing, especially A-mazing Acts of courage and imagination; (Daly, 1987, p. 146)

Moments: pieces of time that are big in a significance sense, though not necessarily big in a temporal sense; ... periods of time that are almost no time ... that carry meaning in a big way; a Momentous leap (Erchick, 1993, p. 18)

Amy

Amy had no meaningful memories of mathematics from her early schooling, suggesting a quality of sameness, or flatness throughout those experiences. However, the mathematics Amy learned during those years, and the experience of that learning, followed her into middle school. Amy's first memories of mathematics learning came from middle school and her seventh grade mathematics class.

Amy had her first male mathematics teacher in seventh grade and experienced a class where the teacher was the sole authority and where no questioning was permitted. Something in that experience awakened Amy, and she re-membered her Self. Amy entered seventh grade vulnerable to a belief that she was unable to learn simple facts and vulnerable to allowing the teacher's statements to disorient her way of knowing mathematics. Suddenly, she could not accept silent/received schooling.
The confrontation between Amy's awakened way of knowing and the essence of that seventh grade class was more than uncomfortable for Amy. Powerless in the way that seventh grade school children often are in classrooms, Amy could do little more than recognize that the class just did not work for her. She might be said to recognize an element of the Space/Barrier, but was unable to name it yet.

Still, her resistance to the methods of that seventh grade class suggests little toward defining the perspective that Amy was experiencing. However, Amy's description of her eighth grade experience of the following year does lend some insight to questions of her ways of knowing, awakened in the previous year. In Amy's eighth grade class, students talked, questioned, and worked together in groups. There was a feeling of equality between the teacher and the students. Amy liked that eighth grade experience, and was happy to connect and be free to talk and question. The classroom supported subjective and provided an environment where connected procedural ways of knowing, could be developed. It may be that Amy's ways of knowing were also subjective perspectives and connected procedural; at the very least Amy's preferred ways of knowing did not conflict with that eighth grade experience as she re-membered, put together her Self, and gathered strength to meet new elements of the Space/Barrier.

Amy experienced the opportunity to nurture her subjective perspective again in her high school geometry class. She found pleasure in being within an environment where she could argue for her own point of view on problems, to have her voice heard and valued. The healing of Amy's re-membering Self continued.

However, Amy quieted her subjective ways, and stilled her Self and her needs the following year in Algebra II. There were fewer girls in that class than in Amy's previous classes, and Amy avoided confrontation with the boys in the class. Belenky,
Clinchy, Goldberger, and Tarule (1986) express a concern regarding this kind of silencing behavior in women in the subjective perspective. Many a woman who knows subjectively stills her public voice, and consequently isolates herself. This self-silencing not only fits with the societal norms of gender role expectations for women and girls, but also decreases the woman's chances for further connection and therefore further development. Isolated, Amy could not develop a connected procedural perspective or a constructed knowing perspective. Her self-silencing placed her a position in the Space/Barrier where she protected herself and embodied the elements of gender expectation. Amy thus created elements that would hinder further development.

The barriers/boundaries that Amy created for herself to protect herself from confrontation and fears also prohibited her from studying more mathematics in high school. Even though Amy felt she was as intelligent or more intelligent than the boys in that Algebra II class, it was they and not she who went on to the senior Calculus. It was not until Amy was in a graduate level statistics class that she was finally able to overcome her fears and silences, ask questions again, and contribute her alternative solutions to class math problems.

Before Amy got to her graduate-level Statistics class, she experienced mathematics in other college classes, notably her economics classes. These were moments for Amy of finding connectedness between mathematics and other content areas. She had found this connectedness in content areas other than mathematics before, and was finally happy to find "relatedness" in mathematics. During these times, Amy built her connected procedural perspective.

Even while Amy found connectedness in her college economics classes, she found disconnection in her Mathematics for Teachers class. The topics in that class were presented as isolated, discrete entities, unconnected to each other. Amy also
found the content to be not relevant to the teaching for which she was being prepared. So, not only was the content disconnected within mathematics, but it was disconnected from the field for which Amy was preparing. The class itself, it's perspectives and curriculum, became a part of the Space/Barrier for Amy. There was no place in that class for Amy's connected procedural perspective to grow and no place for Amy to turn for meaning. While Amy's economics classes helped her to find a thinning passage through the Space/Barrier, her Mathematics for Teacher's class contributed to a thickening of the Space/Barrier that disallowed the development of a connected voice.

Amy experienced both the connections of economics and the disconnections of "Mathematics for Teachers" while she was in college. Because of what Amy experienced and recognized through and around these times between her Algebra II class and her college statistics class, she became comfortable enough with herself to return to a public subjective voice. Through her experiences, Amy built her courage, and having finally broken her silence and overcome her fear, become an Amazon-warrior.

Amy talked of the Moment of overcoming her fear, and what it was like to do so. She saw the same fears and questions that she felt inside of her on the faces of the students around her. She decided just to do it. She believes that "you need to do it just once" and then it is easier to question; the fear doesn't matter anymore. Amy found strength in her identification with the other students in that college statistics class, and took an opportunity to forge through the Space/Barrier, at least for the moment.

Amy now treads carefully through the Space/Barrier. Amy speaks carefully and reflexively. She seems to weigh every word, and presents her explanations while
moving between reason and intuition, as do procedural knowers. She is the Amazon-warrior who is cognizant of the way through some terrain, and who makes her way wisely but cautiously.

Belenky, Clinchy, Goldberger, and Tarule (1986) note that for a woman to be identified as fully procedural, she would need to demonstrate evidence of both separated and connected procedural knowing. All of Amy's procedural indicators were of connected perspectives. Indicators of separated procedural knowing, such as control and mastery over the content, and the desire to remove the self from the content, were not evident in Amy's experiences.

**Bridgett**

One predominant element in the Space/Barrier, as Bridgett interacted with it, is the element of expectation. Bridgett's expectation element is composed of/contained within elements of her own expectations, of those of her colleagues, of her family and friends. Bridgett's voice, emanating from within/around that element of expectation is difficult to hear, confounded by the barrier that expectation was and may still be for her.

Initially, Bridgett learned through her early silent and received experiences that her teachers were the ultimate authority in more than mathematics. They were the authorities on Bridgett's learning as well. Bridgett talked of not only being told what to do, but of being unable to tell others what she was doing unless the teachers told her what she was doing. Even though Bridgett did not explicitly state an indication of being truly lost in a sea of numbers and words or of being totally voiceless, an attitude of blind obedience might be behind Bridgett's doing what she was told, while she adopted the learned perspective that was more silent than received.
It would be difficult to separate what part Bridgett's element of expectation was entirely with Bridgett, from the part that was in the Space/Barrier surrounding her. Whether or not Bridgett learned mathematics was less important to her than whether or not she met the expectations of being a smart and capable student. In any case, Bridgett seemed to find it comfortable and successful for her to stay within both the received and silent perspectives through most of her mathematics schooling. The teaching experienced by Bridgett in those early years supported silent and received knowing, and ultimately led to Bridgett's (partial) academic success.

The complexity of the interconnections among elements in Bridgett's expectation surfaces in efforts to determine elements influencing Bridgett's decisions in learning mathematics. Expectations of what she was supposed to learn in mathematics, how that was recognized, and what she was expected to be in the eyes of others dominated her school mathematics days. Further, the element of Bridgett's own expectation of meeting the expectations of others confounds the exploration of her experiences.

Bridgett allowed her teachers to determine what she was supposed to learn in mathematics. She did not question their authority in that, simply because she was earning the good grades she expected others to expect from her. She maintained a silent/received perspective through her schooling, doing the math she was told to do, the way she was told to do it. By staying a received knower, memorizing, and practicing, Bridgett was able to co-exist comfortably with the expectations around and within her.

At one particular Moment, Bridgett confronted the boundary dividing expectations of herself, peers, parents and teachers. It was important to Bridgett to appear smart to others in her life, to maintain expectations that she was very bright. In
fact, it was so important that she was "devastated" by a school yearbook picture of her being tutored by her math teacher. The caption under the photograph read "Bridgett gets some necessary tutoring in mathematics." The publication of that picture meant that everyone now would know that she was not so smart, or at least was not as smart as she had appeared.

As an adult, Bridgett recognized the role of expectations in the yearbook event and how much of it she had internalized. As an adult she recognized that the photograph had probably meant a whole lot more to her than to anyone else. The fact that she began to recognize that there was less of a need to meet some expectations that may not have even existed in others, was a Moment of thinning in the element of expectation and the Space/Barrier connected to it.

With her silent/received ways working for her in mathematics, Bridgett had no need to question through most of her elementary classes and in Algebra I. She was able to maintain a received knowing perspective and earn good grades. When she needed to question, it was to get information. The teacher maintained the authority, held the knowledge, and dispensed it.

Bridgett's received ways were not challenged in/by her until she reached Geometry. In Geometry, Bridgett found she didn't have the problem solving skills she needed. She believes she had done well in mathematics until she had to think, until she had to determine next steps in proofs. She felt unprepared to create solutions.

Bridgett was forced again, or in other ways, to confront elements of expectation in that Geometry class. Not only was her expectation of how she would learn mathematics shattered, but the expectation of being successful was again in jeopardy as well. If she did not do well in geometry, the expectation that she and others had of her success would not be met. Bridgett's usual way of negotiating the Space/Barrier was
failing her, and some new way was needed. Bridgett moved into adulthood still uncertain of how to negotiate the terrain of the Space/Barrier around higher level mathematics, and experiences like those in Geometry. Only now does she know that the unthinking ways of her received days are insufficient.

While parts of Bridgett's Amazon-warrior self confronted the inadequacy of her received ways, and the elements of expectation in her life, other parts of her were beginning to negotiate Space/Barrier elements from other perspectives. There were times when Bridgett maintained a deep desire to understand, times when she saw some value in viewing mathematical knowledge like a connected procedural knower. These times of procedural knowing were intertwined with Bridgett's received experiences, and were connected, again, through the elements of expectation.

For example, Bridgett commented that she did not like to do things she did not understand and that she found it frustrating not to be complete in her understanding. In junior high she was angry because she could not understand. Still, while she was feeling her anger at not being able to understand, she was taught by an "overbearing" teacher who left no room for any authority but his in the classroom. For Bridgett, for the student she was at the time, this "overbearing" teacher left no room for perspectives other than received or silent knowing. The element of expectation was a part of those experiences as Bridgett cared more about maintaining good grades than she did about learning mathematics.

Bridgett needed to understand what she was doing both to keep her confidence alive and to keep her grades high. Often, she did not seek understanding in mathematics to satisfy any deep desire to learn and understand mathematics, but, rather
to maintain the element of expecting to be a good student. When the received ways began to falter for her in maintaining elemental expectations, Bridgett pushed her own boundaries.

By being an Amazon-warrior and pushing her own boundaries, Bridgett came to recognize her own limitations. For example, Bridgett recognized no experiences of connections with mathematics in her mathematics schooling, and knew of no understanding of connections from those experiences. Only as she taught mathematics, pursued professional development, and taught herself mathematics in the process, did Bridgett begin to see connections. The notion of connections moved from being an elemental barrier for her to being an Elemental bridge facilitating movement toward more understanding in mathematics. Searching connections among topics within mathematics and between mathematics and other content areas indicates a time of connected procedural knowing for Bridgett, a time when she was able to move away from her received perspectives for a while.

However, Bridgett only sees her understanding of connections in mathematics to be at the level of mathematics she teaches as a Primary teacher. She described her lack of such a connected understanding at her own level of mathematics, at the level of mathematics that she has been able to complete as a student of mathematics. Although she seeks understanding of connections in any mathematics she encounters, she seems only to be comfortable with the connected procedural perspective in certain mathematics; that is the mathematics of the Primary grades.

Bridgett does not allow the boundary she believes to exist for her in understanding mathematics beyond her primary classroom to remain a solid limitation. As she continues to negotiate the Space/Barrier, Bridgett pushes her way through that
barrier, challenging it. Bridgett does this in multiple ways, but being the Amazon-warrior she is, she does this only for two people. One is her Self; the other is any others she can help.

A Moment of fighting for her Self occurred for Bridgett when she encountered her lack of understanding in mathematics in a toothpick puzzle activity for fourth grade children. She worked for hours at home on that problem, already knowing the answer, and wanting to push herself towards more understanding. Although part of her motivation was rooted in needing to know the solution well enough to explain it to others (and again meet with their high expectations), part of Bridgett's motivation was reserved for her Self. She did not care about the problem or the mathematics, and she had no fun determining the solution to the problem. However, she pursued simply for her Self.

Bridgett's experiences of pushing through her own understanding barrier in order to help others occur often in her efforts to provide professional development for her peers. Bridgett's role as a mathematics specialist provides many such opportunities and one was particularly Momentous for her. She was presenting a professional development session for teachers in her district and made an error in identifying a particular concept from a fifth grade problem. Later in the session, while still discussing the problem Bridgett recognized her error and mentioned it to the group. She struggled openly with her understanding and talked to the other teachers about ways she and they might use to help distinguish the troublesome concept from others. She braved her own boundary, and tried to move with others through it.

The struggle of the Amazon-warrior is not always forward through some boundary. At times, the warrior turns away, or turns towards another boundary. In the experience of understanding the fifth grade concept that was just described, Bridgett
encountered a new element within the Space/Barrier. Some of the teachers participating in the session were troubled with Bridgett's confusion of the concept in question and were rude in their treatment of her because of it. Although they were reprimanded by an administrator for their insensitivity, their behaviors were not without consequences for Bridgett. She encountered their attitudes as a boundary and one which she has chosen to avoid, at least for a time. She has requested another specialist be selected within the district who would focus on the upper Elementary grades where she herself feels less comfortable.

Bridgett's reflection upon notions such as her limited understanding or expectations for success may be an indication that she is less silent than she once was. Silent knowers are not aware of an ability to look within or to reflect upon themselves. It just may be that Bridgett uses these Moments of reflection to move silence away from her ways of knowing, and to simultaneously move herself away from silence in the Space/Barrier.

In her movement from silence, Bridgett shows indications of constructed knowing concepts. She believes that mathematics is created, and can express somewhat how that creation might happen. Yet, as she moves among her perspectives, that notion of construction is separated in her by a boundary. Even though Bridgett believes in the notion of mathematics being constructed, she believes that learning mathematics means learning about what has already been created. Bridgett's interactions with the Space/Barrier and it's elements remain fluid and always changing.

Carrie

Carrie's contact with elements of the Space/Barrier were nonconfrontational for her in most of her mathematics experience. She seemingly glided smoothly through school mathematics, never expecting that her gender or some other (dis)ability would
get in the way. She always liked mathematics, and did well in it. She earned good
grades in mathematics, and enjoyed maintaining a competitive spirit with classmates,
especially through her public school experiences.

Throughout this dissertation, some of the women's experiences have been
difficult to interpret because of the women's movement into and out of perspectives, or
because of connected elements that confound interpretation. Carrie's experiences are as
complex as others, but for a different reason. I less often found Carrie moving into and
out of perspectives, but, rather, found her experiences and her telling of them to
indicate multiple possibilities, and therefore less definitive interpretation.

Consider, for example, Carrie's self-identification as a "sponge", soaking up
mathematics in her classes. A first thought might be to interpret that as an indication of
received knowing, where Carrie simply takes in what she is given. The interpretation
of received knowing could be supported by additional indicators, too. First, Carrie did
not ask questions in mathematics classes; she simply saw no need for questions as
received knowers would not. Second, Carrie maintained a belief that teachers were the
"fount of all knowledge". In Carrie's experiences as a student, teachers dispensed
knowledge. Even in her own early teaching experiences, Carrie believed dispensing
knowledge to be her charge. The giving and taking of knowledge could easily be
interpreted as a further indicator of the presence of a received knowing perspective.

Still, Carrie seemed to maintain no perception of herself as voiceless or
unheard. When she was not permitted to continue solving her fraction problem until
her competitor had the opportunity to catch up to her work, she found that unfair.
Although she did not say she verbally confronted the teacher with this, she did question
the situation within herself. She questioned the authority of the teacher as a silent or
received knower would not.
Carrie also talked of finding mathematics easy, and of times when "the numbers just came." If she were a receiving sponge, she could conceivably take in the numbers and concepts, as they were given to her, and then have them available to give back on demand, as in the instance of a test. However, hearing Carrie talk of how the numbers just came, watching and hearing the comfort with which she spoke of those numbers, raises suspicions about whether this is actually an example of received knowing. Carrie talked of those numbers coming as though there was a flow, a natural movement of the numbers into herself. The soaking sponge might have been assimilating the mathematics, without confrontation or conflict, as opposed to simply taking the concepts into storage. If so, Carrie would certainly be much more of a connected procedural knower than a received knower.

There was little in Carrie's learning experiences that would suggest that the environment was anything but received or silent. This, too, might confound interpretation of her way of knowing. If Carrie exhibited the behaviors and discourse fitting a received knower, and if she spent her time in received environments, it would be easy to believe that she was a received knower. With the only questions allowed in any classes limited to questions of procedure, of how to do what had been shown, a Space/Barrier element in the form of a silencing of students was an expectation in those classes. Carrie's comfort with mathematics might be viewed as an indication of a synchronicity between her way of knowing and those classroom environments and expectations.

However, if Carrie was not a received knower, then, as a student in classrooms with teaching styles and environments supporting received ways of knowing, Carrie was an Amazon-warrior for much of her mathematical life. She was able to succeed in mathematics, and to maintain components of a connected procedural way of knowing in
classrooms where the received environment was an element that might have prevented her from being the kind of knower she needed to be. Carrie was able to succeed in school mathematics, in the received classrooms of most of her experiences, doing what she was told and shown to do, and earning the grades that told her she was learning mathematics.

Had Carrie not been successful, or had her experiences been uncomfortable for her, she might have found a need for confrontation. She might have created Moments to push the boundaries of the Space/Barrier elements around her and within her even further than her Amazonian self did on a regular daily basis. As it was, Carrie, did feel successful and comfortable in mathematics (after all, in classroom competitions, she "always won") and accepted the elements she confronted as appropriate. She negotiated the elements of the Space/Barrier by seeming to push forward, through them, and disallowing interference from them.

Still, Carrie was not left unaffected by those elemental classrooms. The elements she experienced led her to believe that mathematics is just out there, that the teacher knows it, and that the teacher will give it to the students. She also maintained some belief in the ultimate authority of the teacher, even though she was questioning that authority to some degree. Consequently, her beliefs grew into other elements of the Space/Barrier, elements Carrie would confront in her teaching and in her professional development experiences.

Through her professional development experiences Carrie recognized boundaries and elements in the Space/Barrier, and began to question her prior success in mathematics and also the authority of the teacher in mathematics. Solving problems in professional development sessions, Carrie came to believe that she had not understood the mathematics that she had learned in her schooling. Carrie also began to
see herself and the other teachers as authorities for the first time. They were expected to solve problems without being given a procedure to follow, and had to rely on their own knowledge to come to solutions. Carrie learned, too, of the value for her in talking things out with others to come to an understanding in mathematics. As she and her colleagues became the new authorities in learning mathematics, Carrie was again an Amazon-warrior, moving more openly into the terrain of the subjective and connected perspectives and being aware of her movement.

A public move into the subjective perspective is a particularly important Moment for Carrie. She had been taught to trust the voice of authority for most of her life. She may have questioned the fairness of the teacher in the fraction incident, but she did not challenge the teacher. She continued to do as she was told to do, and continued to be successful in school mathematics. Although Carrie maintained her own intuitive knowing in mathematics, this remained private for her. She saw no apparent need for intuitive knowing in her received classrooms. Additionally, she had learned, because of "life" as she put it, that it was a man's world. The acceptance of a woman's intuitive knowings was something that was an elemental boundary for her. Pushing that boundary was an act of an Amazon-warrior.

During Carrie's school experiences, there were some opportunities for procedural knowing available to her. Procedural experiences were a part of the presentation of the school mathematics content. In the learning of that procedural content, Carrie learned not only the procedure for doing mathematics, but what it was that the teacher wanted her to learn. The procedural knowers require learning not just content, but what the teacher is thinking and what the teacher expects her to learn.

However, Carrie's school experiences lacked opportunities for the development of a full procedural perspective. Since Carrie's experiences with a procedural
environment were all separated procedural experiences, she had no opportunities for the
development of a connected procedural perspective. Knowledge was the dominant
theme and, as already indicated, Carrie was successful in absorbing that knowledge.
Maintaining indications of a connected procedural knowing as when the numbers just
came, is again a case of the Amazon-warrior fighting for her own way.

Belenky, Clinchy, Goldberger, and Tarule (1986) note that it is necessary for a
woman to exhibit indicators of both the connected and separated perspectives to be
considered fully procedural. The absence of opportunities to develop a connected
procedural perspective becomes an element for a woman who is experiencing an
exclusively separated procedural learning environment. However, such an
environment may not have been an element for Carrie. She may have been able to
combine her connected perspective with the moments of the separated perspective in the
classroom, to develop a fully procedural perspective for herself.

Another Amazonian act for Carrie occurred when she decided that it would be
more interesting to spend her life teaching as opposed to working with numbers all day
as an accountant. She may have been troubling over a sense of a separated procedural
perspective that she encountered in some classes, and the separation of her self from the
content of mathematics. If mathematics was a field of knowledge that had no notion of
people connected to it, Carrie preferred to move to the side of the people.

Claire

When Claire was in first grade, she solved the problem of 7+3 by counting
ceiling tiles. Her method of solution was her own, and it was the only one she
understood. However, it was not the way she was taught to do the problem. Claire
was "caught" counting the tiles, and was punished for her methods. She was told that
she was cheating and was required to stay after school. Claire knew, even as a five-
year old that it was wrong to be punished for her methods, and vocally resisted. Still, as Claire stated, she learned from that experience, and did not forget that the right way to do mathematics was the way the teachers told her to do it.

Claire confronted elements as barriers to the subjectivist beginnings in her mathematical thinking. Those elements were classroom expectations and ways of doing mathematics that prescribed for her a silence in mathematics. Claire resisted such elements when she yelled about the 7+3 incident, and at other times as well. Even though Claire resisted silent knowing, she accepted the behaviors of the silent knower. The Space/Barrier became apparent to her, as did silence as a way to safely negotiate her way through the Space/Barrier. Claire remained a silent mathematics student, at least behaviorally so, often "disappearing" in class, throughout her mathematics learning. She is a woman who sees herself now as just coming out of a life of silence as mathematics learner, a silence that she says she learned well.

Belenky, Clinchy, Goldberger, and Tarule (1986) indicate that the silent perspective occurred rarely in their work and then only in cases of extreme abuse. In earlier work I have questioned that, considering the notion that many women seemingly are within the silent perspective in mathematics, just what must these women perceive the study of mathematics to be? Claire answers that question when she talks of what the she believes her experiences in mathematics were.

From the 7+3 experience until she began her professional development at the age of 26, Claire saw her school mathematics experiences as "repeated abuse" and "public humiliation." Those times of humiliation became barriers for Claire, elements of the Space/Barrier that hindered her movement towards mathematics. Claire tried throughout her schooling to avoid confronting the Space/Barrier elements, and developed coping skills to do so. In elementary school, she learned how to be invisible
in mathematics classes. In high school, she developed a "symbiotic relationship" with a friend who was a successful mathematics student. Claire wrote her friend's papers, and her friend did both of their mathematics assignments.

The teaching style that Claire encountered in schools was primarily a showing and telling on the part of the teacher. Just as Claire accepted behaviors that sent the message that she was compliant in her silence, she likewise seemed to accept both the teacher as authority, and the dispensing model of teaching mathematics. She was not punished for her compliant behavior, and managed to make it through her school mathematics experiences as a seemingly accepting and silent knower. So, from learning first to be silent, to learning to be invisible, to being compliant, and finally to avoiding mathematics all together, Claire negotiated the Space/Barrier by avoiding confrontation with mathematics.

The cyclic nature of the Space/Barrier and it's elements becomes clear in Claire's choices and experiences. Claire's classroom mathematics experiences encouraged a silent perspective, and allowed her a safe place to maintain that silent perspective as well. However, her silent behavior became an element for Claire in the Space/Barrier. Silent behavior limited Claire in opportunities to question, or to find support for her growth. Claire's safety mechanism became a potential hazard for her.

Claire's perspective and chosen compliance protected her from abusive, elemental experiences, while the elements themselves allowed Claire's selected ways. While Claire dodged elements in the Space/Barrier, she was choosing what was safest for her. She was the Amazon-warrior who understood the field, and negotiated the elements of it as best served her.

More about Claire's experiences contributes further to my own questioning of her silence in her encounters with the Space/Barrier elements. Claire believed that she
only made it through some of her mathematics experiences because she taught herself. It is not the silent learner who teaches herself, or even has an awareness that she can. Additionally, Claire's mother helped her with her homework well into high school. Claire remembered listening to her mother, and the influence of what amounted to lessons about both mathematics and being a woman "playing the game". Claire transferred the authority from her mathematics teachers to her mother, and this transference of authority, again, is not something the silent learner would do.

The silent perspective that Claire used to protect herself for the elements may have also been often hiding a subjective perspective. When Claire turned to her mother to teach the problem-solving skills necessary for her mathematics, she was resisting the abstraction, logic, and analysis of the problem-solving she was being taught in school. Claire's mother wanted to teach her to "play the game", and do what she was taught in school. But Claire could not, and as a subjective knower would need to do, tried to move toward her self as an authority.

These times with her mother become for Claire, collectively, a Moment, as Claire confronts the Element of intuition in the Space/Barrier. The intuitive is an Element necessary for the subject knower. Accepting the Element of intuition within the Space/Barrier takes an act of courage, especially for the woman who is being taught by her mother to play the game, do what you need, and do not listen to the self. Claire could listen to herself. Confronting the Element was an Amazonian act.

As Belenky, Clinchy, Goldberger, and Tarule (1986) have discussed, many women come into the subjective perspective because of a failed male authority. Claire believed that her teachers failed her, again and again. When a teacher would say, "See this Claire? See this?" and she would not see, Claire felt that the teachers were failing her. She wanted to know why they did not teach her.
Yet, even though Claire did have some failed authorities in mathematics, most of her mathematics authorities were women. A connection between the failed female teachers and mathematics as male domain may be reasonable to consider. First, mathematics as a male domain is an element for Claire in the Space/Barrier. She talked at length of how "odd" it was for a woman to be a mathematician, and how a typical mathematician was a male, with "white coats and glasses and clipboards and calculators and sliderules". Second, Claire's failed teachers were an element in the Space/Barrier closely connected to her. Claire's move to subjectivist perspectives at a time when she was beginning to recognize that her teachers were failing her, could indicate that she saw her teachers as teachers-as-male-authorities in mathematics.

Considering such a gender connection, it seems that gender role concepts within the Space/Barrier were disconnected from biology for Claire. In a culture that determines gender role expectations based on one's biological sex, this is a rather radical perspective. However, the perspective is fitting for an Amazon-warrior.

Claire identified herself as having been mostly silent, and only coming out of silence as a 31 year old. She behaved as a silent or received knower most of her life, and has revealed indications of moments of being a subjective knower throughout. Yet, other perspectives also emerged in Claire's re-memberings, as she pieced together her mathematical Self for this project. Claire sought logic, patterns, and understanding in mathematics and in what the teacher was doing. Mathematics was presented as separate topics while Claire knew, subjectively, that there were connections. Claire questioned why her teachers did not teach her time, while she was finally able to "figure out what time was" in seventh grade, on her own. Again, if Claire were truly silent, she would not even hope to understand the topic or teacher, and she would not
be figuring out mathematics on her own. She would not even know that understanding existed for her, and connected procedural preferences would not be considered by her.

Throughout her school experiences Claire recognized a sense of authority within herself with respect to areas outside of mathematics. She also recognized the absence of that sense of authority for her in mathematics, even though she did indicate, with Moments like the 7+3 problem, that she had some sense of inner authority in mathematics. However, it may have been that the negotiation of the Space/Barrier was too consuming for Claire, or she chose to place her focus and energies elsewhere. Perhaps she simply chose to confront other elements besides the element of a sense of authority. In any case, Claire's inner sense of authority was so hidden at times that Claire often did not even decide on her own needs. She allowed her needs to be determined by her teachers, and, because she "got the basics" chosen by her teachers, she felt her needs must have been met.

Claire's experiences and perspectives were intertwined and partial in most of her re-memberings. Together, they reveal a negotiation of the Space/Barrier that is both nonlinear and complex. That negotiation was at times dependent upon the moment, the element, and Claire. Her experiences support the claim that *Women's Ways of Knowing* are not developed in stages. As she encountered elements in the Space/Barrier, she selected behaviors and ways that worked for her. Claire resisted the punishment for cheating at 7+3 in first grade, because she knew the accusation and punishment were wrong. She believes that if she were in a class today, she would demand she be taught. In the moments in between the two, Claire was always an Amazon-warrior in fighting for her Self. She resisted elements that might have made her epistemologically silent, and the Amazonian resistance she did as a five-year old never really stopped.

193
Claudia adamantly stated that, as a student, she never would have questioned the teacher. She never would have pushed the Space/Barrier boundaries separating her from her teachers. Claudia does not say whether or not she thought she was capable of questioning; only that she would not question the teacher. This circumstance might have led me to believe that Claudia was, if not silent, at least a received knower throughout her school experiences. However, after learning about Claudia's experiences, I found there was more to Claudia's statement than a preference for a way of knowing.

An element of the Space/Barrier that was connected to Claudia's refusal to question the authority of the teacher was what she referred to as "niches". Niches were the crevices into which women's expected behaviors were placed in society. Claudia believed that women were more pressured to fit into niches set up by society than were men, especially the niches that dictated a woman should be the "okay person for everybody". Knowing that these niches existed was enough for Claudia to buy into them most of her life.

Some of the behaviors that were attached to the notion of fitting into these societal niches included being a good student, and not causing a disruption in school. Claudia's refusal to question the authority of the teacher in mathematics was also a part of the control of the elemental niches. Claudia only realized in her late thirties that she was trying to fit into those niches, and found it "scary" that she had been doing it all of her life.

Claudia negotiated the Space/Barrier niches by buying into and accepting them and their mandates for most of her life. Claudia gave power and strength to the niches with her compliance, but had much to gain in that. She received good grades and was
accepted in her school by teachers and friends. As an adult, Claudia was accepted by her teaching peers as well, for always being there for others, and always able to help.

The niches began to lose their strength when Claudia recognized their existence and began to resist. As an Amazon-warrior, Claudia began to question the requirements of the niches. She learned to say no to the expectations for behaviors that were placed upon her. Claudia did not share, and indeed may not know the exact Moment her consciousness was raised. Nevertheless, recognition stirred Claudia into Amazonian action and resistance.

Another element that Claudia confronted in the Space/Barrier was the element of authority in mathematics. Claudia negotiated her way carefully around and with this element, and experienced moments of subjective knowing in the process. Subjective knowers often find their way into the perspective after experiencing a failed male authority, and Claudia seems to have done just that. She identified the man teaching her graduate statistics class as a "god awful" teacher, and, because of his failure in that class, Claudia sought alternative authorities. As with other women who made the courageous leap to the intuitive side of themselves, Claudia experienced a Moment of being an Amazon-warrior when she turned from the authority of the Statistics teacher and explored a moment of subjective knowing. Her negotiation of the Space/Barrier element of authority is very much the compromise and arrangement that negotiation is defined to be.

Claudia's negotiation included two separate components. One was the choice of teaming with another teacher in the class. The decision is typical of a subjective knower, who begins to rely on authorities other than the teacher, authorities who are more like herself. Claudia was beginning to accept her own inner voice in mathematics and teamed with another to support that change.
That the other teacher with whom Claudia teamed was a man who taught high school mathematics is significant, and is a second component of Claudia's negotiation of the Space/Barrier. Claudia connected to this other student, as already mentioned, because he was more like herself than was the teacher-as-authority. However, since, at the time, Claudia defined an authority in mathematics as anyone who taught mathematics, this teacher/student was still closer to being the male-as-authority in mathematics than she saw herself to be.

Whether or not Claudia viewed the statistics class colleague as a peer or another authority, or both, the period became a time when Claudia began questioning. Not only did she question the particular authority in the teacher, but she eventually questioned the very meaning of authority in mathematics. Claudia had believed that anyone who taught mathematics was an authority. She made a Momentous leap in turning her definition of authority in mathematics away from someone who did or taught mathematics to someone who empowered others in mathematics. What is particularly interesting in Claudia's confrontation with the elemental authority here, is the way of knowing Claudia's turn indicates. A preference for sharing in the empowerment of others is one of the characteristics of the constructivist knower. Without having specific opportunities in classes that were designed to foster a constructivist perspective, Claudia showed a personal preference for a part of the perspective.

In her negotiation of the elemental authority in the Space/Barrier, Claudia experienced an Amazonian Moment that was a first for her. It was an event that empowered her with respect to her own authority in mathematics. She met with her daughter's high school mathematics teacher at a parent teacher conference. When she first began to question him, he interrupted her and began to "spout off" things about
mathematics and teaching. He talked down to Claudia, and she was more than offended. He knew her to be "just a first grade teacher," but was not aware of her expertise in mathematics education. In her outrage at his "talking down to her" she came right back at him quoting from the NCTM *Standards* (1989) She knew what the mathematics education authorities were saying, and where in the *Standards* they were saying it. She was empowered, and used that power to push away a part of the elemental boundary that she was encountering.

Claudia said that the confrontation was the first time she had ever put a man in his place. She said that it felt good to stand up for herself, and to decide that she was not going to let anyone put her down again. During her next conference, Claudia found that the mathematics teacher spoke directly *to* her, and not down to her. The Amazon-warrior had dissipated a piece of her elemental Space/Barrier.

Claudia's elemental confrontations and Space/Barrier negotiations with the niches and authority occurred only after she was in her thirties and early forties. It was during those times that she also initiated her own intensive professional development in mathematics, and learned more mathematics in that process as well. Claudia began putting pieces together in mathematics. She also began to infuse herself into her learning of mathematics. That and her need for understanding were indications of Moments of the connected procedural perspective and further indications of the constructivist perspective.

The boundaries that Claudia confronted were more than elements of authority and societal expectations. She worked towards connecting with mathematics, and integrating it into who she was. She experienced Moments of connected procedural and constructivist knowing in the process. The depth to which Claudia has connected, and intends to continue to connect, with the mathematics she is learning indicates the
breaching of an internal boundary, an allowance of a move of mathematics into the Self. To describe these experiences, Claudia found the word pleasurable to be inadequate. She preferred to think of them as "self-satisfying" experiences. To Claudia, these self-satisfying experiences were experiences were ones where the involvement of the self was total for her. All of who she was became a part of what she was doing with mathematics. Claudia was experiencing Moments where she was dissipating elements of the Space/Barrier that resided within her as well as outside of her.

Leigh

Leigh did not need to confront the elements of the Space/Barrier in her early schooling for a number of reasons. The elements simply may not have been apparent to her. She resided within a bounded space, multiply protected from the elements. First, Leigh earned good grades in her early years, and therefore believed that she knew her mathematics. She had no reason to confront barriers that she did not know existed.

Had Leigh encountered a problem with her study of mathematics, her mother was there to support her, assuring her that it was okay for Leigh to be having trouble in mathematics. After all, Leigh was a girl. Leigh's father also helped her negotiate the Space/Barrier, although differently than did her mother. He worked with her, teaching her in a way that Leigh found somewhat successful, and being very patient and understanding with her.

Leigh experienced a silent environment in the early years, and was able to find safety in that as well. In a silent classroom, not only did Leigh not have to speak out, or confront the teacher or the mathematics, but the teacher did not confront her either. This silent space, combined with the messages that she was doing well in mathematics,
and the protection offered by her mother and father, allowed Leigh to accept her position in the Space/Barrier. She had no reason to resist, confront, or rebel, until she reached Algebra I.

The element of the Space/Barrier that Leigh confronted in Algebra I was her own silence. She only determined in Algebra I that she had not learned the mathematics that she thought she had learned prior to entering Algebra I because she suddenly had trouble in Algebra. She had never had trouble before. Leigh's apparent silence in experiencing Algebra I may have also been more of a lack of understanding about the skills needed in Algebra. She may have been comfortable with the skills she had developed up until Algebra I, and not even been aware that Algebra I would require new skills from her.

Still, Leigh remained silent in Algebra, not even knowing what was wrong with the experience. Belenky, Clinchy, Goldberger, and Tarule's (1986) description of the silent learner as one who was "lost in a sea of numbers and words" sounds much like Leigh in Algebra I, where she had "no clue," no understanding, and where the mathematics made no sense.

Along with the recognition of her lack of understanding came Leigh's movement into a received perspective. Something in that Algebra I experience, some Moment that may have been her Moment of awareness, awakened Leigh and she began to move herself outside of her protected space. She seems very much the Amazon-warrior, one who fought to save her Self and gain a hold of her own voice.

Once Leigh began her move out of silence, she confronted an element that was a space within which voice was allowed. This space was a place she believed she could not enter, a place where she had no voice. It was a place inhabited only by the teacher.
As Leigh began to breach the boundaries and dissipate the element, she still continued to place all knowledge in the authority. However, Leigh no longer was limited to the blind obedience of the teacher that she knew as a child. She began to listen to other authorities, voices she allowed to enter the elemental space. She worked at home using her text, and allowed that voice into the element. She reviewed her teacher's words, and allowed that voice to stay in the element. She worked on mathematics at home with her father, and integrated his voice into the element as well. Through all of this allowing-in, Leigh was softening the boundaries of the element as it existed in the Space/Barrier. She was making a way, as an Amazon-warrior, for her self to move into the space. She was transforming an element into an Element.

Leigh's thinning of the elemental voice boundaries benefited her in ways that were not immediately apparent. Even while Leigh was unknowingly silent, or becoming aware of other voices, or dissipating the elemental voice in the Space/Barrier, she was encountering conflict in certain experiences with mathematics in addition to the problems in Algebra I. When she was faced with having to do a story problem, Leigh knew only panic. This panic stayed with her into adulthood. However, from the early years and into adulthood, Leigh found ways to negotiate the elemental panic that hindered her movement through the Space/Barrier.

Leigh's panic may be added to Mary Daly's list of plastic passions, "those blobs of inner space which paralyze their victims ... draining energies (Daly, 1987, p. 217). Her panic became a boundary within and outside of Leigh, hindering movement through the Space/Barrier. Her panic was the result of her dependence upon authorities outside of her self, and as she thinned the boundaries of the elemental space where voice was heard, she fought for her Self, and also began to dissipate the element of panic.
In moments of silence, Leigh could not think, for she did not believe she had a voice with which to do so. In silence, she could not hear the teacher, either, and so, having no way to solve a story problem, could only know panic. As Leigh began to dissipate the Space/Barrier element confining voice, she opened herself to hearing other voices, including the voices of other teachers like herself. She built a potential for hearing and for knowing that there were different ways to solve problems. An awareness of and learning about those different ways was a part of her professional development experiences. The skills Leigh learned in her professional development helped her again through Amazonian acts of courage in trying to do word problems and in trying to overcome her panic.

While Leigh was dissipating the elemental space confining voice, she was simultaneously creating an element as well. As she opened herself to other voices she moved into moments of received knowing. As a received knower, Leigh would have a preference for having one right way to do things and would find comfort in that. However, she would not find a one-right-way to solve story problems, at least not one that worked to ease her panic. Leigh was simultaneously dissipating and creating elements in the Space/Barrier as she negotiated the terrain.

Leigh continues in adulthood to negotiate the panic/voice element and, with reticence, has learned to trust her own voice. She has confronted her subjective knowing through professional development. Those experiences have helped her move into a subjective perspective and hear her own voice. She also works with her young son on his school problems, and faces her panic in that. She works through her panic, the acceptance of her own intuitive knowings, and her efforts to help her son as well.

As Leigh grows and negotiates the Space/Barrier elements, she moves in and out of perspectives, and continues to do so. However, as an adult, Leigh currently
learns within a cyclic process, one through which she passes in new learning situations. These new learning situations involve all content areas, including mathematics.

In this cyclic process, Leigh first observes and listens. At this first step in her cycle, she would appear to be a silent learner, for she is behaviorally so. She maintains this observation stance for as long as necessary to gain an understanding of what is being discussed. This is not an attempt so much to understand the content as it is an attempt to understand the context, and to situate herself within it. Only after she situates herself will Leigh contribute to the discussion or ask questions.

As a step within her cyclic processing, Leigh then "internalizes" what she has learned. It is here that moments of a procedural way of knowing emerge. To internalize, Leigh must participate in the discussion, connect, with others, come to an understanding of the topic, and show someone else what is to be learned.

If Leigh's intent through this cyclic processing is to gain information and to clarify rather than to question the authority, she remains within the received knowing perspective. Part of her may be doing just that. However, she moves into a connected procedural perspective, and cycles through components of it, as she looks for understandings, especially of the common experiences of the group, and as she builds connections within the group through that understanding.

Leigh's negotiation of new learning situations could easily be an example of her negotiation of the Space/Barrier. In both negotiations, she approaches with cautions and determines the context and her position in it. She observes, listens and takes action. Leigh continues to confront the elements as a cautious warrior.
Lindsay moved among perspectives in learning mathematics at various points in her experiences. When and how she shifted from one perspective to another was based upon the circumstances of the experience. In any given situation, Lindsay determined which behaviors or perspectives would be more useful to her in her efforts to negotiate the Space/Barrier at some particular time or in some particular place.

For instance, for most of her schooling, Lindsay chose to be behaviorally silent and epistemologically received. In her traditional school experiences, this combination worked well for her. She could avoid confrontations in the Space/Barrier. She would not bother to question, she could get the good grades that were so important to her, and she could get by.

Getting by was just what Lindsay did through most of her school and college experiences. She studied only the mathematics that she needed to study. Lindsay studied the courses and earned the grades she needed to get through school and into college. She did well in mathematics, even though she did not ever enjoy it, at least not in comparison with other subjects. Mathematics was not a priority for her. Her negotiation of the Space/Barrier in many ways, seemed to be little more than moving along the path of least resistance.

Lindsay did not always have a need to maintain a behaviorally silent and epistemologically received perspective. She found that there were times when she could best negotiate the Space/Barrier from and during the development of a separated procedural perspective. At those times, Lindsay would follow procedures as they were taught in mathematics without understanding the content. Maintaining a procedural perspective and caring little about the content, Lindsay could work with mathematics, and have limited contact with the elements of the Space/Barrier. These ways worked
well for Lindsay. She worked toward getting good grades without thinking about questioning what she was doing in mathematics. She learned about what the teachers wanted her to think.

Lindsay periodically moved into a subjective perspective, when the need arose. When she found herself in classes where she had to work independently and rely on her own sense of authority, Lindsay did so. Although Lindsay did not seem to consider these moments as particularly monumental, I see them as so.

Both Lindsay's summer Algebra I class and a college mathematics class for teachers were structured for independent work. In these classes, Lindsay relied on herself, said she had to do her own thinking, and had no one "up front" to tell her what to do. She used the text, other resources made available to the classes, and her own thinking to learn the mathematics. Rather than think of Lindsay as complying in some way, or being flexible enough to change her ways to suit her environment, I prefer to consider her to be an Amazon-warrior who meets the challenges of each new situation. She negotiates the Space/Barrier by meeting her needs at every turn, and getting it done.

Once Lindsay had experienced her subjective perspective she was able to use it more frequently. She shows some preference for this way of knowing as she negotiates the Space/Barrier in her professional development experiences. Working alongside colleagues, Lindsay can more safely develop her own sense of authority through those experiences. She and her colleagues confront elements of the Space/Barrier together, within groups and without instruction from a teacher. The subjective perspective that Lindsay seems to be so comfortable with, can be and is nurtured in these experiences.
An element of the Space/Barrier that hindered Lindsay's development of a constructivist perspective was in the form of a lack of constructivist learning experiences. Lindsay wished she had had experiences where she could have integrated some of the things that mattered to her into her mathematics experiences. She liked to draw and make charts, and wished she could have done projects where she would have been able to write. It wasn't until she was teaching that Lindsay even knew of these possibilities. Therefore, confronting an element in order to dissipate it was unlikely as a student, when she did not even recognize its existence.

The teaching of mathematics in Lindsay's student experiences made for a belief in mathematics as a content that is isolated from other content areas, and that consists of discrete topics. Lindsay knew of connections among other content areas in school, and saw that connection as a good thing. If connections were not a part of mathematics, then that characteristic became an element in Lindsay's Space/Barrier. An Element of connections is the foundation of Lindsay's hopes of a fully integrated approach to mathematics. It is a part of Lindsay's vision of what would be ideal in learning mathematics - to have math class be about being "in math" as opposed to going to do math.
CHAPTER 6

POINTS OF CONVERGENCE?

My Selves In The Space/Barrier

As I re-view the Space/Barrier, my efforts and intents in exploring it, and the stories and contributions of the participants of this study, I am cognizant of a particular absence. Within my struggles to interpret and define, place, and describe the components of the Space/Barrier and the role/place for each of us in it, I find parts of my self that emerge again and again in my reflections. Although I find much of my self within the documentation of my inquiry, much more of my self is not recognized.

Although I believe myself to be implicitly present within the style and manner of my writing and reasoning, an explicit discussion of that presence has not been included in this documentation of my work. It is that explicit discussion of my presence, the influences, beliefs, and essences of my self as they merge with and lead to conclusions in this study that I wish to include here. In order to draw together my thoughts and find some sort of closure in this dissertation effort, in order to reflect upon my work, I can
only do so by turning my view for a moment away from the outside, the participants, the research, mathematics, women and the Space/Barrier. I need now turn my view to some parts of my Self that have learned about negotiating the Space/Barrier.

My Woman-Self

I am a 44 year old, white, middle class female, who is the oldest of five children from an ethnic, working class, Catholic family. I was born a post World War II baby-boomer, and have 2 brothers and 2 sisters. Our lower middle class family lived in a suburb of a large industrial city. Although there was some entrepreneurship in those of my parents' generation, for the most part, the men worked in mines, factories, or railroad jobs. Childcare was often shared among the women, to allow for them, too, to work outside the home.

I attended Catholic school for the first 6 years of my education and then moved into public education for the rest of my school experience. I was the first in my immediate family to attend college, the first to earn a degree, and thus far am the only one to earn a graduate degree. Neither of my brothers has completed undergraduate study. Our mother never seemed to try to force the issue for the boys. My two sisters, however, have degrees in journalism and education. Our mother always felt that education was vital for the girls in the family. The boys would make it in the world without an education, because they were boys. The girls needed more; they needed skills and proof that they could do more.

Although, as a family, we clung to many of the ways of "the old country" of both my Italian and Polish grandparents, we also learned of the changes in the new world that life in the United States and the science of the times (war) had created. We disposed of many of Grandma's handmade doilies and table covers because they were not made in the (modern) factories. We worked hard to be able to live in new homes, with dishwashers.
and modern fixtures, because these were better conditions than our grandparents had. We had cars and televisions. My mother never nursed her children because science provided her with something better.

Much of what I learned of how to live in the world as a women was taught to me by my mother. I call her "Mommy", still, as do my siblings, and think of her as my first feminist teacher. I haven't asked her if she would agree with that classification. We talk of so much, and do so often. We talk of spirituality, and politics, and inhumanity in the world. But I believe she would scoff at the label "feminist", would even, perhaps, find it silly.

I had been advised out of mathematics study by a high school guidance counselor who assured me that there was nothing for a girl to do in mathematics. I was a very good student, and it would do me well, he said, to major in chemistry. I could then get a "nice little job as a lab assistant."

Chemistry did not do me well, however, and I left school and followed the expectations of family and friends, of the world around me, and married. It was only after my reflection on my mother's talk of might-have-beens in her own life, of what she might have done in life without the constraints of her culture, that I decided to return to college and earn a degree in mathematics. Thus, I come to my mathematician-self.

My Mathematician-Self

I identify part of my self as a mathematician. There are some who would cheer yea's to my self-identification. They are those with whom I have studied mathematics, those with whom I have learned to appreciate and value the science. I have been awarded and honored as a student of mathematics, and have been recognized as capable in the study of the dominant form of mathematics as it is taught in schools and universities, and as it is respected in the sciences.

208
However, there are those who would express nay's to my self-identification as a mathematician, or who would, at the very least, question. They might point to my interest in elementary school mathematics - less valued than the more serious mathematics of the upper grades - as an indication that I must certainly not be a dedicated mathematician. There are others who believe that my mere movement from applied and theoretical mathematics to education is an even more stable foundation for doubts about my abilities in mathematics. Education does not matter as much as mathematics to those critics.

To those who yea or nay with the concerns iterated here, I have little to say. I cannot change their beliefs or values as to my worth as a mathematician. However, there is another camp of disbelievers to whom I can and will address a response. That camp of disbelievers is manned (and womanned) by those who seem curious about my choices to stop studying mathematics. It is not the choice to move from mathematician to educator that so concerns these curious folk. It is, rather, my adamant resistance to further study of mathematics at the doctoral level. The program area of my doctoral work was to include a typical selection of mathematics courses, with hours of study, but not specific courses, being required. My resistance to more study after a certain point in my development was so aggressive, that one might indeed wonder why I would still call myself a mathematician.

My perspective of myself as a mathematician is founded in what I believe myself to be capable of, in what I believe mathematics to be, and in what I believe the study of mathematics to be. For articulation of my stance, I speak in my own words, in poetry, and in the voices of the women who have given me words. For all of it, I am struggling, still, with where and how I, too, negotiate the Space/Barrier.

209
When I studied mathematics as a student in school, and in the university, I found mathematics to be about learning what mathematics is, and how to know the whole, the structure of it, as it has been created. I was fortunate to have professors at times who created an environment where students would learn that mathematics was indeed created, and that it could be created further. However, never was there room for a new and different mathematics, a mathematics created to re-describe the same mathematical concepts that were being taught. Not only was there not room for a different mathematics, but there was seen to be no need for a different mathematics. There already existed a right way to do mathematics.

That same feminist mother who taught me life, taught me the beginnings of the creation of my own mathematics. She was not a mathematician by the standards of others, and had never even studied Algebra I. However, when I first studied Algebra I in high school, it was my mother who taught me. I learned from her ways of thinking that fit more with what made sense in my mind than did the text or teacher ways. What I learned was to take the school mathematics, save it, and create my mathematics. I then translated my mathematics into school mathematics for the teachers, and school mathematics into my mathematics for me. I began to learn about negotiating the Space/Barrier.

This re-creation and translation is how I learned the dominant mathematics throughout my undergraduate study. I understood my own mathematics as well as the mathematics I was being taught. I spent much time on my mathematics, but no more than most of my peers. I walked away from my mathematics degree knowing that I not only knew the dominant mathematics, and my mathematics, but that I also knew how mathematics became created, and that I was doing so.
Like Claire (B11), I knew there to be my own "math world", a place where I fit and where my mathematics existed. Like Amy (B7), I knew mathematics to be a "a natural thing" visible to me everywhere. From my study of differential geometry I knew of equations to express the movement of a point in space. I saw that point on the hem of a woman's flowing skirt, a point that moved in a rhythm connected to the energy of the woman and her gait. From my study of symmetries of a square I knew of privilege and entitlement, of power as opposed to integrity (Erchick, 1996), and from my first study of the Calculus, I knew of creation and aesthetics in mathematics. From my study of qualitative research, I found a mathematical thinking that was about patterns and identifying emerging dynamics, but was also a mathematics that I could connect to people, that didn't impersonalize, that recognized an existence of humanity. I found mathematics in the world; I found the beauty, politics, and movement of the world in mathematics.

From all of my study, I learned that I had learned to create and sustain my mathematics world, as well as my view from my mathematics world. I had chosen to create and sustain a mathematics world that resisted power and moved toward respect. I had chosen movement and beauty, as I choose to describe it, for my mathematics world. I had chosen the aesthetics of my Calculus experiences and a sense of continuous re-creation to be among those things included in my mathematics world. In essence, I had chosen to no longer need to know more about how to perpetuate the mathematics world of the dominant mathematics. I wanted and was capable of maintaining my own mathematics world.

When confronted with further study in mathematics, I was confronted, too, with the dilemma of having to learn, again, how to do the dominant mathematics. I saw, again, how it had been done, so that I might learn, again/more, how to continue, how to
re-create more of the same creature, how to help the entity grow. I learned, again how to create more mathematics that fit with the established mathematics, a mathematics that did not fit with my view of mathematics.

I was asked, too, in doing this re-creating, to spend my time on this. The requirements for time were great, as I had already learned many years before. Now, however, I no longer had time to play the game of watching and translating, of connecting my mathematics with the mathematics. My life had more to offer, and I had other things that mattered more than perpetuating a mathematics I did not believe in.

I wonder if things might have been different. When confronted with the conflict of no longer wanting to compromise my mathematics world, of no longer wanting to value the mathematics in my classes, or of no longer wanting to separate myself from both humanity and my mathematics, I could not be heard. Appearing silent, I described my experiences in mathematics class in terms of a poem, one with which I questioned the perceived silence of others in mathematics classes.

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math class

where she knows her self to be within
a one-way-view glass bubble
soundproof
on the outside the image of a person
projected outward?
from within?
from her self?

or onto?
from some other place?
an image selected by someone
else?

invisible is the person inside
well hidden
her thoughts
her feelings
protected from the order outside

the order outside
protected from her feelings
her thoughts?
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212
Through my experiences I began to determine my own definition for mathematics. Earlier in this dissertation I discussed how others define mathematics. I described some of the various ways that dictionaries, students, teachers, mathematicians, and everyday people define mathematics. The women participating in this dissertation study often articulated their own evolving definitions for mathematics as well. I struggled with my definition, trying to find words that included some of the notions of others, and excluded other notions. I settled most often on a definition of mathematics as a way to describe the world around me. It was all of an organizational tool, a discourse, a fluid, evolving dynamic model. It allowed me to visualize the complexity of the world with some sense of order.

My own sense of mathematics, what it is, how it fits in my life, where it emerges in my world, what it means and how it is applied is what I use to determine that I am a mathematician. I am not a mathematician with a singular and uncritical respect for the dominant form of mathematics. I am not a mathematician who necessarily hopes to continue the perpetuation of the dominant mathematics, or its values. Rather, I am a mathematician who hopes to see a creation of a new mathematics, and an appreciation of
all mathematics. I am a mathematician with a love of the mathematics that matters and supports the values in my life. I am a mathematician who is situated in the midst of, and continuing her own negotiation of, the Space/Barrier.

My Educator-Self

I find it difficult to separate some parts of my self, but never so much so as when trying to define my educator-self. My personal, spiritual, and professional selves, my feelings and beliefs about mathematics, interrelationships with people, and the power and politics of education are integrated into one. Trying to pull the thread of my educator-self will most likely result in a tangled mess, as when I attempt to pull a piece of embroidery floss from a package. The effort always starts out well, but eventually leads a knotted and tangled ball. Still, I will do my best to describe some part of my educator-self, and its impact on my work.

What I am and what I do as an educator is grounded in the belief that all people can do mathematics. I entered inner city classrooms and taught children who were determined by others to be unsuccessful in mathematics. These were children who had been told by test scores, teachers, and society that they could not do mathematics. I believed they could learn mathematics, and that they indeed did do mathematics. I set out to learn about the mathematics they did. I have been taught by these students who the system found to be incapable and unwilling. I have learned from their wisdom, their creativity, and their lives.

In both pre-service classrooms and in-service teacher workshops, I worked with teachers, most of whom were women and were teaching elementary school children. These women were again a group determined by many to be unsuccessful in mathematics. I again believed they could and did do mathematics successfully. I again
set out to learn from them. I learned about the choices they made in teaching mathematics, and some of the experiences they had in learning mathematics. I wanted to learn more about how they interacted with mathematics.

In all of these teaching experiences, I taught mathematics, even though mathematics often seemed merely a medium for me. I chose to teach it because I enjoyed interacting with it. I had negotiated the Space/Barrier and believed others did as well. I hoped I could help others reflect upon and understand their interactions with mathematics. I hoped they, too, would learn to enjoy mathematics, or at least enjoy the experience of studying it.

I believed that inquiry with women who had continuous, intensive, professional development, who had learned well the reform movement in mathematics education and had learned mathematics in the process, could voice the beginnings of a complete description of how the women come to know mathematics. I hoped to learn how the Space/Barrier was negotiated by them. With this knowledge, I hoped that I could, as an educator, to find a way to best serve the needs of women who were teaching children mathematics; and I hoped to learn something about how the women did mathematics.

**Summing the Selves**

From my mother, my first feminist teacher, I learned ways of negotiating the Space/Barrier. I also learned that, even though not all would value or recognize my ways, I always could value my own, and choose what I revealed to others. I continued my negotiation of the Space/Barrier as a student of mathematics, enjoying the interactions for most of my study. I came to a point in my study of mathematics where I no longer wanted to expend my energies in Space/Barrier negotiations to learn more mathematics. I directed my energies towards helping others come to know mathematics, and ultimately towards learning more about how they did that.
Re-Searching The Space/Barrier

What Is The Space/Barrier?

I turn to my own definition of mathematics as a way to describe the world around me in my efforts to define the Space/Barrier. As mathematics is to me, the Space/Barrier, too is an organizational tool, a discourse, a fluid, evolving dynamic model. It allows me to visualize the complexity of the world of interactions between and among mathematics and women with some sense of order. The Space/Barrier is a theory describing those interactions.

There are concepts or entities that are elements or Elements in the Space/Barrier, and concepts or entities that are not a part of the Space/Barrier. For instance, research projects do not necessarily belong in the Space/Barrier, but their findings may. Projects, experiments, surveys, or other studies are things that generate elements or Elements; they are not themselves elements. Findings, conclusions, and discussions generated by research may themselves become elements in the Space/Barrier, or they may generate more elements, or both. When a study determines that women are less able than men in mathematics, the element of "difference as deficit" is either created or reified. When a dialogue in the mathematics education community centers around the element(s) of difference and deficit, a message that the notions warrant discussion becomes an element.

People as researcher-warriors, Amazon-warriors, spectators or others are not elements in the Space/Barrier. However, like research projects, they may generate E/elements or dissipate E/elements. They may choose to avoid or interact with elements. For instance, researcher-warriors who choose to show that women are not unable have contributed to the dissipation of the element of female inability; but they have at times simultaneously also thickened elements such as "females as victims".
The Space/Barrier is a theory of how concepts fit together. The concepts are the E/elements that are a part of the interactions between and among women and mathematics. The Space/Barrier is a fluid, dynamic model. It is a contextual map where E/elements evolve and change with time and contact, as do connections among E/elements. How women (dis)connect with mathematics is revealed through their negotiations with the Space/Barrier, with their choices and movements around, through, under, or above elements and Elements.

The Space/Barrier is a place I believe I have negotiated in my interactions with mathematics. I have grown to feel some level of comfort or at the very least familiarity with my experiences within the Space/Barrier. As my woman-self, educator-self, and mathematician-self entered into a world of inquiry where I explored the Space/Barrier as I believed others experienced it, I found myself on ground that was unstable. The terrain of the Space/Barrier that had been firm for me was no longer so. I shifted my position from the familiar position of negotiating the Space/Barrier for myself, to learning more about how others negotiate it. The Space/Barrier looked more hostile to me in its unfamiliarity. The visibility from my new stance was limited. The environment at times felt overwhelming and overpowering, if for no other reason than because I did not understand it, or could not see/hear well enough for my view to be clear. This new perspective, this making the familiar strange, this deliberate disorientation of the self, provided me with a re-newed view of the happenings in the Space-Barrier.

Because I felt I was not on solid ground when I began this inquiry, I chose to grasp a handle to stabilize my self. I chose the Women's Ways of Knowing handle, as I have explained, to help me explore the Space/Barrier, and hear the voices of the women.
above the chaotic noise of the Space/Barrier. I tried, through my inquiry, to hear the words of the women speaking to me, to take those words and to use them to help describe the women's experiences of negotiation.

What About The Women's Ways Of Knowing Mathematics?

I chose to use certain research questions to help me find information and learn about women negotiating the Space/Barrier. I asked about the ways of knowing mathematics that the women of this study developed in the past and continue to develop now in themselves as students and teachers of mathematics. I wondered about how the women of this study maintain or move away from a way of knowing. I wondered how the various ways of knowing chosen by the women contributed to the women's (dis)connection with mathematics; I wondered how any of the women's experiences contributed to a (dis)connection. I asked how the experiences of mathematics content and pedagogy supported a (dis)connection between the women and mathematics.

I found that collectively, the women of this study experienced all of the Women's Ways of Knowing perspectives. Individually, each experienced and continue to experience multiple perspectives. Some experience those ways in a cyclic fashion, and others experience their ways by moving more randomly from one to another. Some see themselves as experiencing perspectives that I saw quite differently. Some described experiences where their perspectives were clearly revealed; others talked of experiences in such a way that the Women's Ways of Knowing were difficult to identify.

Maintaining or moving from one way of knowing to another was often a choice made by these women in response to, or in reaction to confrontation with elements of the Space/Barrier. Some chose quiet compliance and the appearance of a silent or received learner to work around a particular element. Some chose resistance, at times
quietly and at other times more vocally, to elemental influence. All experienced Amazonian Moments where courage or assertiveness supported moves to fight for their own voice to be heard.

Ways of knowing both contributed to and hindered the women's connections with mathematics. A private questioning of teacher choices led a woman to quietly continue with her chosen ways of knowing mathematics. She then developed her connected procedural perspective and connected with mathematics. A choice to still the self, a subjective knower's response to the element of male assertiveness in mathematics class, became a barrier for one woman. She lost instruction as she opted out of further high school study; and she did not allow herself to regain her voice until graduate school.

Experiencing mathematics as disconnected topics supported a (dis)connection between many of the women and mathematics. If the women wanted or needed to see connections in their lives, the discrete pieces of mathematics content became a barrier between the women and the mathematics. Periods where the women experienced environments that encouraged interpersonal connections among students supported movement through elements for those women.

Women experiencing traditional classrooms in which received knowing was encouraged or supported lacked thinking skills in subsequent courses. They attributed the deficit to a lack of preparation for thinking. These women sought help from others and worked independently to overcome their struggles and disconnection with mathematics. They continue their efforts still, negotiating the Space/Barrier elements that remain for them.
How Do These Women Negotiate the Space/Barrier?

The women participating in this study negotiate the Space/Barrier as they might create an improvisational dance, as they might creatively handle a soccer ball as a gifted athlete, or as they might do exactly as they have done – by responding moment by moment to the elements and Elements of the Space/Barrier. The dynamics and confrontations have led to tensions and contradictions at selected moments for each of the women. They carefully tread with footsteps that seem to be at times more hesitant than certain. How these women come to know mathematics has become a part of their interactions, their responses, their hesitations and confrontations, within the Space/Barrier.

I cannot say that any woman in this study is a silent knower or procedural or constructed. I can merely identify moments of silence, of procedural knowing or constructed knowing within experiences the women have shared. Why the women have moved in or out of these identified ways of knowing has not always been clear. Sometimes they seemed to adapt to or comply with situations; at other times they seem to move as an act of resistance, or of a new awareness. Influences of elements and Elements in the Space/Barrier, E/elements of gender expectations, personal needs, and mathematics, often contributed to the women's decisions to comply or resist.

Some women at times forged into new perspectives in Moments of bravery, either alone or with colleagues. Other women at other times, chose to move away from a perspective that was not safe for them in some particular circumstance. Some women found themselves in teacher-made environments that were elemental and unsupportive, that did not fit with the way of knowing that the warrior preferred. Some of the women found themselves reaching new awarenesses of possibilities for ways of knowing in teacher-created environments that were Elemental, that allowed room for movement.

220
within or around the Space/Barrier. In all, the women of this study chose ways of knowing mathematics as a part of their negotiation of the Space/Barrier, even as those ways of knowing contributed to their dance, their footwork through or around the Space/Barrier.

A Word On Memorable Moments In The Space/Barrier

Looking out across the Space/Barrier, the experiences of the women participating in this study, and the turns and decisions made by each in their mathematical Moments, I find myself pausing to wonder about those Moments. They seem somehow pivotal and are outstanding in the women's memories, and I wonder how the Moments became a part of a situational mathematics network in these women's lives.

Sugar and spice and everything nice.

Leigh could not see the chalkboard in second grade because she needed glasses. She handed in a paper to her teacher that was incomplete. She was called a liar for doing so. Leigh remembered that the teacher called her a liar in front of the whole class. She also remembered that the event had to do with math. Leigh further commented that things never really got better for her in mathematics, glasses or no glasses. In fact, when she had trouble in school it always was connected to math. She is still often afraid in learning mathematics.

Claire's first memory of mathematics was of the episode of adding 7+3 by counting ceiling tiles. Counting the ceiling tiles was not how Claire was "taught" to do mathematics. Claire was punished for cheating. She said that she learned from that experience and she learned well. She learned to be quiet, but she did not learn to be a silent learner.

Lindsay was "devastated" because she was twice accused of cheating in first grade. She remembered that there was only one problem in each instance that caused
suspicion of cheating. She still doesn't know whether or not the boy from whom she
supposedly copied was accused as well. She does know that she did not cheat. She also
does know that she learned to do exactly what she was supposed to do to get the grade,
and she adjusted her ways of knowing mathematics to fit the circumstances of the
moment.

For these three women, I wonder about the role of gender expectations of
behaviors of little girls and what that had to do with the mathematics experiences. "Sugar
and spice and everything nice", or at least the message of it was known to Leigh, Claire,
and Lindsay. What does it do to a girl to be called a liar, to be accused of cheating? Might
it not be that establishing such a strong moral connection/risk in mathematical activities
could leave the girls, and the women they grow to be, reticent of mathematics? Why not,
as Claire said, learn well to be silent? Why risk, for mere mathematics, losing the
"everything nice" that made little girls who they were? Leigh, Claire and Lindsay learned
about negotiating the Space/Barrier at an early age.

Continuous messages in teaching and learning.

Amy remembered a teacher telling her she didn't know her mathematics and that
she needed to go home and study. The experience left her in tears and she went home
and cried. She also remembered overhearing that same teacher tell her mother that Amy
was not very good in mathematics (Actually she saw him wrinkle his nose). These
experiences happened for Amy when she was in seventh grade. She had almost no
memory of mathematics before that, but these particular experiences convinced Amy that
she was not a good mathematics student. That belief stayed with her for years to come.
In fact, she still questions her mathematical knowledge when she comments that teachers
come to her for help in mathematics, while she does not see herself as an authority.
Although Amy recalls these moments as pivotal, as times when she learned, from then on, that she was not very good in mathematics, I question whether the belief in her inadequacy actually had its foundation in these seventh grade moments. This time may be more of a culmination point. Perhaps Amy experienced mathematics and environments prior to seventh grade which left her vulnerable to believing in her inability. Was she vulnerable to allowing the teacher's statements to disorient her way of knowing mathematics? Was the Moment of her learning that she was not good in mathematics not a wrinkled nose, but seven years of schooling? In the traditional, received classroom, might not the student wonder why knowledge is "given" to her? Might she not conclude that knowledge is given to her because she cannot create it? If so, the wrinkled nose might be a saturation point, where the message of her inability in complete, and suddenly clear to her.

Niches or not - choosing a way.

Claudia finally began to resist her own conformity in fitting herself in the "niches" she saw society expecting her to fit into. She behaved as she was supposed to, not challenging authority, being a good student, being there to help. It wasn't until she was near 40 years of age that she began to move out of the niches, and when she challenged a male mathematics authority. She stood up to him for the first time in her life, and chose to move out of the niche.

In the incident with the photograph, Bridgett shows less movement out of niches than Claudia revealed in standing up for herself. For much of her life Bridgett carried a need to continue fit the niche that she was very smart in mathematics. She found it increasingly more difficult to maintain what she believed was a facade as she studied higher mathematics in high school. In fact, it was in geometry that Bridgett first encountered her worst difficulties in mathematics, and it was while being tutored for
geometry that the photograph exposing her need for assistance was taken. It was no wonder that she was so upset with the event, as she realized that people would not think she was so smart after all.

How does one handle not being able to fit the niche she is supposed to fit? Claudia chose to move out of the niches, and had Amazonian moments of doing that. However, Bridgett was choosing to stay within the realm of those expectations, even as she found it difficult to maintain the pretense. Even into her teaching years, designated as a mathematics specialist, Bridgett continued to work hard to fit the niches of expectation. Carrie, though, claims no knowledge as a student of a particular niche, the niche of girls' inability in mathematics "or in anything". How such an "ignorance" influences or affects one's perception of the self is difficult to tell. However, we might begin to find understanding of the affects of messages sent to girls in Carrie's experience with fraction sums at the chalkboard.

Carrie remembered the time when she was at the chalkboard, racing against another student to complete fraction sums. Carrie had found a short-cut, or, more accurately, had recognized a need to change to a common denominator before adding. Therefore, instead of recording the fractions on the chalkboard as they were given to her, Carrie chose to change each, mentally, to its common denominator form. She then recorded only the changed form on the chalkboard. Her competitor did not follow the same procedure as Carrie, and the teacher had Carrie stop and wait for the other student to rewrite his fractions in changed form.

Carrie might have been "devastated", as have been others in similar circumstances, by a perception/message that she was not doing the problem the "right way", or that, with her way of doing mathematics, she was taking undue advantage of her competitor. Instead, Carrie maintained her confidence, and did not sway from her
belief that she could do mathematics. She recognized that the teacher's decision was not fair, and that she was ready to continue with her mathematics her way. She did not hear that as a girl she shouldn't have been able to do mathematics, simply because the element had not been recognized by her or had not existed near enough to her in the Space/Barrier for her to know it.

What Does This Mean For Women?

The Space/Barrier evolves, always. Women as researcher-warriors, Amazon-warriors, and other warrior types have the power to contribute to the evolution of the Space/Barrier and the thickening or dissipating of the elements comprising it. Like the women of this study, they can make choices for themselves and perform Amazonian acts of power to move themselves through or around elements they encounter. They can fight for themselves, as per the first half of the definition of Amazon-warrior, and have control of their voices and their developments.

For the acts of power to happen most consistently and most effectively for the women involved, the women need an awareness. Teaching the Space/Barrier can become an act of consciousness-raising. For those who are in a position to do so, teaching the Space/Barrier can be their choice of an Amazonian act towards dissipating elements.

For those who hear the message, for those to whom the Space/Barrier is real as a description of their experience, consciousness-raising can lead to a recognition of the self as an Amazon-warrior, as one who fights for herself and her sisters. She can appreciate her own power, ways of knowing mathematics and negotiation of the Space/Barrier. She can make active choices to confront and dissipate or circumvent Space/Barrier elements in ways that are most effective for her. She can also work towards ways to change confronted elements into Elements in the Space/Barrier.
This brings me to the second half of the definition of Amazon-warrior where the Amazon-warrior fights for other women. This is where the Amazon-warrior might use her knowledge to help raise the consciousness of other women as a move toward power for all of them. The teacher who teaches the Space/Barrier to women is one such Amazon-warrior. Another such Amazon-warrior is the teacher who uses her knowledge of her own negotiation of the Space/Barrier, and of her own ways of knowing mathematics to support other women and teachers. The Elementary school mathematics specialists participating in this dissertation study were this kind of Amazon-warrior. They provided support for the Elementary school teachers of mathematics (most of whom were women) in their districts or counties. They helped their colleagues find ways to negotiate the Space/Barrier in their classrooms and in their lives.

A third form of the Amazon-warrior who fights for other women is the classroom teacher. It is she who not only learns about her own ways to negotiate the Space/Barrier, to confront and dissipate or move around or through the elements in it, but also uses her experiences to change the Space/Barrier in a special way. In her classroom, she may hold the power to teach transformation of elements into Elements. She can teach her students ways not only to negotiate the Space/Barrier and to dissipate elements, but to change those elements into Elements. They can begin to use the e/Elements as a means to move through the Space/Barrier.

An example of how the Amazon-warrior teaches the transformation of elements to Elements might be found in a lesson on interpreting graphs or charts as representations of data. Students might be asked to re-represent some particular data set, exploring the changes in the visual image that result form changes in factors like scaling. Discussions of how the data are presented, and what different messages are sent with different visual effects would lead students to be more critical viewers of data as presented in the media.
When an element of inability is published, the students and teachers can, through critical
discussion and mathematical analysis, use the data and its representation to question the
conclusions. The questioning becomes an act of power in itself, and the element of
inability is dissipated; but more importantly, the element become an Element of ability in
reasoning, and the students and the teacher have begun a transformation.

Further Re-Searching: What Next?

To learn about the usefulness of the Space/Barrier for women as students and
teachers, the Space/Barrier will need to be taught and learned. Those to whom the
Space/Barrier has no meaning may not be able to help in this, either as students or
teachers. Another model or attempt to describe the relationships between women and
mathematics perhaps will work for them. However, for those for whom the
Space/Barrier has meaning, we can learn more. We can collaborate in efforts to find the
usefulness of the Space/Barrier in their classrooms. It is the teachers who can transform
and dissipate elements. It is they who can teach the negotiation of the Space/Barrier, and
the informed choices women must make to be able to be the most effective Amazon-
warriors they can be - for themselves and, again, for other women.
APPENDIX A

INITIAL REQUESTS AND LETTERS
Oral Solicitation Script

Since I have been interested in trying to determine why it is that women have difficulties with mathematics and are underrepresented in the field, my dissertation study will be an investigation of this phenomenon. I am interested in hearing the stories of women who have experienced what they think to be significant change with respect to their relationship with mathematics. Because you have indicated growth in your teaching of mathematics and in your efforts to learn mathematics, I would like to ask for volunteers from among you to be participants in this study about women's experiences in learning mathematics. I have a letter here explaining more about what I would like to do, and can answer any questions you might have.
Dear Teacher Leader,

In my work with students and teachers of mathematics, I have become interested in the relationships that women have with mathematics. In particular, I have begun to examine the ways in which women learn mathematics, being interested in how those ways interact with the ways women have been taught mathematics (content and pedagogy) as well as the ways the women teach their students mathematics. My dissertation research, *Women's Changing Perspectives in Mathematics*, will examine the question of how the experience of mathematics content and pedagogy has supported a (dis)connection between women and mathematics.

Two summers ago, I distributed a grounded survey to the Mathematics Teacher Leader (MTL) participants. Within this MTL group I found, and continue to find, a diversity of experience in learning and teaching mathematics. Because I believe there to be rich and, to date, largely overlooked insights for women and for mathematics education within the voices of your reflections upon experience, I hope to explore with you your evolving relationship with mathematics.

For my dissertation research, I request the participation of female elementary certified teachers who feel they have experienced change in their relationship with mathematics or mathematics education. This change may be represented in the form of a gain in confidence or in competence, or in a change in perspective in mathematics or mathematics education. I hope to facilitate a collaborative reconstructing of your mathematical autobiographies. Data will be analyzed from a feminist perspective and within the frame of *Women's Ways of Knowing* (Belenky, Clinchy, Goldberger, and Tarule, 1986). I hope to be able to identify the perspectives from which you have come to know mathematics as well as a theory on how these ways of knowing are nurtured or hindered through the experiences of learning and teaching mathematics. The data collection will be conducted as follows (expected timing in parentheses):

1. An audiotaping of your mathematical autobiography (60 minutes)
2. A reading of a short paper describing the focus of my analysis (30 minutes)
3. An audiottaped focus group interview/discussion (60 minutes)
4. A short written response to prompts emerging from the group interview (20 minutes)
5. A final audiotaped individual interview (30 minutes)

Data collection will be conducted over a 6 week period and will be concluded by January 31, 1996.

The audiotapes, transcripts, and written responses will be kept, locked, in the researcher's files indefinitely. They will be used solely for my own research purposes and will become a permanent part of my research files. *Pseudonyms* will be used for all participants in any writing to result from this study, and will assure anonymity from outside the group. As the process includes focus group interviews, some sharing of data among participants will reduce confidentiality within the group. However, since pseudonyms will not be shared among participants, the loss of confidentiality will be limited. Additionally, participants are asked to keep all focus group discussions confidential. Please understand that your participation in this study is strictly voluntary and that you may withdraw your consent at any time, without prejudice.

Dr. Suzanne K. Damarin of The Ohio State University is the principal investigator of this study. Dr. Damarin is a Professor in the College of Education, and may be reached at 292-4872.

Sincerely,

Suzanne K. Damarin
Principal Investigator

Diana Erchick
Co-Principal Investigator
Participant Demographic Request

The purpose of this request is to supply information which will be used to select a study sample from among interested volunteers. You will be notified by 10/15/1995.

Name__________________________________________ MTL? ________________

Home Address__________________________________ School Address_____________

__________________________________________

Home Phone______________________ School Phone____________________

High School Mathematics Courses___________________________

___________________________

College Mathematics Courses___________________________

Approximate number and brief description of workshops/conferences attended in last two years:_____________________________________

Have you (co)presented at a workshop or conference in that past two years?____ If so, please describe: _________________________________________________________

Please describe your teaching assignment, ie classroom teacher, resource, chapter 1, etc. Include your grade level(s).____________________________________________

Please place an X on each continuum below to identify your current position:

Your comfort level in learning mathematics

Your comfort level in teaching mathematics

Your comfort level in learning about teaching mathematics

Please use the back of this form if more space is needed for any of your responses.

231
APPENDIX B

INTERVIEW PROTOCOLS
Autobiography Protocol

Women's Changing Perspectives in Mathematics

Main question:
Would you tell me about, please, your life story as it relates to mathematics? What is your mathematical autobiography?

Follow up on:
* feelings and emotions
* specific instances, ages, situations
* Definitions of good teaching, problems/ease in learning
* Beliefs about reasoning mathematically, doing mathematics

Focusing Topics

I. Learning mathematics
* What is your first memory of mathematics?
* Describe pleasant memories from learning mathematics.
* Describe less than satisfactory experiences in learning mathematics.
* In what ways were your needs in learning mathematics both met and not met at various times and in various situations?
* What does one need to be able to do to be a mathematician? What kind of learning experience would you need to get that done for yourself?

II. Teaching mathematics
* Thinking in terms of what you remember of former math teachers and classes, what kinds of things do/have you kept and why? What will/have you done differently and why?
* How has professional development in mathematics helped you in learning about mathematics and what mathematics is?
* If you were given the opportunity to teach a class of all girls, how would your classroom differ from what it is now? Why?
* If you were asked to advise a school teacher on ways to prepare girls for further study in mathematics, what would you say?
Group Interview Protocol

The group interview was chosen for the purpose of drawing forth elaboration on topics that emerged from the autobiographical data as well as providing an opportunity for the participants to stimulate each others' memories through the open discussion of experiences. The group was asked an opening question determined from the initial, preliminary analysis of the autobiographical data. Themes emerging from that data that reflect an application of Women's Ways of Knowing will form the basis for questioning. For example, if a common theme was "feeling safe doing algorithms" an opening question might be, "Some of you mentioned feeling a safety in doing algorithms. Why do you think that is so? Is that a good thing in learning mathematics?" Or, an opening might be, "Each of you had very different reasons for liking or not liking doing algorithms in mathematics. How do you explain that?" Further questions were posed as needed, using the same format and based on the emerging themes of the analysis of the autobiographical data.
Final Interview Protocol

The purpose of this interview was to retrieve information that was considered relevant by either the participant or myself in completing the story of the participant’s mathematics biography. The specific topics for my questions emerged from the preliminary analyses of the data of the autobiographical interview, the group interview, and the written responses to date. The participant had the opportunity to share any additional information that she decided she would like to have included in her biography. An effort was made to verify interpretations of the perspectives of knowing mathematics that had thus far emerged in the experiences of the participant. For all cases, I wrote the actual questions to be asked on the transcripts situated within the text where appropriate. Additional global and less specific to the text questions were include as well.
APPENDIX C

INDIVIDUAL AND FOLLOW-UP QUESTIONNAIRES
Post Focus Group Writing Request

Women's Changing Perspectives in Mathematics

Name/pseudonym ____________________________________

Please respond to the following questions. Feel free to use the back of the paper or additional paper if you would like more space for your response.

1. Is there anything you would like to have added to the discussion, but did not have the opportunity to add?

2. Is there anything you would like to have added to the discussion that you would rather not share with the others?

3. How has this ongoing discussion, including the autobiography and the group discussion, left you feeling?

4. What more would you like me to know about you being a woman learning about mathematics and yourself?

Thank you!
Post Interview Demographics - Amy

Age: __________ Years teaching: __________ At your grade level? __________

Breaks in your teaching career? __ Explain _____________________________________________________________________________________

Ethnicity: ___________________________ Race: ___________________________

Please respond as you find most appropriate:

Social Class (growing up) _____________________________________________________________________________________

Social Class (as an adult) _____________________________________________________________________________________

Home setting as a child (suburb, urban, rural? _________________________________________________________________________

Home setting as an adult (suburb, urban, rural?) _______________________________________________________________________

What was your parents' level of education? __________________________________________________________________________

What were their career choices? _____________________________________________________________________________________

Was education valued in your home? ____ Please explain. _______________________________________________________________________

What were the expectations your parents had for you as far as your education was concerned? ________________________________________________________________________________

What impact has your race had on your experiences with mathematics? __________________________________________________________

What impact has your gender had on your experiences with mathematics? __________________________________________________________

What impact has your social class had on your experiences with mathematics? ______________________________________________________

Comments: (Please use the back of sheet if more room is needed)
Post Interview Demographics - Bridgett

Age: ____________ Years teaching: ____________ At your grade level? ____________

Breaks in your teaching career? Explain __________________________________________

Ethnicity: _____________________________ Race: _____________________________

Please respond as you find most appropriate:

Social Class (growing up) ______________________________________________________

Social Class (as an adult) ____________________________________________________

Home setting as an adult (suburb, urban, rural? I know you were raised on a farm, so where do you live now?) _____________________________________________

What was your parents' level of education? It sounds as though education was valued in your home. Correct me if I'm wrong on that _______________________________________

What were the expectations your parents had for you as far as your education was concerned? ______________________________________________________________

What impact has your race had on your experiences with mathematics? ____________

What impact has your gender had on your experiences with mathematics? ___________

What impact has your social class had on your experiences with mathematics? ________

Comments: (Please use the back of sheet if more room is needed)
Post Interview Demographics - Carrie

Age: ___________ Years teaching: ___________ At your grade level? ____________

Breaks in your teaching career? Explain ____________________________________________

Ethnicity: _____________________________ Race: _____________________________

Please describe however you find most appropriate:

Social Class (growing up) __________________________________________________________

Social Class (as an adult) ________________________________________________________

Home setting as an adult (suburb, urban, rural? I know you were raised on a farm, so where do you live now?) ________________________________________________________

What was your parents' level of education? It sounds as though education was valued in your home? Correct me if I'm wrong on that __________________________

What were the expectations your parents had for you as far as your education was concerned? ________________________________________________________________

What impact has your race had on your experiences with mathematics? _______________

What impact has your gender had on your experiences with mathematics? ____________

What impact has your social class had on your experiences with mathematics? _________

Comments: (Please use the back of sheet if more room is needed)
Post Interview Demographics - Claire

Age: ___________ Years teaching: ___________ At your grade level? ___________

Breaks in your teaching career? ___ Explain ____________________________________________________________________________

Ethnicity: _____________________________ Race: __________________________

Please respond as you find most appropriate:

Social Class (growing up) ________________________________________________

Social Class (as an adult) ________________________________________________

Home setting as an adult (suburb, urban, rural?) _____________________________

Home setting as a child (suburb, urban, rural?) _____________________________

What was your parents' level of education? Was education valued in your home? Is there anything you can add about that? ________________________________

What were the expectations your parents had for you as far as your education was concerned? __________________________________________________________________________

What impact has your race had on your experiences with mathematics? __________

What impact has your gender had on your experiences with mathematics? _________

What impact has your social class had on your experiences with mathematics? _______

Comments: (Please use the back of sheet if more room is needed)
Post Interview Demographics - Claudia

Age: __________ Years teaching: __________ At your grade level? __________

Breaks in your teaching career? Explain ____________________________________________

Ethnicity: _____________________________ Race: _____________________________

Please respond as you find most appropriate:

Social Class (growing up) __________________________________________________________

Social Class (as an adult) _______________________________________________________

Home setting as an adult (suburb, urban, rural?) _________________________________

Home setting as a child (suburb, urban, rural?) _________________________________

What was your parents' level of education? Was education valued in your home? Is there anything you can add about that? ____________________________________________

What were the expectations your parents had for you as far as your education was concerned? ________________________________________________________________

What impact has your race had on your experiences with mathematics? ______________

What impact has your gender had on your experiences with mathematics? ______________

What impact has your social class had on your experiences with mathematics? __________

Comments: (Please use the back of sheet if more room is needed)
Post Interview Demographics - Leigh

Your background and family history were the most complete of all of the 7 participants. The only demographic information I am a little unclear on is your graduate study. Are you in a program? If so, in what? (counseling?). How far into the program? Anything else that is appropriate to tell?

_______________________________________________

What impact has your race had on your experiences with mathematics?

_______________________________________________

What impact has your gender had on your experiences with mathematics?

_______________________________________________

What impact has your social class had on your experiences with mathematics?

_______________________________________________

Comments: (Please use the back of sheet if more room is needed)

243
Post Interview Demographics - Lindsay

Age: ____________ Years teaching: ____________ At your grade level? ____________

Breaks in your teaching career? ___ Explain? ______________________________________

Ethnicity: _____________________________ Race: _____________________________

Please describe how you would find most appropriate:

Social Class (growing up) ___________________________________________________

Social Class (as an adult)_____________________________________________________

School and home setting as a child (suburb, urban, rural)_______________________

Home setting as an adult (suburb, urban, rural)_______________________________

You said both of your parents were educators. Could you say more about that? What did they teach or do? What were their education levels? What were the expectations/pressures for you in your home as far as education was concerned? I am assuming that education was valued. Correct me if I am wrong. ______________________________________

How much graduate work have you done? Have you completed a Masters Degree? If so, when? In what? If not, do you plan to? Why or why not? ______________________

What impact has your race had on your experiences with mathematics? __________

What impact has your gender had on your experiences with mathematics? __________

What impact has your social class had on your experiences with mathematics? ______

Comments: (Please use the back of sheet if more room is needed)
Post Interview Individualized Questionnaire - Amy

Please explain how you came to be the Mathematics Teacher Leader (MTL).
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

Please explain the kinds of things you have done or services you have provided as a MTL.
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

The title Mathematics Teacher Leader has a significant amount of power accompanying it. In an interview you were quite adamant about not being identified as an authority. Yet, like it or not you are most likely seen as an authority in math. Considering your resistance to accepting that identification, how do you feel about being identified as an authority in math? _________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

The MTL position is a voluntary position. You could opt out at any time. But you have chosen to stay in the program. True, you do get a couple of release days for MTL workshops, as well as activities and ideas for your class. But I still wonder about you staying in this leadership role in mathematics.
What do you gain in your interactions and relationships with administrators by being a MTL? _________________________________________________________________
__________________________________________________________________________

What do you gain in your interactions and relationships with parents by being a MTL?
__________________________________________________________________________
PIIQ-Amy-Continued

What do you gain in your interactions and relationships with colleagues by being a MTL?

__________________________________________________________________________

What do you generally have to gain professionally by being a MTL?

__________________________________________________________________________

What do you gain personally by being a MTL?

__________________________________________________________________________

What do you gain in your interactions and relationship with mathematics by being a MTL?

__________________________________________________________________________

You have commented that the ways of reformed mathematics education, like using manipulatives and concrete representations, were not necessary for you, because you understood the abstract. Yet you also talked of knowing that if you had not understood the abstract as much as you had, manipulatives and other new methods would have really helped. Would you discuss in writing a little about how you know that?

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

Please add any further comments you might have.

__________________________________________________________________________

__________________________________________________________________________

Please use the back of this paper if more space is necessary.
Post Interview Individualized Questionnaire - Bridgett

Please explain the kinds of things you have done or services you have provided as a MTL. ________________________________

The title Mathematics Teacher Leader has a significant amount of power accompanying it. Like it or not, you are most likely seen as an authority in math. You responded to a teacher's comment that you know so much math with a disbelief that she would think you know so much about math. Considering these feelings about your knowledge base in mathematics, how do you feel about being identified as an authority in math? __________

The MTL position is a voluntary position. You could opt out at any time. But you have chosen to stay in the program. True, you do get a couple of release days for MTL workshops, as well as activities and ideas for your class. But I still wonder about you staying in this leadership role in mathematics.

What do you gain in your interactions and relationships with administrators by being a MTL? ________________________________

What do you gain in your interactions and relationships with parents by being a MTL? ________________________________

What do you gain in your interactions and relationships with colleagues by being a MTL? ________________________________
What do you generally have to gain professionally by being a MTL?

What do you gain personally by being a MTL?

What do you gain in your interactions and relationship with mathematics by being a MTL?

You know so much about the Ohio Model, and about mathematics content strands and ways to teach them. You have commented on your belief that the reformed mathematics that we are now teaching would have been so helpful for you as a student. How do you know that? How can you be certain that it was the reformed methods, and not the methods and the lifetime of experiences that you had already had?

Please add any further comments you might have.

Please use the back of this paper if more space is necessary.
Post Interview Individualized Questionnaire - Carrie

Please explain how you came to be the Mathematics Teacher Leader (MTL) _________

_______________________________________________________________

Please explain the kinds of things you have done or services you have provided as a MTL._______________________________________________________________

_______________________________________________________________

The title Mathematics Teacher Leader has a significant amount of power accompanying it. How do you feel about having a role that places you in the position of an authority in mathematics, especially when considering the resistance that you have already discussed regarding allowing women into power and/or math positions.___________

_______________________________________________________________

The MTL position is a voluntary position. You could opt out at any time. But you have chosen to stay in the program. True, you do get a couple of release days for MTL workshops, time for networking, and collegial support, as well as activities and ideas for your classroom. But I still wonder about you staying in this leadership role in mathematics.

What do you gain in your interactions and relationships with administrators by being a MTL?_______________________________________________________________

_______________________________________________________________

What do you gain in your interactions and relationships with parents by being a MTL? ________________________________________________________________

_______________________________________________________________
PIIQ-Carrie -Continued

What do you gain in your interactions and relationships with colleagues by being a MTL? ______________________________________________________________

What do you generally have to gain professionally by being a MTL? ______________________________________________________________

What do you gain personally by being a MTL? ______________________________________________________________

What do you gain in your interactions and relationship with mathematics by being a MTL? ______________________________________________________________

You have commented that the ways of reformed mathematics education, like using manipulatives and concrete representations, were not necessary for you, because you understood the abstract. Yet you also talked of knowing that if you had not understood the abstract as much as you had, manipulatives and other new methods would have really helped. Would you discuss in writing a little about how you know that? ______

________________________________________________________________________

Please add any further comments you might have. ______________________________________________________________

________________________________________________________________________

________________________________________________________________________

Please use the back of this paper if more space is necessary
Post Interview Individualized Questionnaire - Claire

Please explain how you came to be the Mathematics Teacher Leader (MTL) ____________
______________________________________________________________
______________________________________________________________

Please explain the kinds of things you have done or services you have provided as a MTL. ____________________________________________________________

c________________________

The title Mathematics Teacher Leader has a significant amount of power accompanying it. Believe it or not, you are most likely seen as an authority in math. You have talked about being just coming out of silence in mathematics, and about avoiding high level talk of mathematics. Considering these feelings about mathematics, how do you feel about being identified as an authority in math? ____________________________________________________________

c________________________

The MTL position is a voluntary position. You could opt out at any time. But you have chosen to stay in the program. True, you do get a couple of release days for MTL workshops, as well as activities and ideas for your class. But I still wonder about you staying in this leadership role in mathematics. What do you gain in your interactions and relationships with administrators by being a MTL? ____________________________________________________________

c________________________

What do you gain in your interactions and relationships with parents by being a MTL?

c________________________
PIIQ-Claire-Continued

What do you gain in your interactions and relationships with colleagues by being a MTL?

__________________________________________________________________________

What do you generally have to gain professionally by being a MTL?

__________________________________________________________________________

What do you gain personally by being a MTL?

__________________________________________________________________________

What do you gain in your interactions and relationship with mathematics by being a MTL?

__________________________________________________________________________

When you encountered mathematics with manipulatives, you said you finally understood certain concepts for the first time. You also said that learning mathematics that way would have been so helpful to you as a student. How do you know that? How can you be certain that it was the manipulatives, and not the manipulatives and the lifetime of experiences that you had already had?

__________________________________________________________________________

__________________________________________________________________________

Please add any further comments you might have.

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

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252
Post Interview Individualized Questionnaire - Claudia

Please explain how you came to be the Mathematics Teacher Leader (MTL) ____________
______________________________________________________________
______________________________________________________________
______________________________________________________________
______________________________________________________________

Please explain the kinds of things you have done or services you have provided as a
MTL. __________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

The title Mathematics Teacher Leader has a significant amount of power accompanying it. Believ
it or not, you are most likely seen as an authority in math. You have talked about keeping yourself in
the niches that were expected for you. Mathematics does not typically become one of those appropriate
niches for women. Assuming this to be true about mathematics and women, how do you feel about being
identified as an authority in math?
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

The MTL position is a voluntary position. You could opt out at any time. But you have chosen to stay in
the program. True, you do get a couple of release days for MTL workshops, as well as activities and ideas for your class. But I still wonder about you staying in this leadership role in mathematics.
What do you gain in your interactions and relationships with administrators by being a
MTL? __________________________________________________________________
________________________________________________________________________
________________________________________________________________________

What do you gain in your interactions and relationships with parents by being a MTL?
________________________________________________________________________
PIIQ-Claudia-Continued

What do you gain in your interactions and relationships with colleagues by being a MTL?

________________________________________________________________________

What do you generally have to gain professionally by being a MTL?

________________________________________________________________________

What do you gain personally by being a MTL?

________________________________________________________________________

What do you gain in your interactions and relationship with mathematics by being a MTL?

________________________________________________________________________

When you encountered mathematics with manipulatives, you said you finally understood certain concepts for the first time. You also said that learning mathematics that way would have been so helpful to you as a student. How do you know that? How can you be certain that it was the manipulatives, and not the manipulatives and the lifetime of experiences that you had already had?

________________________________________________________________________

________________________________________________________________________

Please add any further comments you might have.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Please use the back of this paper if more space is necessary
Post Interview Individualized Questionnaire - Leigh

Please explain how you came to be the Mathematics Teacher Leader (MTL) ___________

___________________________________________________________________________

Please explain the kinds of things you have done or services you have provided as a MTL. ________________________________________________________________

___________________________________________________________________________

The title Mathematics Teacher Leader has a significant amount of power accompanying it. Like it or not, you are most likely seen as an authority in math. You have expressed feelings of panic in your interactions with mathematics and continued insecurity with mathematics. Considering these feelings about mathematics, how do you feel about being identified as an authority in math? ____________________________________________

___________________________________________________________________________

The MTL position is a voluntary position. You could opt out at any time. But you have chosen to stay in the program. True, you do get a couple of release days for MTL workshops, as well as activities and ideas for your class. But I still wonder about you staying in this leadership role in mathematics.

What do you gain in your interactions and relationships with administrators by being a MTL? ________________________________________________________________

___________________________________________________________________________

What do you gain in your interactions and relationships with parents by being a MTL?

___________________________________________________________________________

255
PIIQ-Leigh-Continued

What do you gain in your interactions and relationships with colleagues by being a MTL?

______________________________________________________________________________

What do you generally have to gain professionally by being a MTL?

______________________________________________________________________________

What do you gain personally by being a MTL?

______________________________________________________________________________

What do you gain in your interactions and relationship with mathematics by being a MTL?

______________________________________________________________________________

When you encountered mathematics with manipulatives, you said you finally understood certain concepts for the first time. You also said that learning mathematics that way would have been so helpful to you as a student. How do you know that? How can you be certain that it was the manipulatives, and not the manipulatives and the lifetime of experiences that you had already had?

______________________________________________________________________________

______________________________________________________________________________

Please add any further comments you might have.

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

Please use the back of this paper if more space is necessary
Post Interview Individualized Questionnaire - Lindsay

Please explain how you came to be the math specialist (MS) on your team.  

__________________________________________________________________

Please explain the kinds of things you have done or services you have provided as the MS.  

__________________________________________________________________

The title mathematics specialist has a significant amount of power accompanying it. How do you feel about that, especially since this leadership role is in mathematics, a place where you have not enjoyed study, or seen yourself as successful?  

__________________________________________________________________

Your position as the MS is a voluntary one. You could opt out of that role at any time. But you have chosen not to quit. In fact, you have talked about developing professionally in the direction of a curriculum person (I'm assuming from the context that it was in math). I wonder about you staying in this leadership role in mathematics inspite of you reiterations of not liking mathematics and not being particularly successful. Aside from perks such as professional development opportunities and new ideas for you classroom, you get little concrete reward for your MS position. So, I wondered about the following:

What do you gain in your interactions and relationships with administrators by being the MS?  

__________________________________________________________________

What do you gain in your interactions and relationships with parents by being a MS?

__________________________________________________________________
PIIQ-Lindsay-Continued

What do you gain in your interactions and relationships with colleagues by being a MS?

What do you generally have to gain professionally by being a MS?

What do you gain personally by being a MS?

What do you gain in your interactions and relationship with mathematics by being a MS?

You have commented on the effectiveness of the ways of reformed mathematics education, like using manipulatives, developing reasoning skills, communication and more. How do you know that these new methods are better for kids in learning than if they would have experienced mathematics as you did? Maybe these new methods only seem effective to you because you have already experienced the mathematics you have had as a student. Would you comment, react, discuss?

Please add any further comments you might have.

Please use the back of this paper if more space is necessary.
APPENDIX D

MANUSCRIPT:
WOMEN'S VOICES AND THE EXPERIENCE OF MATHEMATICS
Prelude

Consider, with me, the phenomenon of women's experiences in mathematics. In approaching this consideration I ask that we try to do this from a new perspective. In order to present this new perspective, I have taken liberties with certain spellings, and grammatical constructs. The usages are nontraditional, and are often influenced by feminist readings. The purpose is at some times emphasis, and at other times to change meaning. One example of such a usage may be found in the use of case in the word "t/They". The uppercase refers to the authority, while the lower case symbolizes equality; the use is consistent with Perry (1970) and others.

Another example is the use of the word "herstory". Even though I am aware that history is not a word that is meant to say his story but rather is a derivation of words implying learning by inquiry, I understand, too, from a feminist perspective, that the word 'history' has come to mean, through practice, his story. This story is about women, and as such this paper is 'her story'. Therefore, I feel I would be remiss in not using the word herstory.

As I began this paper, I did not know exactly what I meant by a new view. I did not know what this new perspective might look like, or what its potential might be. I only knew that the perspectives from which I had been viewing the phenomenon of women in mathematics seemed somehow inadequate - very much like staring at the same
word problem for hours, repeatedly trying the same method(s) of solution (varied though they may be in themselves) and never finding a satisfying, creative process of solution. Without an exploration from a new view, the problem solver knows neither what possibilities lie ahead nor whether the old ways are truly either adequate or inadequate.

I have attempted a re-consideration of women and mathematics myself. The result is described herein. I decided that I needed to examine what viewpoints had been used by others, so an exploration of the history of the study of women in mathematics was in order. I then tried to keep myself attuned to the world of mathematics and pedagogy around me, colleagues and mentors, teachers and students. I hoped to find and reflect upon possibilities for a meaning of a new view.

What follows is the result of my process of searching history, observing my world, and positioning myself within a re-searching of theory and practice. This positioning leads to an exploration of women's experiences in mathematics via their own telling, and via the hearing of their voices and their experiences through the lens of *Women's Ways of Knowing: The Development of Self, Voice and Mind* (Belenky, Clinchy, Goldberger, and Tarule, 1986).

**Searching History/Herstory**

**Her Story in Mathematics**

In the early days, when questions regarding the participation of women in mathematics were finally being seen as warranting study, researchers explored issues from varied perspectives. Within herstory, woman has been able to observe this study of her (dis)connection with mathematics as it has been scrutinized, examined and hypothesized around. Woman has been able to see Sheila Tobias, for example, lead the study of the possibility that mathematics anxiety, and the avoidance that accompanies it, impacted women's study of mathematics (1976; 1978; 1980a; 1980b). With what might
seem like a simple turn of the head, woman could also see Elizabeth Fennema raising questions about the relationship between sex differences and mathematics achievement of women (1974). Following Fennema as she continued in her work with Julia Sherman, woman as observer would see investigative conclusions of the importance of socio-cultural influences on sex differences in mathematics (1977a; 1977b). In fact, the woman watching the study of her self could find this and more evidence that her performance in mathematics had much to do with the culture surrounding being female (Fauth & Jacobs, 1980; Burton, 1979).

While these socio-cultural and psychological findings were being discussed and viewed, another conversation was ensuing as well. Instead of the hypothesis, for instance, that mathematical achievement is a result of culturally influenced course-taking, the hypothesis rising from the alternative conversation reverses this perspective. This other voice, also heard by the woman as observer, now realizing that she is also woman as object, was suggesting that the difference in course-taking is a consequence of mathematical ability - an ability that was determined by sex differences (Goldman & Hewitt, 1976). By 1980, Camilla Benbow and Julian Stanley favored the hypothesis "that sex differences in achievement and attitude toward mathematics result from superior male mathematical ability" (p. 1264).

The theory of biological influence on mathematical ability continued as a part of the tug and pull that emerged in the theory of how women experience mathematics. That hormones cause giftedness was hypothesized again in 1983 (Benbow & Stanley) and was popularized in the media in following years (Hensel, 1989; "Hormones Cause", 1986; Young, 1986).

Meanwhile, The Mathematical Association of America (MAA) Committee On the Participation of Women called on all to help change beliefs about the inferiority of women
in mathematics by drawing attention to "Fifty-five cultural reasons why too few women win at math". The MAA Committee's position that the performance of females in mathematics is the result of cultural influences is supported by the logic that since "in many cultures girls perform mathematically as well or better than boys, we cannot believe that the biological effects of sex in other countries are different than those in ours" (Kenschaft, 1991, p. 11).

(Un)real* Voices

*(un)real: a form of the word intended to display the true meaning, i.e. what is real in the standard type is not the reality that the women know exists.

The voice of Susan Griffin describes the female experience in her poetic herstory Woman and Nature; The Roaring Inside Her (1978). Griffin's work is self described as a work of poetic prose where a philosophical beginning traces a history of judgements about nature and women. Woman and Nature explores the logic of civilized man, an objective logic, separated from emotion. Griffin explores that objective logic "by going underneath logic" (p. xv) and exploring from the perspective that thinking not be separated from emotion. Included in this exploration of logic is a historical compilation of women's herstories, herstories known as truths to women who live them. These truths, ancient as some are, have become a part of who women are. The place for women in mathematics is included in these truths.

In her writing Griffin speaks both in the objective, authority voice of "absolute truth" (p. xvi) and the "embodied voice" (p. xvi), a collective voice consisting of her own voice and "the voices of other women" (p. xvi). In the Griffin text, the objective voice, the voice of Western science, printed in standard type, is what is said and written, what is concrete and (un)real. The other voice, printed in italic type, is the voice of the truths as
heard by women, truths that many women know, or come to know simply by virtue of being female. As academia continues to search for an absolute truth, voices are variously heard and counted, and academia, too, has its italicized voices.

For instance, looking again at the research on women in mathematics, we find that in 1977 Fennema and Sherman suggested socioeconomic factors influenced mathematics achievement more than sex, age, or mathematics difficulty. Additionally, the authors concluded that there exists an equal mathematical potential for both males and females. *Females can do well in math.*

Benbow and Stanley would take issue with the Fennema and Sherman conclusions. After all, if males and females differ in achievement and attitude in mathematics because of superior mathematical ability on the part of males, as Benbow and Stanley concluded, then it is not likely that females can do as well as men in math. *Females are inferior.*

Damarin, in her 1990 article "Teaching mathematics: A feminist perspective", alludes to the messages within both the authority and embodied voices. In short, a part of the mathematical reality of the female student is the messages that she and others have received concerning her mathematical ability. The two burdens of these messages are (1) that the question of whether females are innately inferior in mathematics is a legitimate question meritng continued scientific study, and (2) that the answer has generally been reported to be yes. Even if the second message is being falsified by research, in the absence of publicity for findings of no difference, the power of this message remains intact unless we, as teachers, confront it. (p. 147)

Without necessarily even being aware of the complicated influences on her experiences, the observant woman often has been able to see herself examined as a curious object in connection with mathematics. She has seen an exploration of this curiosity that has been an attempt to answer the question of how one might change the
environment of the woman, or the perspective of the woman so that she might enjoy, study, perform or achieve better in mathematics. Whether the cause is culture or biology, it is hoped that the consequence is a performance for females that is equal to that of males. Is there a voice of reason in this search?

**The Voices of Reason**
Calculations, they said, constitute objectivity because we are more emotional than they are and based they said... only on what is observably true because we lack the capacity to be reasonable and emotions they said must be distrusted

(Griffin, 1978, p. 118)

Somewhere in the search for the answers to the questions surrounding the experiences of women in mathematics are the reasonable, unheard voices of women. Given the opportunity to speak as they have been in the work of scholars such as Carol Gilligan (1982) and Mary Field Belenky, Blythe McVicker Clinchy, Nancy Rule Goldberger and Jill Mattuck Tarule (1986), women could guide us in our efforts to better the conditions of the relationship between women and mathematics.

In Gilligan's (1982) work we see the power in hearing women's voices as they resolved dilemmas of morality. Gilligan reexamined basic assumptions of developmental theory through the new lens of women's perspectives. The result was a theory of moral development organized around responsibility and care, in contrast to the dominant model of an ethic of justice described by Piaget (1965) and Kohlberg (1981,1984).

Similarly, Belenky et al. (1986)*, in *Women's Ways of Knowing: The Development of Self, Voice, and Mind* presented a model for intellectual development as an alternative to Perry's *Forms of Intellectual Development in the College Years* (1970). (The authors credit Perry, who used only his interviews with men to validate his model,
in the stimulation of interest and images for their own work as well as for a shared phenomenological approach.) Although women have been found to have experiences in common with the Perry model, discrepancies have been viewed as deficiencies for women. Additionally, themes that might have been more prominent among women were not uncovered in the Perry stages. In an attempt to dis-cover (discard the cover that has hidden) those patterns which more adequately, or at least alternatively, describe women's intellectual development, Belinky et al. undertook a project that began for them in 1970 with Perry's model. The Women's Ways of Knowing team set out to determine "what else [emphasis added] women might have to say about the development of their minds" (p. 9).

**Women's Ways**

For the project culminating in the publication of *Women's Ways of Knowing* in 1986, Belinky et al. chose to listen only to women. Unlike the subjects of Perry's study which were privileged Harvard undergraduates, the 135 women who participated in the Belinky et al. project were of diverse ages, circumstances, and outlooks. The common patterns of their experiences, in spite of the diversity of their lives, emerged from interviews over an extended period of time.

The *Women's Ways of Knowing* model groups the women's perspectives into the five categories of silence, received knowledge, subjective knowledge, procedural knowledge, and constructed knowledge. Within the perspective of procedural knowing, two forms of knowing, separate knowing and connected knowing emerge. The authors
note that although others might have organized their observations differently, and these categories are neither fixed nor exhaustive, this remains a model to be shared.

Belenky et al. (1986) deliberately chose to use the metaphor of voice to depict women's experiences. This choice of "voice" was more than a description of a point of view. Voice applied to many parts of the women's experiences, all of which were related to a sense of mind and self, and feelings of isolation and connectedness. The consistent use of the metaphor of voice by the women themselves as they participated in the study reinforces the appropriateness of the application of that metaphor in the Women's Ways of Knowing model.

Differing Perspectives: Art and Mathematics

In moving this discussion from what has been to what might be, I will share an experience which models a change in perspective on mathematics and which also has the potential to model a change in perspective on research into women's experience with mathematics. A professor of mathematics, during a discussion of the dihedral four group, explained ways of describing the movement of the square in space. A contrast between the artist's and the mathematician's ways was explained. In viewing the square, the professor said, the artist examines it from one perspective and describes what he sees. (The choice of the masculine pronoun in this exposition, both for the artist, and the mathematician, was made by the professor. *There must be no females who are artists and/or mathematicians.*) The artist, if he wants to view the square from another perspective, moves himself through space so that he might then enjoy a view of the square from some new perspective. He can then describe what he sees again. He does not touch the square, or move it. He moves himself through space to change perspective.

The mathematician will begin as does the artist, by examining the square and describing what he sees. However, unlike the artist, the mathematician will then take the
square and move it through space, to some other position, in order to view it from
another perspective and re-describe it. He will handle it, rotate it, spin it around some
chosen axis, manipulate it. He will, in this way, generate a group of descriptions of this
figure and its various positions in space.

My discomfort here has nothing to do with symmetries of a square. It does,
however have much to do with the differences in perspectives between the artist and the
mathematician. The discomfort emerges within the concept of integrity. The artist, it
seems, has a respect for the integrity of the subject, in this case the square. She or he
takes on no claim to power, no entitlement, no right to touch, move or manipulate the
subject. The artist only examines and interprets from multiple perspectives, moving
herself or himself in order to change perspectives. The square exists untouched and
unmoved.

Mathematicians somehow seem to view the square as an object, and one over
which they have the power (and the right to that power) to move, solely for the purpose
of examination. There exists no concern over the movement or manipulation of the
object. And in this process of investigation, the mathematician does not move herself or
himself. The change in perspective does not involve any sort of inconvenience on the
part of the mathematician. The object is moved. It is that simple. Does the
mathematician’s respect for the integrity of the object differ from that of the artist?

A Possibility

Now my wandering from history/herstory to hearing a professor’s exposition on
art and mathematics has led to a question: What is it in the artist/mathematician
representation of study that is the source of discomfort? Is it connected to the sense of
entitlement or lack of entitlement in manipulating the object of study? Is this sense of (a
lack of) entitlement emerging as a part of the (dis)connection between the object in mathematics and the one who studies? Within the presentation of mathematics, is there a (dis)connection between the study of mathematics and being female?

Undoubtedly, in the search for answers to these questions, the nature of the issues involved are rather complicated. Examining the learning experiences of females may mean, as it has at times in the past, examining questions within the contexts of sociocultural factors and societal expectations; it may also mean maintaining an awareness of the messages embedded in the female mind and the role of the teacher in confronting those messages. Additionally, what mathematics means and how it is used may matter as much to women as what it means to participate in the study of mathematics.

As the woman as observer/object becomes the woman with voice, she becomes a participant in this exploration of the female experience in mathematics. She can join in the study of her experiences instead of observing the study of her experiences. She and the researcher, like the artist, can describe the experience of women and mathematics from a new perspective, without manipulating the women or the female experience.

The Ways and Mathematics

Silence: The Simplest Way of Knowing

The silent women had limited experience and . . . were lost in the sea of words and numbers that flooded their school. For them school was an unlikely place to "gain a voice." For them the experience of school only confirmed their fears of being "deaf and dumb".

(Belinky et al., 1986, p. 34)

The simplest way of knowing, silence, was found infrequently in the experiences of the women interviewed in the Women's Ways of Knowing study. It is interesting that the cases of silence that did emerge were present in women whose lives had included
excessive abuse, severe violence, or social isolation. What is also interesting is the possible connection between this infrequent way of knowing among the women interviewed for *Women's Ways of Knowing*, and the seemingly frequent occurrence of this way of knowing for females in mathematics. Erchick (1994) repeatedly heard talk of this silent way of knowing.

In the Erchick interviews, one fifth grade teacher remembers watching her own teacher mark homework problem after homework problem wrong without explaining why the problems were wrong. She could easily fit the model of the silent learner who believes that authorities rarely tell you why something is as it is. She never asked, as silent learners would not, why things were so, since for silent knowers survival depends on blind obedience; trying to know "why" is neither important nor possible (Belinky et al., 1986, p. 28; Erchick, 1994).

The feeling of being unable to hear and unable to speak reverberated through the words of these elementary teachers, as the women spoke of how they "just never got it" in math, no matter the particular content or instructor or level. One woman described her feeling that mathematics was like building blocks, and she had missed the very first one. These women asked no questions, and few asked teachers for help. They felt voiceless, were silent, and stayed silent regarding mathematics well into adulthood (Erchick, 1994).

The women participating in Erchick's interviews were all college graduates between the ages of 25 and 55, and were all capable students. It was only in mathematics that they found themselves maintaining positions of silence. Reflecting on the connection between this way of knowing and the developmental consequences of isolation, violence, and abuse, (Belenky et al., 1986) one might be left wondering just what women perceive the experience of being a mathematics student to be.
There is a way of surviving as a silent learner. In fact, the silent learners might seem to fit rather well in the mathematics classroom, especially in the elementary years. They may even be rewarded for their silence with praise for being a good student. Further, being told will have no meaning for the silent knower who does not hear the voices of authority. As Belinky et al. (1986) found, the silent knower simply "wanted to be shown" (p.39); the typical mathematics classroom often leaves little reason for the silent knower to move away from this perspective.

This way of knowing will not always continue to be functional in mathematics classes as the student moves along the curriculum. Yet, even at the university level, the typical mathematics classroom, operated by the traditional mathematics teacher, seems designed for a silent student. The silence of the mathematics student is more than behavioral in these classes. As steps in an algorithm are shown to the student, for instance, there is little need for voice. The student may only see how to work the algorithm; she need not hear, need not think. The mathematics class becomes part of the overall school experience of being "an unlikely place to 'gain a voice'" (Belenky et al., 1986, p.34).

**Received Knowledge: Listening to the Voices of Others**

The silent knower not only does not speak, and does not expect reasons to be given, but she does not believe that she needs to hear explanations or that she would understand any explanation given. In contrast, the received knower depends on words. She sees words as a vital link, as the way for knowledge to be transmitted. She learns by listening.

This perspective is parallel to the Perry position of dualism. There is only one right answer that the professor will dispense. The formal system of mathematics, with its "only one way to do things" (Turkle, 1988, p. 56) should feel somewhat comfortable to
women in this way of knowing. These knowers will feel confused if they are asked to do original work. If the instructor is making them find answers, he or she is perceived to be making them feel stupid. After all, "how could she learn if he wouldn't pass along the answers?" (Belenky, 1986, p.40).

Differences between the man/Perry (1970) model and the woman/ Belinky et al. (1986) model are evident. One difference surfaces in the way the men aligned themselves with the authority via an "Authority-right-we" perspective. The women seemed to say "Authority-right-they". So, even though both the men and the women saw the authority as the source of and dispenser of knowledge, the men had a sense of identification with the authority and the knowledge while the women did not.

Another point of difference arises in the division of speaking and listening. Perry's (1970) men in the dualist level seem to speak more than listen. The women of Belinky et al. (1986) focused on listening. The reason is related to the women's role as subordinates in this culture and their tendency to participate in conformist thinking. Taking into consideration these factors, it is reasonable to see how women would develop their capacities for listening while allowing space for the men to speak (Belinky et al.).

Again, this type of learner was evident in the exploration of the math experiences of elementary teachers. One woman talked of how she attended all of her college math classes, took notes, and expected that if she were a good student, attending and listening, she would learn. This method had worked for her in previous mathematics classes (Erchick, 1994).

Just as authority has all of the knowledge for women in the silence mode of learning, authority has all of the knowledge for women in the received knowledge mode.

272
No knowledge originates from the student. This way of thinking can be particularly damaging in the study of mathematics as the student knows nothing of the creation of mathematical ideas, only of their transference.

Mathematics always existed as a finished product; at best, mathematicians at times discover and reveal some new parts of it, while each generation of students "absorb" the finished products as they are transmitted to them.

(Borasi, 1990, p. 176)

**Subjective Knowledge: Personal, Private, and Subjectively Known**

The women in the Belenky et al. (1986) study who found themselves moving into the subjective perspective of knowing were women who became aware of an inner resource for knowing and valuing. It was no longer only the authority who knew. With this perspective women began to move into becoming their own authorities.

The subjectively knowing women differed from subjects in models of theorists such as Maslow in that their progression into this perspective of knowing was not dependent on any specific age. In fact, many of the women from the *Women's Ways of Knowing* interviews listened to outside voices much of their lives, only developing the subjectivist perspective at the age of 45 or 50.

The *Women's Ways of Knowing* women typically come into this perspective of subjective knowing not from some educational experience directly, but rather from having encountered a failed male authority. Women in the transitional period turn still to authorities, but different from the male authorities previously depended upon. The new authority will be someone more like themselves, such as a mother, aunt, or sister. It is the experience of these new authorities that becomes the foundation for the truth they know and share (Belinky et al., 1986).
An elementary teacher speaking to Erchick had found that listening and following directions in math class was the way to learn. However, in a particular college math class she found that this skill no longer worked for her. She did not learn by the teacher telling, and was forced by her own desire not to fail this particular class, to work with other students who were able to teach (tell) her how to do the work. She saw some of these students as authorities themselves in that they had taken (even though unsuccessfully) this particular course before, in some cases multiple times. The experience of difficulty and effort in this mathematics class may have been the common bond between a subjective learner in transition and the new authorities who were like the learner herself.

A problem arises for women moving into this subjectivist perspective that is directly related to the myths and stereotypes about women's thought. A subjectivist knower is just beginning to believe in her own resources. She is just beginning to give credence to herself as an authority. Now, she finds she must contend with the society's emphasis on rational thought. After all, "It is said that that which cannot be measured and reduced to number is not real" (Griffin, 1978, p. 11). The subjectivist learner is left with the difficulty of finding validation for her intuitive knowings.

Another concern for the woman moving into the subjectivist perspective rests in her insistence on independence. She will be optimistic and confident in her knowledge, and at the same time so insistent on independence that she may ultimately isolate herself. With a shift into her own opinions comes a potential for taking a stand against people around her, thereby risking a separation from those people. One solution is for the woman to still her public voice, avoiding confrontation and possible isolation. However, through a time of intellectual growth, this behavior carries even more consequences than
the isolation from peers, family or friends. For the woman choosing not to share her private world, opportunities for finding mentors for intellectual and emotional support are hindered.

For the silent and the received knowers, the absolute truth that is known by the authorities is true and consistent for all; for the subjective knower, the absolute truth is true only for the individual. Each person's experiences yield her or his own view of reality. Truth is private; abstraction, logic, and analysis are to be distrusted. Truth derived from internal sources discounts knowledge belonging to masculine space (Belinky et al., 1986).

His certainty:
How he rules the universe
He says that through numbers 1 2 3 4 5 6 7 we find the ultimate reality of things 8 9 10 11 He says 12 13 14 that quantities are the most rigorous test of things 12 13 . . . 14 15 16 He says the final proof 16 17 is always a sum 18 19 20 . . . . He measures the distance from his land to his neighbors land. He measures his wealth . . . He calculates his feelings . . . He measures his intelligence . . . He measures productive acres. He calculates the value of his existence . . . He counts 82 83 necessity. He counts what he imagines to be necessary. He says six combat divisions are necessary . . . Counting. They have counted the targets . . . 71 were cities . . . they count 263 bombs . . . they count the dead to be 42 million . . . He tells us how powerful he is.

(Griffin, 1978, p. 126-127)

Consider the connection between the knowledge of masculine space and the (ab)uses of mathematics in that space. If women hear that "he tells us how powerful he is" by using mathematics, if women hear the measurement of feelings and intelligence, as well as the counting of bombs and deaths, perhaps they will become avoidant of involvement. If this is mathematics, it may not be anything for which women have a use.
Procedural Knowledge: The Voice of Reason

From the procedural knowledge perspective, the voice of reason again becomes a goal for women. This time, however, the reason for which the women search is their own. In this perspective, procedural knowers do not readily accept the voice of authority as they had as silent or received knowers. But they do not instantly accept their own intuitive responses from their subjectivist self, either. It is here that procedural knowers become critical of their own thinking, where they begin reflective thought.

This perspective has the look and feel of a leap backwards to both the women experiencing it and the women hearing it. Because of the reflective, critical nature that develops, women become careful in their speech. They become, often, silent again. Procedures and method become of paramount importance, and the form takes precedence over the content.

Belinky et al. (1986) express a particular concern for the development of women at this stage. To them, the emphasis of this group of knowers is "chillingly academic" (p. 95), so much so that they describe the emphasis on procedure in terms of Mary Daly's (1987) "methodolatry":

methodolatry: common form of academic idolatry; glorification of the god Method; boxing of knowledge into prefabricated fields, thereby hiding threads of connectedness, hindering New discoveries, preventing the raising of New Questions, erasing ideas that do not fit into Respectable Categories of Questions and Answers (p. 82)

The researchers find this focus on method and procedure to be of special concern for women. As women have not designed the procedures that are in place for coming to knowing in the various disciplines, the procedures that are in place may actually hinder or prevent them from gaining the knowledge they need.
In some ways this seems to be almost a merging and evolution of the ideas of the previously discussed perspectives. Instead of the blind acceptance and dependance on authority of the silent and the received knowers, there is now an interest in the opinions and ways of thinking of others. Instead of the totally intuitive view of the subjective knower being preferred, the procedural knower now hesitates and critically reflects upon her intuitive responses. Gone is the rigid acceptance of only one perspective, whatever that might have been. Present is a desire to see from multiple perspectives, and a kind of knowing that is definitely more objective.

**Separated and Connected Knowing**

Separated and connected knowing emerge as two strands of the perspective of procedural knowing. Although these two strands are similar, they do differ, with that difference depending on either a theme of understanding or a theme of knowledge. Both themes are present in each strand, but to differing degrees. For the connected knower, understanding is predominant; for the separate knower, knowledge is predominant (Belenky et al., 1986).

A look back at the dihedral four group of the symmetries of a square allows insights on knowledge and understanding as they apply to the separated and connected procedural knowers. Knowledge predominates in the mathematician's examination of the square. There exists a separation from the object. There is control, and mastery over it. There is none of the equality that is found in understanding. There exists the component of power.

Separated knowledge is seen as an adversarial model where the knower learns about how that adversary wants her to think. She learns how to see the world through
the lens that is supplied for her, how to think like They want her to think, how to remove
the self. The separated knowers have greater difficulty moving from this perspective into
the constructed knowledge perspective.

Understanding, however, predominates in the artist's examination of the square.
There is an element of equality, a need to understand, a lack of evaluation, and an absence
of superiority. There is a connection between the object and the knower.

The connected knower converses intimately as opposed to impersonally. She is
concerned not with what They want her to think, but on what they (lower case) think.
She is trusting and nonjudgemental, and seeks the logic behind an idea strictly for the
purpose of understanding and connecting.

The connected knower also finds it helpful to maintain a group connection where she can
grow. Expertise is found within that group and a "connected" (Belinky et al., 1986, p.
118) criticism accepted within that group. If the group is allowed to remain connected
over a period of time, as a cohort group might be in a program of study, the common
experience that is still important to the connected knower builds within the group.

For all of the procedural knowers, whether separate or connected, neither reason
nor intuition is totally abandoned. Both are seen as necessary, although neither is seen as
sufficient for knowing. The struggle becomes one of finding a way to include both in
the functions of knowing. From this position, as the knower nears the constructed
knowing perspective, "what is needed is not reversion to sheer feeling but some sort of
integration of feeling and thinking" (Belinky et al., 1986, p.130).

At first glance many of the elementary teachers interviewed by Erchick would
seem to be procedural knowers in mathematics. The emphasis on procedure that
dominated their learning of mathematics is still a part of their knowing of mathematics as teachers. To them, knowing mathematics primarily means being able to do an algorithm, and students demonstrate knowledge by “following the steps” (1994).

However, a less cursory analysis of the separated and connected knowers reveals the intricacies of these perspectives. As one teacher spoke of hating how her college math professor insisted that she do the problems “his way” (emphasis hers), she was also asking herself why she could not do it her own way. She seems to fit the pattern of the separated knower who wants to determine how They want her to think. Yet, it is unclear how much a part of her thinking is dependent upon “reasoned reflection” (Belenky et al., 1986, p. 88), and whether or not she is merely resisting the “suppressing of the self” as she might in the subjectivist perspective (Belenky et al., p. 104). It is also unclear how much of her chameleon-like behavior is epistemological, involving “ways of looking” and thoughts beyond what to how the professor’s ideas were formed (Belenky et al.).

Procedural knowers do not limit themselves to speaking in either the separated/knowledge voice or the connected/understanding voice, but, rather fluctuate between the two. The elementary teacher’s need to remove herself and to “take away the logic of it” when learning mathematics in college, might be only a single facet of procedural knowing, and further description by her is needed to determine if the voice of understanding is present as well (Erchick, 1994). Although the existence of two voices again complicates the identification of this way of knowing, the presence of both distinct voices in each of the procedural knowers of Women’s Ways of Knowing was a factor that helped distinguish these voices from the “more balanced voice(s)” of the perspective of constructed knowledge (Belenky et al. p. 103).
**Constructed Knowledge: Integrating the Voices**

The key to constructed knowledge lies in the integration of thought, feeling, and experience. Compartmentalizing thought and feeling, seen as a shortcoming of men, is to be avoided. A development of a sense of whole is a goal. It seems as though this is the time in the woman's knowing that the puzzle pieces fit together. In putting together this puzzle, pieces are sorted and analyzed. The woman creates/constructs her own system and own authorities. She creates her own voice with which to communicate her understandings. She appreciates the complexity of life, and does not try to simplify it. She learns it and shares it.

As a student of mathematics, the constructivist knower may truly find conflict between her concept of mathematics and her way of knowing. For instance, if mathematics had been presented to her in her learning as a completed system of knowledge, or if, in some way, this message had been sent and reinforced, she might be among the many maintaining the belief that mathematics is a completed system of knowledge. If so, she could see her readiness to create/construct her own knowledge and to connect it to the ongoing study of mathematics to be a worthless skill.

Additionally, conflicts that are more closely connected to gender socialization may arise. If the constructivist knower wants to integrate her feeling and experience with her thoughts, she must do so while considering the societal messages devaluing her experience and feeling. She knows, too, about the expectation of separation between her thoughts and feelings in mathematics, and therefore may see additional barriers to integration. Furthermore, experiencing mathematics courses as unconnected topics, a development of a sense of whole may seem an unlikely possibility to her.
Constructivist Passion

passion: the movements within the soul that express deep
Fire/Desire
Passions are caused by something that is perceived. They are
movements rooted in knowledge and are not static, inexplicable
blobs of "feeling".

(Daly, 1984, p. 198)

There are Passions of differing varieties that are traced by the feminist philosopher
Mary Daly as they exist in the experiences of women. There are "plastic passions"
(1984, p. 200) which paralyze women (predominantly) while draining energies. Some of
these passions are anxiety, frustration, and resignation. Another variety, the variety that
propels, is that of "Real Passions" (1984, p. 200). These Passions, such as desire,
hope, and daring to name a few, are, according to Daly, active movements within
women. They are the Real Passions that ignite the constructivist knower.

According to Belenky et al. (1986), as a woman develops into a constructivist
thinker, she also begins to move toward being the Passionate knower. This is a special
kind of constructivist, one who realizes that maintaining an awareness of her mind's
workings is necessary to her well being. These women speak a language that reflects
attentive caring and understanding, intimacy between the knower and the known, and an
integration of their passions and their intellectual life. Integrating care and feeling into
their work, "constructivist women aspire to work that contributes to the empowerment and
improvement in the quality of life of others" (Belenky et al., p.152).

Passionate constructed knowing may be interpreted as a rich form of connected
knowing that emerges when the woman has learned “to use the self as an instrument of
understanding” (Belenky et al., 1986, p. 141). What distinguishes the procedural from
the constructivist perspective lies in this ability, as a lack of self-knowledge in the

281
procedural knower prohibits the connection between what she trying to understand and what she experiences. Connection moves from being an "objective" procedure to the means of creating a "recognizable whole" (Belenky et al., p. 141) out of her passions and her intellectual life.

Again, one may be left wondering about the constructivist woman's aspirations and the (mis)fit of those aspirations within the study of mathematics. For instance, if the constructivist knower works in her life toward the goal of empowerment and improvement of the quality of life, where does mathematics belong? With his mathematics, remember, he tells us how powerful he is. He counts the bombs. He counts the number dead. These messages speak not to empowerment, but to power over. The constructivist knower may have no need for this mathematics.

**How Are The Voices To Be Heard?**

As women experience the constructivist way of knowing, they may again/still experience being silent. However, the difference now is that even though the silence may be behavioral, and may even be a choice on the part of the knower, the implication that it is also epistemological does not necessarily follow. The choice to be behaviorally silent itself may be interpreted as a voicing, and other alternative voicings may be made as well.

An alternative voicing of a woman's experience in mathematics might emerge as words chosen and arranged for the particular purpose of expressing what otherwise seems to go unheard. In this voicing a woman might tell about her experiences in math class

where she knows her self to be within
a one-way-view glass bubble
soundproof
on the outside the image of a person
projected outward?
from within?
from her self?
or onto?
from some other place?
an image selected by someone
else?

invisible is the person inside
well hidden
her thoughts
her feelings
protected from the order outside

the order outside
protected from her feelings
her thoughts?

no one sees her
hears her screaming
and pounding
no one knows
she is there

or wants to?
she cannot find a way to be heard
so,
now,
finally,
the order continues.
without her.

Is this the voice of the silent knower, feeling voiceless and unable to
hear? Or, is this the voice of a constructivist, the voice of a woman who knows what it is
like to be heard, somewhere, sometime in her life, struggling in math class to be heard
again? Is this the voice of a woman somewhere else on the continuum? In some ways,
where she is matters little in this message. What matters most is that she be heard.

As the women in Belenky et al. study became constructivist knowers, they
became more able to communicate. They directed their Passions toward, among other
things, the creation of a voice. They found a way to be heard and to be understood. The
voice of "math class" could be an example of one such created voice.
In "math class" women may not appear to be heard. They may appear to be silenced by a glass bubble, protected from the order outside. They may appear (dis)connected from the order. Even though the order outside continues without them, so do they continue without the mathematical order prescribed in the mathematics class. More importantly, the math class woman finds a voice and speaks about the experience.

**Constructing a Hearing of Voices**

In this consideration of the experience of women and mathematics, we speak of needs and of fixing. We contemplate the effects of changing women's perceptions of the self or of the experience of mathematics. We make choices for the math class women, based on what we assume they want or need, and based, too, on the end of having them achieve as well as men.

However, as shown in the preceding pages, mathematics may not fit into women's ways of knowing very comfortably. If mathematics is (or is perceived to be) a formal system that threatens connectedness, a language that expresses power over and control, a masculine space, a space that disallows subjectivism, perhaps most women really would choose not to participate in it. If the mathematics classroom is a place that nurtures women's silence, where compartmentalization of thought and feeling are valued over integration of these constructs, would women want to be there? If the experience of mathematics discourages connectedness, and stifles Real Passions in women, is the experience any less than a threat to women's development? What is it that researchers, educators, women and other humans can do to help women make a choice in the experience of mathematics?

Some questions might be considered. For instance, what is it that women need in or from mathematics? What will help them redefine mathematics in such a way that they
can decide on its appropriateness for their lives? What experience will help them come to an informed choice regarding mathematical study? What do the math class women want?

The search for answers need begin with women themselves. No longer must we make choices and plan changes for women in mathematics without asking women the simple question of what is wanted. Then, of course, we must hear their answers.

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