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**GENDER DISCOURSE IN SMALL LEARNING GROUPS
OF COLLEGE-LEVEL DEVELOPMENTAL
MATHEMATICS STUDENTS**

by

Allen W. Emerson

**A Dissertation
Submitted to the
Faculty of The Graduate College
in partial fulfillment of the
requirements for the
Degree of Doctor of Philosophy
Department of Mathematics and Statistics**

**Western Michigan University
Kalamazoo, Michigan
December 1996**

GENDER DISCOURSE IN SMALL LEARNING GROUPS OF COLLEGE-LEVEL DEVELOPMENTAL MATHEMATICS STUDENTS

Allen W. Emerson, Ph.D.

Western Michigan University, 1996

This study was motivated by the question as to whether women's and men's membership in different gender communicative cultures gives rise to gender-differentiated ways of talking that are implicated in the failure of a mixed-sex group to achieve good mathematical discourse when women and men sit face to face engaged in various mathematical tasks. If so, in what ways and to what effect is gender discourse implicated in the failure of a mixed-sex group to achieve good mathematical discourse?

Models of feminine and masculine discourse styles based on the theory of communicative cultural difference, as well as a model of good group mathematical discourse, were developed. Codes called "floors" were devised that enabled me to partition the groups' discourse into nine categories of interactions, thus permitting an analysis of who was doing what and when in the groups. Using the models mentioned above, I applied these floor codes to a combined total of two and a half hours of audio-taped discourse that the two groups produced during a group exam and then examined the gender effects I discovered in the context of the oral and written discourse collected from these two groups throughout the

semester. Analysis revealed the type of group interactions in which these gender effects were most likely to manifest themselves and the particular conditions of good mathematical discourse that women and men were most likely to violate.

Women and men were found to be equally responsible for the failure of their groups to achieve good discourse, but in quite different ways due to their membership in different gender communicative cultures:

1. Men had difficulty in achieving intersubjectivity.
2. Women avoided mathematical argumentation for the sake of group harmony and consensus.
3. Women were more likely to defer to the authority in the belief that argumentation disrupts group harmony and consensus.
4. Women's avoidance of mathematical argumentation exacerbated their feelings of helplessness, especially if they believed that mathematics is a meaningless language game in which outcomes are determined on the basis of authority.

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Allen W. Emerson

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CHAPTER I

INTRODUCTION

Motivation for the Study

Before undertaking this study, I had worked with collaborative mathematics groups in my developmental classes for a number of years, studied the transcribed talk of some of these groups, sat in and recorded for a semester the talk of first-year college collaborative English writing classes of my wife and colleague, Cheryl Forbes. I presented papers at various mathematics and writing conferences, both individually and in collaboration with Cheryl, and conducted a pilot study in which I transcribed and analyzed the talk of a mixed-sex, college-level developmental mathematics collaborative learning group.

Reflecting on what I had learned, it seemed to me that one of the reasons for the disaffection I had observed in some women at the entry level of mathematics might be that certain ingrained language strategies of the feminine discourse style, as described by Deborah Tannen (1990) and others (e.g., Maltz & Borker, 1982) are at odds with certain normative language practices in the mathematics classroom. Was there something inherent in mathematical discourse and its particular mode of argumentation that was incompatible with women's culturally-induced ways of talking? I knew that a number of research studies of

small mathematics groups in elementary, junior high, and high schools (Webb, 1991) had strongly suggested that gender was implicated in the nature of small group mathematical discourse. Depending on the particular circumstances involved, these studies found, among other things, that boys tended to give more justifications and content-related explanations than girls and that girls tended to be less successful in obtaining help when they needed it. Although these studies were provocative and lent support to my suspicion that language, gender, and mathematics were somehow intertwined, they did not offer any explanation as to why these gender effects should be taking place or what could be done about them to ameliorate the situation. From the language and gender studies I had read, I thought that I might look to the differences between the ways women and men handle disagreements while working together in small groups. Confrontation (or aversion to it) is one of those not-unexpected facts of group life when people argue the rightness or wrongness of mathematical constructions, and I thought I might look to it as a clue as to how the habitual language patterns of the feminine discourse style might conflict with the demands of spoken mathematical discourse, thereby interfering with women's access to mathematical learning. Since the women I had observed working in mixed-gender writing groups in a college-level English class did not seem to find conflict or confrontation in any way problematic, I if it were the peculiar nature of mathematical argumentation itself that might be responsible for the difference in the behaviors of women in the English and mathematics classes I had observed. Then too, the work of scholars such as

Aries (1976), Edelsky (1993), Gilligan (1982), James and Clarke (1993), Kramarae (1981), Maltz and Borker (1982), and Thorne and Henley (1975) led me to wonder if differences in power, status, and language use between women and men sitting face to face in a small learning group, a mathematics learning group, might determine in some situations who sets the group's agenda, who controls the flow of topics, and whose ideas prevail. This, in turn, might constrain women's ability to enter fully into the give and take of group discourse. Additionally, might what happens in a small mathematics group itself be a reflection or distillation of what was happening in the larger culture of school mathematics?

After I began the study proper, the work of mathematics education researchers Paul Cobb and Heinrich Bauersfeld and their four American and German colleagues, Götz Krummheuer, Jörg Voigt, Terry Wood, and Erna Yackel was published (Cobb & Bauersfeld, 1995). Although their research involved grade-school children working mathematics problems in pairs and was not concerned with gender, these researchers provided me with concepts, vocabulary, and findings from which I was able to build a model of good mathematical discourse, which provides, in turn, the possibility for not only discerning when things go amiss, but also of suggesting what could be done to make things right. My original research questions became incorporated into questions concerning how gendered discourse might be involved in group participants' failure to achieve good mathematical discourse, the goal of which is to provide opportunities for participants to be actively engaged in constructing mathematical

knowledge.

More changed, however, than just the particular statements of my research questions as I moved deeper into the study. This had to do with my growing suspicion that, while it might be true that mathematical discourse makes greater sociolinguistic demands on women than it does on men, male discourse was making its own powerful, and often subtle, demands also. Even beyond this, I began to wonder whether women themselves employ conversational strategies that sometimes inhibit each other's mathematical growth—at least in the presence of men.

Context of the Problem

This study is an inquiry into gender, language, and the learning of mathematics. It joins lines of research from three disciplines: gender studies, sociolinguistics, and mathematics education. On the one hand, researchers in mathematics education have been trying to determine why women are underrepresented in mathematics and mathematics-related courses, and, on the other, researchers in sociolinguistics have been uncovering systematic differences in the ways women and men tend to use language. The field of gender studies has informed the research in both of these areas.

The locus of this study is the small-group, collaborative-learning mathematics classroom. Many mathematics educators are shifting their pedagogical strategies from individual work to group work, from teacher-dominated talk to student-controlled talk, as a way to provide space for students' voices to emerge

and to help them actively construct their mathematical understandings. Such a setting also allows the researcher and the teacher to listen to these emerging voices, to hear how men and women attempt to adapt their differing discourse styles to one another and to the particular demands of mathematics discourse as they endeavor to understand mathematics.

General Research Question

This study adopts the theoretical perspective that there are systematic differences between masculine and feminine discourse styles and that these differences originate and are reinforced as a result of the enculturation of the sexes into different communicative gender cultures (Maltz & Borker, 1982; Tannen, 1994). As a result, men and women tend to bring differing sociolinguistic expectations to various communicative situations, including the mathematics classroom. The central question addressed by this study is the following: How might the gender discourse styles of men and women working in a small, mixed-sex group engaged in learning and applying basic algebraic/statistical concepts and skills be differentially implicated in the failure of the group to achieve good mathematical discourse?

This general question will be further explicated and subdivided into more specific questions after the theoretical framework of the study has been developed.

The Nature of the Study and Its Methodological Context

Studies of gender and language are highly interdisciplinary enterprises and their methodologies can often be quite varied and eclectic. This particular study falls into the kind of gender/language studies that Tannen (1994) submits are characterized by their sociolinguistic, anthropologically-oriented approach. It is sociolinguistically oriented in that it attempts to relate larger cultural influences to the ways that individual men and women talk in small groups in a particular kind of mathematics classroom. The methodology of the study is anthropologically-oriented in the sense that I closely examine individual cases of group interactions over a semester in the microculture of a classroom in which I was a participant/observer. In addition, the analysis I conducted of systematic cross-gender differences in communicative style is positioned in a research tradition called "interactional sociolinguistics" (Tannen, 1994, p. 5), which has its own methodological approach that, by and large, I have appropriated. Beyond this, however, the study sometimes ventures into the particular linguistic subfields called "discourse analysis," and "conversation analysis," which look at connected language patterns "beyond the sentence." That is, they look beyond the formal organization of sounds, words, and sentences in spoken discourse to a "characterization of how, in the process of negotiation, participants go about the process of interpreting meaning" (Coulthard, 1985, p. viii). Other times I have had to go "within the sentence" to the recurrence of particular words in order to interpret

the meaning of certain interactional sequences.

Another theoretical and methodological influence on this study, and that influence comes from the study mentioned above (Cobb & Bauersfeld, 1995). This study appropriates "ethnomethodology" as its theoretical and methodological underpinning. For these researchers, ethnomethodology is "the study of the patterns of interaction that emerge in a classroom . . . and focuses on the roles, obligations, and expectations of the participants and how they are implicitly negotiated" (p. 294). More will be said of this in Chapters III and IV.

Spoken discourse between four people working together in a group operates on many levels, and it should come as no surprise that the study of gender effects operating at these different levels reflects the very interdisciplinary nature of the study of such. Researchers working in the field of gender and language, observes Tannen, "have their roots in wildly divergent academic disciplines, including sociology, education, anthropology, psychology, speech communication, literature, and women's studies, as well as my own field of linguistics" (Tannen, 1994, p. 4)—though linguists are actually the smallest contingent, she adds. Given all this, it is fair to ask whether this study more properly belongs to some field other than mathematics education. Or more to the point, of what value is such a study to mathematics teachers if they have to become discourse analysts in order to find it applicable to their own classrooms?

To begin, although I analyze spoken discourse, I do not consider myself to be a discourse analyst. Indeed, when describing the field of discourse analysis

in his Introduction to Discourse Analysis, Malcolm Coulthard writes, "I am not, paradoxically, describing only the work of researchers who consider themselves discourse analysts—many of those mentioned here would be bemused or annoyed by the label" (Coulthard, 1985, p. 3). I would not consider such a label for myself bemusing or annoying, but merely inaccurate. But this would be of no particular concern to Coulthard, who avers, "[discourse analysis] is useful to anyone interested in the analysis of situated speech or *spoken discourse*" (p. 3). The point being made here is that it should not be any more problematic, and perhaps even less so, that a mathematics education researcher be a discourse analyst in order to use certain discourse analytic techniques than that the researcher be a statistician in order to use certain statistical techniques in particular studies. The value of discourse analysis for mathematics educators lies in what such analysis can reveal about the understandings of students sitting face to face in small group engaged in mathematical tasks.

The Value of Discourse Analysis for Mathematics Education

Reviewers of the research literature on small group processes have called for more direct observation of the qualitative nature of small group interactions (Bossert, 1988-89; Good, Mulryan, & McCaslin, 1992; Webb, 1991). Good et al. (1992) call for researchers to develop models that will allow teachers to obtain information about students' cognitions and instructional needs that could provide guidance as to how teachers should interact with and intervene in collaborative

groups. In addition, in their review of the research concerning gender issues that have appeared in the Journal for Research in Mathematics Education for the past 25 years, Fennema and Hart (1994) note that few qualitative studies have appeared, and no scholarship dealing with a reexamination of mathematics education from a feminist perspective can be found. They call for studies that explore some of the underlying mechanisms that have resulted in gender differences in mathematics and that might provide insight as to why females tend to develop less positive attitudes toward mathematics than males.

Since spoken discourse is the primary medium through which students interact in small groups, the call from the mathematics research community (see above) for direct observation of small group interactions would seem to evoke close attention to what students say to each other when sitting face to face discussing mathematical tasks, a situation, says Coulthard (1985), for which discourse analysis should prove useful. Moreover, the call for qualitative studies examining the underlying mechanisms that have resulted in the disaffection of women in mathematics (Fennema & Hart, 1994) provides further rationale for the study of the differing discourse styles of women and men. This study might provide some useful sociolinguistic perspectives for the development of such models.

CHAPTER II

BACKGROUND STUDIES

The following review of literature is divided into three major sections. The first, "Sociolinguistic Perspectives," provides the research base and theory for gender communicative cultures and discourse styles, as well as providing the rationale for the particular theoretical approach the current study adopts for the study of gender and language. The second section, "Research Findings and Perspectives on Gender and Discourse," presents research on language and gender from various perspectives and contexts relevant to this study, including the mathematics classroom. The third section, "Emergence of Meaning in Small Mathematics Groups (A Study)," presents the research findings and theoretical perspectives of a five-year collaboration of a team of American and German mathematics educators that have strongly influenced my thinking and analytic constructs. Although this study is not concerned with gender, it has afforded me a model of good group mathematical discourse within which to study gender effects.

Sociolinguistic Perspectives

Sociolinguists have developed two different theoretical approaches for the study of gender and language (Kramarae, 1981; Roman, Juhasz, & Miller, 1994; Tannen, 1994; Thorne & Henley, 1975): (1) the "cultural difference" approach,

and (2) the "cultural dominance" approach. Although these approaches are not mutually exclusive, the particular theoretical approach adopted for research has significant implications not only for which discourse characteristics might be identified in the data but also for how findings will be interpreted. In the current study, I adopt the cultural difference approach. After explicating this position, I will give my reasons will be given for adopting the cultural difference approach rather than the cultural dominance approach. I then present research findings as to how boys and girls are enculturated into their respective gender communicative cultures. Finally, I characterize feminine and masculine discourse styles in terms of their respective communicative gender cultures.

The Cultural Difference Approach to Gender Discourse

This study was based on the proposition that certain differences between the way men and women tend to use language result in misunderstandings between the sexes that can be attributed to the membership of the sexes in different "communicative cultures." A communicative culture exists when a set of norms (rules that guide behavior, the violation of which may incur disapproval or sanction) regarding how to communicate is shared by a group of people. Members of the culture share common understandings of how their talk is used and what purposes it serves (Wood, 1994a, 1994b). This means that members in one culture will not only use talk differently to accomplish the same purpose than would members in another culture but will also use talk for purposes that would not

habitually be used by members in a different culture. Feminine and masculine communicative cultures have been identified and described by a number of scholars, including Maltz and Borker (1982), Tannen (1990, 1993, 1994), and Wood (1994a, 1994b). It is through interaction and communication with others that we learn what masculine and feminine mean in our society, meaning that are central to how we perceive ourselves and how we act in the world (Wood, 1994b). Although some people resist gender socialization, the strength and pervasiveness of gender norms ensure that most girls will be socialized into feminine culture and most boys into masculine culture. Since language is one of the primary means by which the sexes are initiated and then held in conformity to social views of gender, most girls and women hold assumptions about communication and use rules for communicating that differ significantly from those of boys and men (Sheldon, 1993). As a result, men and women operate from often differing sets of language assumptions and rules. This means that they will not only differ in their intentions and purposes in certain communicative situations, but they will also, in some circumstances, misunderstand each other since each will tend to interpret the other sex's speech acts according to the language norms of his or her own communicative culture.

Rationale for Adopting the Cultural Difference Approach

The major competitor to the cultural difference approach outlined above is the "cultural dominance" approach, which asserts that language is a means

through which males subordinate females. Gender inequalities embedded in the function and form of language are enacted, reinforced, and transmitted by economic, family, political, and legal structures based on male dominance (Kramarae, 1981; Roman, Juhasz, & Miller, 1994; Thorne & Henley, 1975). Moreover, patterns of miscommunication between the sexes not only occur in the context of male dominance and female subordination, but can also contribute to the perpetuation of the social structures of male dominance. Although proponents of the dominance approach may grant that there is truth in the cultural difference approach, they argue that the cultural difference approach cannot account for why certain language features, as opposed to others, are associated with one or the other sex. The cultural dominance approach, they contend, affords a rational explanation for such in terms of male power and dominance (Tannen, 1994).

Writing as an advocate for the cultural difference approach, Tannen (1994) argues that cultural difference does not preclude male dominance and that the difference framework "provides a model for explaining how dominance can be created in face-to-face interaction" (p. 10). Moreover, Tannen states that the difference approach can reveal language processes that result in male domination in conversational interactions without ascribing to every individual the intention to dominate in every instance.

I adopt the cultural difference approach for this study for the following reasons:

1. It allows for the inclusion of dominance effects at the level of analysis

relevant to this study.

2. It provides more precise and well-developed analytical categories for studying conversational interactions in group discourse.

3. It offers an adequate rationale for ascribing various language features relevant to this study to one or the other of the gender discourse cultures.

4. Since it is an essentially "no-fault" approach, it would seem to be more promising for teacher training and use in the classroom for improving students' learning of mathematics in small, mixed-gender groups.

The Formation of Gender Communicative Cultures

The next part of this review of literature describes how boys and girls become enculturated into their respective discourse cultures, beginning with their earliest years of life and then extending to their interactions with their peers in childhood games. From this account, a fundamental criterion is developed which, when applied to given situational contexts, is useful in distinguishing which linguistic features might be ascribed to which gender communicative culture.

Gender-Role Acquisition in the Earliest Years of Childhood

The acquisition of gender roles for boys and girls in early childhood is crucial to their initiation into their respective masculine and feminine communicative cultures. Accordingly, an account must be given as to what is generally agreed upon concerning gender-role acquisition, where differences lie, and how it all

relates to the development of differing communicative cultures.

The following tenets have been established by research and clinical observation and are generally uncontested (Brooks-Gunn & Matthews, 1979; Wood, 1994a):

1. Most parents or primary caregivers tend to treat young girls and boys differently in a manner consistent with what they regard as fitting feminine or masculine behavior.

2. By age five or younger, children know which sex they are and have a basic understanding of society's expectations of masculinity and femininity.

According to Brooks-Gunn and Matthews (1979), there are three major theories of gender-role acquisition: (1) identification theory, (2) social learning theory, and (3) cognitive development theory. After these theories have been outlined below, it will be shown that they all share a common characteristic that underscores a fundamental difference in girls' and boys' gender-role acquisition.

Identification theory posits that in the early years of childhood quite different relationships are formed between mothers and their sons and mothers and their daughters. These relationships, in turn, contribute to the cultivation of masculine and feminine gender identities in children (Chodorow, 1978; Eichenbaum & Orbach, 1983; Miller, 1986; Roman, Juhasz, & Miller, 1994). Since daughters can identify with the gender roles of their mothers, they are able to develop their identities within that primary relationship. Sons, on the other hand, must differentiate themselves from the mother and establish their selfhood apart from this

primary relationship. As young children mature, they carry with them the basic identity they formed in this first relationship with their mothers. Girls elaborate their identity in connections with others, and relationships tend to take a prominent place in their lives and value systems. In contrast, as boys elaborate their identities, independence becomes central to their lives and value systems.

Social learning theory (Brooks-Gunn & Matthews, 1979; Wood, 1994a) claims that children learn their gender roles through reinforcement (rewards and punishments), observation, and imitation. Parents or other adults communicate to children what they consider to be appropriate gender behavior for girls and boys and then train them to conform to these roles by reinforcement. Studies suggest that parents or primary caregivers tend to emphasize social abilities in young girls and physical independence in young boys (Wood, 1994a).

Cognitive development theory maintains that by age three or so children develop a sense of gender constancy, that is, that gender is relatively unchanging. After they come to understand that being feminine or masculine is a fixed part of their identities, they develop a strong internal motivation to become competent at their identified gender role. They then actively devote themselves to identifying and enacting those behaviors appropriate to their gender from the models available to them. Gilligan (1982) posits that young girls learn to value connections and relatedness to others, and to communicate care and responsiveness. She also maintains, as does Kohlberg (1966), that young boys are more likely to value autonomy and to communicate in ways that express and preserve

independence.

All the above differing theories of early gender-role acquisition come to the same point of agreement: girls tend to define self in relation to others, whereas boys tend to define self independently of others. The emergence of this fundamental difference in gender-role acquisition becomes the controlling context for the differentiated development of feminine and masculine communicative cultures.

Early childhood gender-role acquisition is not the only influence, however, in the genesis of gender-communicative cultures. Peer-socialization processes foster the development of feminine and masculine cultures. These peer interactional processes have been observed in the kinds of games girls and boys play.

Peer Interactions in Sex-Segregated Games

Boys and girls engage in differing forms of gendered play based on different forms of social organization that result in different gender behavior, including language. The following characterization of girls' and boys' games is based primarily on research summarized and synthesized by Maltz and Borker (1982), which includes the work of Brooks-Gunn & Matthews (1979), Eder & Hallinan (1978), Goodwin (1980), Lever (1976, 1978), and Savin-Williams (1976).

Most girls' games usually require two or three participants and do not have preset, fixed rules and objectives. To make many of their games work, girls have to negotiate and agree upon rules, roles, and goals each time they play. From the

unstructured, cooperative nature of these games, girls learn several deeply ingrained linguistic strategies that promote, among other things, collaboration, egalitarian relationships, and sensitivity to the feelings and needs of others. Girls' games encourage the development of a culture that emphasizes relationships over outcomes, and ostensible social leveling over trying to outdo others. Many girls' activities (such as playing house) do not have winners or losers. Girls' talk tends to center more on accommodations to others' feelings and needs through skillfully employed conversational strategies that mediate potential conflict.

In contrast, boys tend to play team games, such as baseball or football, that involve relatively large numbers and have winners and losers. Both team and individual achievement is paramount, and competitiveness and individual power are played out within the constraints of rules and hierarchies. Relationships in girls' games are replaced by outcomes in boys' games. Language is a way of asserting one's dominance. Boys' talk tends to be focused on ritualized conflict, jostling for position in the hierarchy, achieving goals, making things happen, solving problems, and appealing to rules that are imposed externally (that is, the rules are not negotiated from within the group but exist apart from the group, such as the rules of baseball), as well as arguing over their applications.

Sheldon's study (1993) of three- and four-year olds fighting over a play item (a plastic pickle) indicates that even at this early age the girls in this study tended to mitigate conflict and preserve harmony by compromise and avoidance of direct confrontation. The boys, on the other hand, prolonged conflict,

confronted each other directly, became more and more insistent, appealed to rules (unique to the boys' conflict), and made violent threats. Sheldon observes that her results are consistent with those of Miller, Danaher, and Forbes (1986), who observed 162 five- and seven-year olds and analyzed over 1000 conflict episodes. In that study, boys engaged in more conflict than did the girls, and their language was more heavy-handed and controlling (for example, "Gimme that!"). Girls mitigated conflict through negotiation more than did boys, and their discourse was characterized as more collaborative ("I'll trade you this boy doll for...").

In her study of school-age boys and girls, Haas (1979) reports that one of the differences in the use of language between the sexes is a male tendency to make direct requests and to give out information and a female tendency toward compliance. In a study of fifth-graders, Lever (1976) found that girls could not deal with quarrels that resulted in open conflict and, as a result, the groups broke up. As girls grow up, they learn increasingly subtle ways of dealing with potential conflicts before they erupt because they feel that open conflicts threaten the community. Goodwin (1980) found that girls avoid conflict and making overt criticisms since both can rebound against the instigator and threaten social relationships. Instead, they tend to hide themselves as the source of criticism by presenting it as coming from someone else or by making it indirectly through a third person.

The above research findings concerning gender-role acquisition and peer

interactions in sex-segregated games provide an account as to how and why women and men become enculturated into their respective discourse cultures. These findings also provided me with explanatory links connecting the gender effects I detected in my study to the social construct of gender communicative cultures.

A Characterization of Masculine and Feminine Discourse Cultures

Tannen (1990) characterizes the fundamental differences between the communicative cultures in which boys and girls grow up as follows. If boys have to become independent from their mothers, they must act from a position of opposition from her, and ultimately from others. There has to be a way of determining degrees of social independence, some criterion that allows a boy or a man to define himself in opposition to others. This criterion takes the form of how successfully he contends for status in various well-defined hierarchies, such as those found in boys' games. In this way one can determine whether one is subject to or independent from another and whether one must accede to or impose upon the will of another. Masculine culture, then, is based on asymmetrical relations (two people cannot both have the upper hand over each other), outcomes of contests, independence, and exercising power.

If girls, on the other hand, are to become identified with the gender role of their mothers, they must act from a position of closeness and association with her and ultimately others. Girls and women learn in their games to negotiate

complex networks of friendship, to minimize differences, to reach consensus, and to avoid appearing better than others. Relationships must be egalitarian in order to allow girls and women to negotiate for closeness in a web of intimate connections. A girl or woman will tend to accomplish what she wants based on the strength of her affiliations with others and by having others cooperate with her, rather than by imposing her will on others. Feminine culture is based on establishing symmetrical relations, connecting with others, and preserving closeness with a necessarily small number of intimates.

A Characterization of Masculine and Feminine Discourse Styles

Differences in communicative cultures lead to systematic differences in masculine and feminine discourse styles that Tannen characterizes in the following way. Most men are accustomed to using talk as a means of achieving status and preserving independence in a hierarchical social order, on the one hand, and avoiding being put in a subordinate position by others, on the other. Tannen describes the relation between the norms of masculine culture and the ways men use talk as follows:

This is done by exhibiting knowledge and skill, and by holding center stage through verbal performance such as storytelling, joking, or imparting information. From childhood, men learn to use talking as a way to get and keep attention. So they are more comfortable speaking in larger groups made up of people they know less well—in the broadest sense, "public speaking." But even the most private situations can be approached like public speaking, more like giving a report than establishing rapport (Tannen, 1990, p. 77).

Most women, on the other hand, are accustomed to using talk as a way of negotiating connection and closeness, of seeking and giving confirmation and support, and of reaching consensus with others, on the one hand, and of avoiding being pushed away or isolated by others, on the other hand. This means that women will tend to use talk as a way of displaying similarities and matching experiences in order to negotiate closeness. Women, then, are more accustomed to using talk in a manner appropriate for speaking to one or a few people they feel close to rather than in a manner required for more open, public forums. In addition, since one of the norms of feminine culture instilled from childhood is adherence to egalitarianism with a small number of intimates, women will tend to criticize female peers who try to stand out or appear better than others. Tannen (1990) uses the term report-talk (reflecting its connotation with public speaking) to characterize the masculine discourse style and the term rapport-talk (reflecting its connotation with private speaking) to characterize the feminine discourse style.

Having presented the cultural difference approach to gender discourse, my rationale for adopting it, and a characterization of the masculine and feminine discourse cultures, I turn to other research findings that have informed my study. These findings not only provide additional support for the cultural difference approach to gender discourse but also serve to further characterize the differences between the two gender communicative cultures. In addition, some of these findings establish connections between gender and the nature of small group

mathematical discourse.

Research Findings and Perspectives on Gender and Discourse

Regarding Conflict

Research has consistently found male speakers more likely to be competitive and to engage in conflict than females (Tannen, 1993); they tend to argue more, give more commands, and are more likely to take opposing stands. In their summary of research, Maltz and Borker (1982) observe that in the male communicative culture direct confrontation is normal since boys use language "(1) to assert one's position of dominance, (2) to attract and maintain an audience, and (3) to assert oneself when others have the floor" (p. 207). In the feminine communicative culture, on the other hand, direct confrontation and verbal aggressiveness are antithetical to the ways girls learn to use language, which are "(1) to create and maintain relationships of closeness and equality, (2) to criticize others in acceptable ways, and (3) to interpret accurately the speech of other girls" (p. 205). Tannen (1990) observes that one of the consequences of women's avoidance of verbal conflict is that because "girls do not learn to resist others' demands on principle and don't expect others to resist theirs on principle either" (pp. 154-155). That is, they are not accustomed to using language to gain and maintain a dominant position.

Based on their review of the literature, Maltz and Borker (1982) observe

that men and women interpret verbal aggressiveness differently. Women tend to regard overt aggressiveness as "personally directed, negative, and disruptive" (p. 213), whereas men tend to regard it as conventional way to organize and structure the flow of conversation. Another difference between the way women and men interpret verbal aggression and conflict is that men often use ritual aggression and mock attack as a way of establishing solidarity, and even of initiating friendships. Men's adversarial stances toward each other can be a way of showing respect, and playing devil's advocate can be a way of lending support (Ong, 1981; Tannen, 1990, 1993). Because conflict, competition, and verbal aggressiveness are not normative behaviors in feminine communicative culture, "women are inclined to misinterpret and be puzzled by the adversativeness of many men's ways of speaking and miss the *ritual* nature of friendly aggression" (Tannen, 1990, p. 150).

Regarding Control of Talk and Group Structure

Control of topics is related to the amount of talk produced by the participants in a group. The more a speaker talks, the more control he or she has over the topics of the discourse. In a review of 56 research studies appearing from 1951 to 1991 concerning gender differences in the amount of talk in adult interaction, James and Drakich (1993) found that men talked more than females, either overall or at least under some circumstances. The reviewers also categorized the studies according to whether the context of the research involved (a) formal tasks; (b) formally structured, non-task-oriented interactions; or (c) informal, non-task-

oriented activities. A formal task is an activity that takes place within a socially structured setting, such as a classroom, for the purpose of accomplishing some instrumental goal by coming to a joint decision. An example of a formal task is solving a problem in a small collaborative mathematics group where the group must come to closure with regard to a solution(s). An example of a formally structured, non-task-oriented activity is discussing various interpretations of a poem in a small collaborative English group. The talk of both the mathematics collaborative group and the English collaborative group occurs in a formally structured setting (a teacher-monitored classroom), but there is no expectation that everybody in the small English group should agree on the same interpretation of the poem (this is not to imply, however, that all mathematical problems have unique, correct solutions). An example of an informal, non-task activity is a group of teachers chatting in the luncheon room. James and Drakich report the consistent finding that not only do men talk more in both formal task and formally-structured, non-task-oriented contexts, but also that a greater percentage of men's speech consists of specifically task-oriented kinds of verbal behavior (even in non-task settings) such as giving information, offering opinions, and making suggestions. On the other hand, a greater percentage of women's speech consists of facilitating conversation and providing positive social-emotional support, such as agreeing, showing interest in what others are saying, and trying to draw others out. In contrast, the amount of talk produced by women in informal, non-task-oriented contexts was much more likely to equal or exceed that of the men.

However, even when women talk more frequently than men in groups, there may be a difference in the weight or importance the groups accord to men's and women's talk. In a study of college students conversing in small groups, Aries (1982) found that college women talked more frequently in small discussion groups than men, but men tended to take longer turns and to set the agenda by offering opinions, suggestions, and information that were followed or acted upon. Women tended to react by offering agreement or disagreement, rather than having their own ideas acted upon. The findings presented in the following section further corroborate and elaborate the differences between women and men regarding the control of the group's agenda.

Regarding Floor in Groups

One aspect of control in mixed-gender groups has been addressed by Carole Edelsky in her study, "Who's Got the Floor" (Edelsky, 1993). After reviewing the various definitions and uses of the notion of floor, Edelsky defines floor as the "the acknowledged what's-going-on within a psychological time/space" (Edelsky, 1993, p. 209). In a study of five faculty committee meetings (seven women and four men), Edelsky (1993) found that differences between the sexes could most clearly be discerned by distinguishing two types of floors: singly-developed floors and collaboratively developed floors. In singly-developed floors (one speaker at a time), the men dominated the construction of the floor by taking longer turns (though not more turns); in collaboratively-developed floors

(joint building of an answer to a question or collaboration on developing ideas), the number and length of turns for men and women were about the same. Moreover, women in collaborative floors joked, argued, directed, and solicited responses more and men less, which was the reverse of the situation in single floors. In other words, as Tannen (1990) observes about Edelsky's study, "women were less likely to participate when the situation felt more like report-talk, more likely to do so when it felt like rapport-talk" (p. 203).

In addition, solicitations of responses by the chair (a male) in single floors were concerned more with planning and clarifying points of information than they were in showing interest in another's topic, whereas response solicitations in collaborative floors, though often connected to plans, were combined with teases and word play, often uttered in tandem and often produced by women. Although Edelsky found that women were more comfortable speaking up in collaborative floors, she did not address the issue of how effective the women's increased verbal interactions were in furthering the task at hand.

Regarding Gender and the Nature of Discourse in Mathematics Groups

How a student asks a question relates to the kind of response the student receives. Requests that are explicit and direct are more likely to elicit elaborated, content-related explanations than those that are vague and indirect (Peterson, Wilkinson, Spinelli, & Swing, 1984; Webb & Kenderski, 1985; Wilkinson, 1985; Wilkinson & Calculator, 1982a, 1982b; Wilkinson & Spinelli, 1983).

In a study of above-average junior-high mathematics groups, Webb (1984b) found that boys tended to ask more specific and pointed questions than did girls and therefore were more likely to receive more elaborated, content-related explanations. In a study of second- and third-grade mathematics groups, Lindow, Wilkinson, and Peterson (1985) found that boys tended to give more justifications, evidence, or reasons during disagreements than did girls and were more likely to sway the group to accept a particular student's answer during episodes of dissension.

In an analysis of seventeen quantitative studies, Webb (1991) found the following significant correlations between the kind of responses students received to their questions in peer groups and their achievement:

1. There was a positive correlation between achievement in those groups in which students received elaborated, content-related explanations and the group members' individual achievement.

2. There was a negative correlation between achievement in those groups in which students received a lower level of help than was requested (e.g., asking for an explanation and receiving only an answer) and the group members' individual achievement.

Webb reports that these results were independent of mathematical topics and grade levels, showing a wide generalizability to various mathematics classrooms.

Webb (1984) found that groups with equal numbers of girls and boys did

not differ on any group interaction variable (e.g., giving, receiving, or asking for explanations; giving or receiving procedural knowledge), nor on achievement. However, in majority-male groups (three boys, one girl) girls were less successful than boys in obtaining help (the girl tended to be ignored). Likewise, girls in majority-female groups (three girls, one boy) were also less successful in obtaining help (girls directed their questions to the sole male, who tended not to answer their questions). Achievement followed the same pattern: boys outperformed girls in majority-male and majority-female groups, even though they did not differ in ability from the girls.

The evidence from research, then, strongly suggests that gender does indeed have something to do with the nature of small group mathematical discourse. Boys tend to ask more specific, direct questions that consequently elicit more adequate explanations. Boys tend to produce more justifications, evidence, or reasons during disagreements in the group, and to give more elaborated, content-related explanations, which, in turn, relate positively to achievement. In her review of the research, Webb (1991) observes, however, that many of these findings were from above-average classes; the situation in below-average classes is not as clear. Regarding gender composition of groups, girls are more likely to obtain answers to their questions in groups with equal numbers of boys and girls than they are when in groups with a predominance of either sex. The findings summarized in Webb's review are generally consistent with those James and Drakich (1993) reported in their review.

A Perspective on Giving Information

Experimental studies by Leet-Pellegrini (1980), Aries (1976), and Fox (1990), as well as those studies reviewed by James and Drakich (1993) and Webb (1991), suggest that men tend to give more information and explanations in formally-structured activities and groups. Tannen (1990) offers an account for why this might be so from the perspective of gender discourse cultures. In masculine discourse culture, information is a currency with which status may be purchased. The person who has information, says Tannen, is deemed to be more knowledgeable and competent, and therefore higher up on the hierarchical ladder. The giving of information is an asymmetrical act in that it situates the information-giver in a higher position of control and authority. Accordingly, the person receiving the information is placed in a subordinate position.

In feminine culture, on the other hand, the sharing of information can be a way of eliminating differences in knowledge and hence apparent superiority. Since women value connections and egalitarianism, they are motivated to minimize differences in expertise in order to maintain the appearance of similarity and equal status. This is not to say that women do not wish to feel knowledgeable or powerful, but they interpret the meaning of knowledge and power differently from men.

[Women] feel their power enhanced if they can be of help. Even more, if they are focusing on connection rather than independence and self-reliance, they feel stronger when the community is strong (Tannen, 1990, p. 68).

This difference in men's and women's perception of information and knowledge can affect the nature of the interactions in a mixed-sex group. Since men resist being placed in a lower position because of having less knowledge, they tend to resist receiving information from others, especially women. Accordingly, some women are cautious about giving information they possess to men in a mixed-sex group for fear of making men feel in a subordinate position, thus destroying the sense of community that women value in small groups.

Emergence of Meaning in Small Mathematics Groups (A Study)

This study is a 5-year collaborative research project conducted by a team of three American researchers, Paul Cobb, Terry Wood, and Erna Yackel, and three German researchers, Heinrich Bauersfeld, Götz Krummheuer, and Jörg Voigt. The team's research is reported in a book edited by Cobb and Bauersfeld (1995), the eight chapters of which were written by various members of the research team. Hereafter, this research project will be referred to as the "Cobb et al." study.

General Description of the Cobb et al. Study

The collaborators in the Cobb et al. study shared a common set of video recordings and transcripts of four pairs of second-grade students working together during 27 mathematics lessons conducted in a single classroom over a 10-week period from January to March, 1987. Although the interests and perspectives of

the researchers were varied, over the first three years of the project they developed a common basis for communication. The researchers concerned themselves with issues such as the reflexive relationship between students' mathematical activity and their group interactions, the reflexive relationship between the quality of students' explanations and the social situation in which they occur, the reflexive nature of the emergence of mathematical themes and individual student contributions and negotiation of meanings, the interactions between teacher and students in an inquiry classroom, the anatomy of mathematical argumentation, and the view of mathematical discourse as a specialized language game.

Underlying the Cobb et al. study is the assumption that an individual's mathematical learning in a small group is interactively constituted through the taken-as-shared meanings and themes negotiated in the group situated within the microculture of the classroom. Moreover, the social relationships that define and constitute the activities of individual students, the groups, and the microculture of the classroom are reflexively related to each other, meaning that not only do they mutually influence each other but that their very existence and nature depend upon all the others.

The study's underlying line of inquiry is to identify those conditions for group interactions that produce opportunities for learning for an individual's mathematical conceptual growth and that enable the individual to contribute to the development of taken-as-shared meanings in the group, which, in turn, again promote learning opportunities for the individual. The study's focus relevant to

the present study is on the reflexive interactions between individuals and the discursive practices of their small groups situated in the microculture of the classroom.

Group Norms and Interaction Conditions

The researchers found that the group social norms deemed necessary to promote opportunities to learn in small groups are constituted by the following obligations on the part of the group participants (Cobb, 1995; Cobb, Yackel, & Wood, 1995): (a) persisting to solve personally challenging problems; (b) explaining personal solutions to others; (c) listening to and trying to make sense of others' explanations; and (d) attempting to achieve consensus about an answer, ideally by means of a noncontradictory solution process in situations in which a conflict between interpretations or solutions has become apparent.

Additionally, based on their research findings, these researchers report that two characteristics of group interactions appear necessary for productive opportunities for learning in the group: (a) the development of a taken-as-shared basis for mathematical communication, and (b) the routine engagement in interactions in which no one in the group is an authority.

Taken-As-Shared Meanings and Mathematical Argumentation

Meanings ascribed to mathematical objects and concepts are taken-as-shared when they are negotiated to the extent of having become so compatible

that the group members discourse as if they ascribe the same meanings to the mathematical objects and concepts under consideration, even if an observer can reconstruct different subjective meanings for the individual group participants. This intersubjectivity concerning the objects of the mathematical discourse constitutes a working consensus amongst the participants rather than a content-related congruence of the participants' individually constructed meanings (see Glossary, Cobb & Bauersfeld, 1995).

The range of taken-as-shared meanings and understandings constitutes the extent of the consensual domain being developed in the group over time, the viability of which is evident when members of the group produce acceptable interpretations or act acceptably in particular learning or problem-solving situations (Cobb & Bauersfeld, 1995). The reflexive nature of the first research findings concerning the characteristics of group interactions necessary for productive learning (the negotiation of taken-as-shared meanings and the establishment of a consensual domain) and the second finding (the occurrence of routine engagements in which no one is an authority in the group) is elaborated through argumentation. Argumentation involves interactions in the group by which cooperating individuals attempt to adjust their intentions and interpretations in the group by orally presenting rationales for their actions through such discourse moves as explaining, justifying, illustrating, exemplifying, analogizing, and disputing (Cobb & Bauersfeld, 1995; Krummheuer, 1995). Not only is argumentation an important means by which a consensual domain is developed, genuine

mathematical argumentation is most likely to occur in groups in which no one person is an abiding authority.

Another important aspect of the nature of argumentation concerns the manner in which mathematical claims are established as valid or acceptable in the microculture of the classroom and this, in turn, can account for how a taken-as-shared basis for mathematical communication can be developed in learning groups. Argumentation does not proceed formally or axiomatically in the elementary classroom or in the college-level developmental classroom of the present study as would be the case in an advanced mathematics class. Rather, support for mathematical arguments is accomplished by a "convincing presentation of backgrounds, relations, explanations, justification, qualifiers, and so on" (Krummheuer, 1995, p. 236). In the absence of the development of taken-as-shared meanings through the logical stringency of a formal deductive process there is less likelihood that students will share precisely the same meanings concerning the mathematical objects and processes under discussion, even though they might act as if they do and even though they may come to the same acceptable conclusions. Krummheuer (1995) argues that this is possible because students can agree upon a correct association or inference (the warrant) between previously accepted data and a subsequent conclusion, but not have the same reasons or justifications (backings) for supporting that connection. The nature of college-level developmental students' explanations may vary then, some arguments appearing to conform more than others to the standards of the professional mathematics

community.

Types of Interactions

Based on his research findings, Cobb reports that differences in the types of interactions in which group participants engaged influenced the learning opportunities that arose for them (Cobb, 1995). This was apparent both when the group participants were in the process of working through a task as well as when one or more of the students had arrived at a solution for or resolution of a task. Cobb distinguishes two types of interactions that occur in the latter situation: those involving univocal interactions and those involving multivocal interactions.

Univocal interactions occur when the perspective of one child dominates in the group; multivocal interactions occur when two or more group members attempt to advance their perspectives by explaining their thinking and challenging those of others. In univocal interactions one student judges that another student either has made a mistake or does not understand something. These interactions appear to proceed smoothly without dissonance as the first student explains his or her thinking to the other, who usually responds if only in some minimal way. Opportunities for learning were observed only when the second student accepted the first student's judgment and fulfilled his or her obligation to listen to and make sense of the explanation. Those univocal explanations in which the listener did not fulfill this obligation did not usually give rise to learning opportunities for either the listener or the explainer (Cobb, 1995).

Multivocal interactions often occur when a conflict arises in the group because a student judges that another student's ideas are not correct and makes his or her judgment known. In contrast to a univocal explanation, however, the second student challenges this assumption by explicitly questioning the proffered judgment or explanation and perhaps forwards his or her own perspective. Cobb states that his analysis suggests that multivocal interactions were usually productive in those cases where the group had established a consensual domain that could serve as a viable basis for mathematical communication.

In those situations in which students were in the process of working through a task and had not yet arrived at its solution or resolution, Cobb again identifies two types of interaction: direct collaboration and indirect collaboration. Group members engage in direct collaboration when they coordinate their activities as they work independently on different subtasks (Cobb, 1995). Cobb reports that instances of direct collaboration did not usually give rise to learning opportunities. Indirect collaboration occurs when the group is working concurrently on the same task and one of the group members thinks aloud while apparently solving the task independently of the others, who, nevertheless, find something interesting in what is being said. That is, a student will talk to himself or herself in a lowered voice in such a way that there is no obligation for others to listen or respond, but they nevertheless monitor the monologue and capitalize on what they overhear because it happens to be significant for their ongoing activities at the particular moment. Cobb reports that instances of indirect collaboration

frequently gave rise to opportunities for learning.

Group Authority

Univocal interactions often occur because one student is accepted by the other group members as a mathematical authority. Opportunities for learning are restricted when an established mathematical authority judges that another group member does not understand and then fulfills his or her obligation to explain. In this case, listeners accept the proffered judgment without question on the basis of that person's authority. Moreover, not only are the listeners' opportunities for learning restricted in isolated instances, but a pattern of interaction develops in which the resulting power imbalance tends to cause others to habitually accept the mathematical authority's judgments in order for them to participate in the group interactions at all. Cobb states that not only are the listeners' opportunities for learning restricted, but those of the mathematical authority as well.

The group's acceptance of a mathematical authority is not the only cause for an imbalance of power in a group. A power imbalance can also arise when someone attempts to be or is allowed to be a social authority in the group. A social authority controls the way group members interact with one another and the way they talk about mathematics, including the way taken-as-shared meanings are constituted in the group, as well as whose interpretation of a situation prevails. A social authority need not necessarily be the most mathematically competent member of the group. Instances in which a social authority is established in

a group may give rise to inequities in learning opportunities.

Breakdowns in Group Communication

In addition to those mentioned above, there are other ways in which good group discourse may be inhibited or prevented. If group members do not uphold their obligations to the group norms, learning opportunities will be limited. For example, students may not have an abiding commitment to themselves to learn in the group or may not persist in attempting to solve challenging problems; they may not feel obligated to explain their thinking to others; they may not listen to nor attempt to make sense of others' explanations.

Difficulties in establishing taken-as-shared meanings in a consensual domain can inhibit good group discourse. From her analysis of the Cobb et al. data, Yackel (1995) cites some of the conditions in which these difficulties can occur:

1. Group members have differing taken-as-shared interpretations of a situation and are unaware of such differences. Hence, there is no apparent need for them to elaborate or clarify their ideas, and discrepancies are not resolved.
2. Group members differ in their understanding of what constitutes appropriate mathematical activity or what constitutes an adequate explanation. Some students, for example, might hold a purely instrumental view of mathematics in which reference to procedures alone provides an adequate explanation. Other students, however, seek more conceptually-based explanations and understandings

of on-going activities. The incompatibility of these students' belief systems concerning the nature of mathematical activity may be so great that they are not able to negotiate taken-as-shared meanings (see also Cobb, 1995).

3. Group members may not be able to articulate their thinking in a way that others can understand.

The following situations and discussions arise from the Cobb et al. case studies.

From (1) above, it appears that the establishment of taken-as-shared meanings alone is not sufficient to develop a viable consensual domain in which good mathematical discourse can occur. That is, it is not sufficient in all contexts that group members act as if they ascribe the same meanings to mathematical objects and processes. Voigt (1995) writes, "The participants interact as if they interpret the mathematical topics of their discussion as the same, although they cannot actually be certain that their subjective background understandings are consistent with those of the other participants" (p. 172). Taken-as-shared meanings have to emerge from a context in which argumentation (explaining, challenging, seeking out differences in viewpoints and reconciling them) is normative for the group's discourse. Otherwise, underlying contradictions or insufficient understandings may go undetected.

Moreover, the absence of an authority in a group does not ensure that learning opportunities will arise. Any of the above three conditions could hold in the absence of either a mathematical or a social authority if occasions for

either direct or indirect collaboration do not arise. Moreover, group members may habitually work independently of each other, checking each other's answers only after each has arrived at an answer, has given up, or cannot complete the task before the group begins comparing answers. Even when occasions for multi-vocal explanations arise as group members announce differing solutions, opportunities for learning may not occur because the participants have not established an adequate basis for mathematical communication by collaborating when arriving at their solutions. Hence, they have not negotiated the taken-as-shared meanings requisite for genuine mathematical communication. At this point, not knowing whose answer should prevail or why, the group turns to the teacher for an authoritative answer, which they accept without question.

Cobb writes that the American researchers were surprised to find their initial impressions about the productiveness of certain groups were incorrect, even though they had visited the classroom almost daily during the teaching experiment (Cobb, 1995). Both he and Voigt (1995) warn that learning how to participate successfully in group social interactions does not necessarily mean that mathematical learning is taking place. Cobb writes that "it appears that neither harmonious, on-task activity nor the mere occurrence of explanations are good indicators of interactions that are productive for mathematical learning" (Cobb, 1995, p. 125). To further explicate this statement, the following situations are abstracted from two of the Cobb et al. case studies called "Case Study--Holly and Michael" and "Case Study--Ryan and Katy."

One group member may consistently fulfill her obligation to help others in the group understand the tasks at hand. For their part, the other group members constantly accept or solicit her explanations, perhaps even before attempting the task themselves. No interpersonal disputes arise, there is talking in the group, and to casual appearances, the group is functioning most harmoniously and productively. However, the listeners are not assimilating the explanations nor modifying their own self-generated activities until taken-as-shared meanings are mutually negotiated. In this situation, the group's interactions are univocal and dominated by a mathematical authority.

In contrast, opportunities for learning and significant progress in mathematical learning can take place in a relatively contentious group, even when one of the members is more mathematically advanced. The reason why the interactions in such groups can be productive is that they are genuinely multivocal. The views of the more mathematically advanced member of the group are constantly challenged so that the group's interactions are characterized by justifications, arguments and counterarguments (Cobb, 1995). The more mathematically advanced member upholds her obligation to help others, and the others uphold their obligation to understand and make sense of the activities for themselves. This may result in frequent contentious exchanges. The more mathematically advanced member in the case study group in which this was observed regarded herself as the mathematical authority in the group; her partner, however, refused to concur with this view, continued to attempt to understand problems in personally

meaningful ways, and remained engaged with her (Cobb, 1995). She, in turn, frequently adjusted her explanations to accommodate his challenges, which gave rise to learning opportunities for her.

In summary, the literature reviewed in this chapter provided me the research base supporting my rationale for the analyzing group discourse in the context of gender communicative cultures. It also provided me specific findings regarding differences between women's and men's use of language in certain communicative situations, including small mathematics groups, as well as analytic constructs that informed my theoretical perspectives. I turn now to the development of the theoretical framework that underlies this study.

CHAPTER III

THEORETICAL PERSPECTIVES AND ASSUMPTIONS OF THIS STUDY

A Model of Good Group Mathematical Discourse

The work of Cobb and his colleagues described in the previous chapter provides the basis for a model of good group discourse against which a particular group's discourse may be compared. From that study, four group norms and two interactional conditions seem necessary for producing opportunities to learn for second graders working in pairs on mathematical tasks (Cobb, 1995; Cobb, Yackel, & Wood, 1995). These were listed in the previous chapter and with slight modification will serve as a model of good group mathematical discourse in the present study.

The expectation for group discourse is as follows: Good group mathematical discourse should result in all participants developing taken-as-shared mathematical meanings between them by means of mathematical argumentation as they interact moment to moment on mathematical tasks.

The Conditions for Good Group Mathematical Discourse

1. The dedication condition: commitment to the group effort and persisting to solve personally challenging problems.

2. The helping condition: explaining personal solutions to others.
3. The listening condition: listening to and trying to make sense of others' explanations.
4. The argumentation condition: attempting to achieve consensus about an answer through mathematical argumentation, and, ideally, to resolve any conflicts between interpretations or solutions by appealing to previously agreed to, established mathematical facts, procedures, or warrants.
5. The intersubjectivity condition: developing taken-as-shared meanings when talking about the mathematics under consideration.
6. The authority condition: the groups's agenda and interactional patterns are not determined on the basis of someone's authority or unilateral actions, nor are propositions accepted on the basis on group authority or consensus alone.

The first four conditions listed above (called group norms in the Cobb et al. study) are different in nature from the following two conditions in that they are more concerned with the obligations incumbent on each individual. Conditions 5 and 6 (called interactional conditions in the Cobb et al. study) are more concerned with interactions between the individuals in the group.

A Discussion of the Conditions for Good Group Discourse

Although the conditions listed above for good group discourse are quite similar to the Cobb et al. criteria for a group to produce opportunities for learning, there is a difference between what the two sets of criteria are intended to

accomplish. The Cobb et al. criteria describe the obligations incumbent upon individual group members as well as the regularized, stable patterns of interactions between group members that must be established and maintained in the group over time and must be continually reinforced by the microculture of the classroom in order to promote opportunities for learning. The conditions for good group discourse in this study constitute criteria that must be satisfied on a moment-to-moment basis if the participants' talk is to be considered good group discourse.

The difference in the purposes for which the criteria are employed in the two studies can be illustrated in the following way. Suppose one of the group members does not listen to others' explanations during a few minutes of a class period. The group can still be regarded by the Cobb et al. criteria as having successfully produced opportunities for learning during the period or over several periods if, by and large, the group's habitual ways of conducting its inquiries have fulfilled the criteria. In the present study, however, the group would fail to achieve good discourse during the period of time the individual group member did not fulfill his or her obligation to listen. Success, as determined by the Cobb et al. criteria, is determined over a period of time by means of established and regularized interactional patterns, whereas success in the present study is determined on a moment-to-moment basis. This does not mean, however, that the present study will not be concerned with making a summary evaluation of a group's success in achieving good group discourse during the entire period of time

the group worked together during the semester.

Condition 5, the intersubjectivity condition, may appear to be identical to the goal of good mathematical discourse itself. It is not identical, however, for at least two reasons. First, a taken-as-shared basis for mathematical communication can be developed because someone in the group is accepted as a mathematical authority and his or her ideas are uncritically, or even reluctantly, accepted by the other members during a particular sequence of verbal interactions. Nevertheless, the group members talk as if they ascribe the same meanings to the mathematical objects and processes under discussion. This contrasts to those sequences of interactions in which mathematical ideas are developed through a process of genuine mathematical argumentation as required by the goal of good group discourse. Second, a taken-as-shared basis for mathematical communication need not necessarily be developed by group members working simultaneously on a moment-to-moment basis, but rather by group members working independently of one another and then intermittently comparing results, which is contrary to the on-going collaborative nature of what constitutes good group discourse for this model.

The model conditions are reflexively related in that the existence and nature of each very often depend on the others. Under certain circumstances, these conditions interact in a quasi-ascending hierarchical fashion, where one condition cannot be fulfilled without others being fulfilled first. Under other circumstances, however, certain of the conditions can operate more independently of the

others. Their dependency on one another is demonstrated when, for example, a person fails to fulfill a certain condition and this failure then causes a chain reaction of other unfulfilled conditions, either by the same person or by someone who was not initially involved at all. The first of examples below illustrates how the conditions operate hierarchically and the second illustrates how they do not.

If interactional condition 5 (intersubjectivity, the development of a taken-as-shared basis for mathematical communication) is being satisfied in the group, then usually everyone would have persisted in fulfilling his or her commitment to understand (condition 1, dedication), explained personal solutions to others (condition 2, helping), and listened and made sense out of others' explanations (condition 3, listening). In this circumstance, the conditions behave in a hierarchical fashion in that an interactional condition could be satisfied only if each of the participants upholds his or her personal obligations to the group. However, the conditions at times do not form a hierarchical system as, for example, when condition 5 (intersubjectivity, developing taken-as-shared meanings) is attained in the group but a lower-numbered condition is not being fulfilled. This can occur when group members act as if they ascribe the same meanings to the mathematical object or processes under discussion (that is, they have negotiated taken-as-shared meanings) but, in fact, there are underlying differences between the group members of which they are not aware. As mentioned previously, that these differences go undetected may be due to the fact that condition 4 (mathematical argumentation) is not being upheld by the individuals in the group's discussions. That is,

because consensus was reached without the benefit of strong mathematical argumentation such as explaining, challenging, and seeking out differences in viewpoints, and then reconciling such differences by appealing to previously agreed to, established mathematical facts, procedures, or warrants, good group discourse is not achieved.

In addition, these conditions are reflexively related in that the existence and nature of each often depend on the others. This means that a person's failure to uphold one of these conditions may result in another condition not being upheld either by the same person or by another person who was not involved in the initial violation. For example, if person A makes no attempt to understand B's explanation (violation of condition 3, listening), but just copies down B's solutions, then B may no longer uphold her obligation to explain her solutions to A (violation of condition 2, helping). In addition, B may also be so upset that she responds only to direct, pointed questions. Moreover, not only are her responses short, they may offer little in the way of explanation (violation of condition 4, argumentation). To make matters worse, person C, who was not initially involved in these violations, observes this breakdown in communication, and may decide that it is not worth her effort to explain her personal solutions either (a violation of condition 2, helping).

Ethnomethodology: A Theoretical Component of This Study

Ethnomethodology and Conversation Analysis

As was mentioned in the Introduction, the Cobb et al. study is grounded in a school of qualitative analysis called "ethnomethodology." Since the model of good group discourse given above is based on this study and since other methodological aspects of the present study are based on the theoretical perspectives of ethnomethodology, a brief description of how various ethnomethodological tenets relate to the analysis of conversation is given below. Other aspects of the methodological approach to qualitative research as they relate to this study are presented in Chapter IV.

The central idea of ethnomethodology involves the relationships between norms, accountability, and shared understandings. The relationships between norms and accountability in conversation and how they are related can be illustrated by the following example. If someone we are acquainted with greets us with "Hello, how are you?" we feel compelled to respond as a matter of social convention. Although this reply-to-a-greeting norm is not a law of physics, such as gravity, to which we must conform, we do feel its pressure on us, the force of which ethnomethodology explains as follows. Our greeter is as aware of the rule of greeting as we are and if we choose to make no reply (though we are usually unaware of our decision) our greeter will immediately begin to wonder why we have not replied. That is, the greeter will attempt to account for our behavior

from a variety of possible explanations: Is he angry with me? Didn't he hear me? Is he deliberately ignoring me? Maybe he's merely distracted. We, of course, are also aware that this will go on in the greeter's mind even before we decide not to reply. So even if we are disinclined to reply, we usually do reply because we know we will be held accountable for our nonconformity and we likewise know there may well be sanctions of some sort placed upon us. So our interaction may not end with our failure to respond. Our greeter might well respond to our lack of response in any number of ways depending on the account he has constructed. His response then becomes temporally situated in a sequence of exchanges with us, each of which will, in turn, be interpreted, held accountable, and responded to by both of us.

In the above example, we can discern the reflexive nature of accountability. On the one hand, accountability urges us to follow a certain norm of conversational behavior in responding to a question; on the other hand, after we have displayed our response, either in accordance with the norm or in violation of it, accountability again acts, but this time acting on the listener/initial greeter (and potential next responder), urging him to either confirm or correct our displayed understanding of his initial utterance. If we have conformed to the norm as expected, he confirms our understanding by thinking nothing more of it, saying nothing more of it, or initiating a new conversational topic. In any case, we both have the shared knowledge of this exchange, even though it may be no more than that we know we have acknowledged each other's presence on this occasion. If

we do not conform to the norm, however, accountability is directed back to the initiator, that is, reflexively, and he is compelled to give an account for our violation. Reflexive accountability is a back-and-forth exchange of force exerted on successive speakers that propels a progression of communicative displays. It is through the interplay of norms and reflexive accountability that we come to share understandings in our conversational interactions.

We live and act in a social world of shared meanings and understandings even though we do not have access to each other's private understandings. We handle not being able to directly know one another's thoughts in a quite pragmatic way. We talk to one another under the assumptions that we are able to interpret one another's private meanings well enough to carry on our joint enterprises and, moreover, that any differences in our interpretations of one another's meanings most likely will surface in our subsequent interactions and can be resolved at that time. If no differences emerge, we assume that we have understood each other well enough for all intents and purposes. The mechanisms by which such differences in interpretations are made manifest are built into the way our interactions with one another progress according to the rules of conversation and our concomitant accounts of any violations of these rules.

The following example (adapted and expanded from Taylor and Cameron (1987, pp. 104-105) illustrates these concepts in practice. Suppose I hear you say, "Have you got [inaudible]ime?" I conform to the reply-to-a-request conversational norm by saying, "Sorry, I don't have a watch," thus making it manifest that

I understand you are asking for the time. The reflexive accountability mechanism of conversational interactions now affords you the opportunity to either confirm or correct my displayed understanding of your question. If you reply, "Oh, too bad," you will have confirmed my interpretation of your request for the time. If, on the other hand, you reply "No, not the time, a dime," you would have displayed an understanding of my misunderstanding as well as an understanding, of course, of your own initial utterance, and also provided, on your part, an opportunity for me to adjust my interpretation. I now reply in a friendly voice, "I've got a quarter." There is a sense in which I have nearly violated a norm, the make-a-relevant-response rule. But you quickly construct an account for my response, which you correctly take to mean that I do not have a dime and that I am offering you a quarter in its stead for whatever purpose you have in mind. And so meaningful conversation can continue now that our differences in understandings have been publicly displayed and accounts rendered for the differences. If, however, my first response to your inquiry had been, "Yes," I would have displayed my understanding of your question. If I say nothing more, however, you will undoubtedly construe quite a different account of my response. In this case, your account might be that I am playing the wise guy, or worse, deliberately refusing a small favor.

Taylor and Cameron (1987) aptly summarize the ethnomethodological perspectives on the previous examples:

By means of such a reliance of the reflexive accountability of actions

situated in a sequentially ordered progression, actors may 'display' their own understanding and correct/confirm those of their interactants, thereby coming to construct a shared understanding sufficient for the practical purposes of the interaction. This construction we will call the '(sequential) architecture of intersubjectivity' (p. 106).

The above view of how we constitute intersubjectivity between us is necessarily broad in its scope in that it is meant to account for all kinds of interactive talk about all kinds of subjects in all kinds of contexts, but as it stands it is ready made for ordinary, free-wheeling conversation. Mathematical discourse, however, is not ordinary conversation.

Ethnomethodology and the Mathematics Classroom

For the most part, in the traditional mathematics lecture classroom there is little true conversation that goes on between teacher and students and so any negotiation of meaning between them is not accomplished by sequences of alternating displays of knowledge, reflexive accountability, and mutual correction/confirmation. Bauersfeld (1995) provides an apt description of what many children encounter as they enter such mathematics classrooms, a situation that is undoubtedly replicated for many college students struggling with entry-level or developmental courses:

Children enter mathematics education at school with more or less well-developed mother tongue languaging. What is new, then? Mathematics opens a new perspective on the world. The interest is no longer with properties like type of material, use, color, importance, like and dislike, and so on. What counts is the answer to "how many?" Further, dealing with the different "how many" issues (numbers) develops into an exceptional situation (the math lesson) with special materials (representations), very

special manipulations and signs (operations and number sentences), and a related special language game. It is a very strict game with strange rules about what is allowed and what is not (pp. 284-285).

Bauersfeld goes on to say that official classroom communication in which the teacher does most of the talking proceeds in quite an orderly, correct, and acceptable fashion. The teacher, however, says Bauersfeld, has no direct access to students' minds and what they are making of all this, which all too often has little in common with what the teacher has in mind. One way to ameliorate this situation, given the exigencies of most classrooms, is to put students in groups, thereby allowing them to actively and meaningfully participate in a mathematics discourse community that offers them many opportunities to submit their ideas and inferences to the accounting and correction/confirmation procedures of group conversation.

Group conversation in the classroom, however, cannot proceed without constraints. Teachers have expectations for learning and for the way conversation should proceed in groups, some of which may be embodied in the model of good group discourse outlined above. Moreover, it is the fourth condition of the model in particular (mathematical argumentation) that distinguishes good group discourse in a mathematics classroom from good group discourse in other classrooms, such as an English or history classroom. It is mathematical argumentation that brings differences of interpretations of emerging meanings between group members into sharp relief.

The sequential construction of intersubjectivity in a mathematics group

situated in a particular classroom should ideally proceed in accordance with the established practices of the mathematical argumentation appropriate to the course being taught. That is, the accounts that participants give of each others' displayed knowledge must employ the kinds of warrants and backings appropriate to the level of mathematical sophistication habitually displayed in the spoken and written discourse of the teacher and in the written discourse of the course texts.

Ideally, the norms and conditions for interaction stipulated in the model for good group discourse must be upheld moment to moment as the group participants negotiate their interpretations through the sequential construction of intersubjectivity. The failure of group members to uphold any one condition or combination of these conditions contributes to the failure of the group in achieving understandings appropriate for the level of mathematical sophistication of the course.

A Model of Gender Discourse

I begin with brief definitions of a "norm" and a "communicative culture," followed by a discussion of the key theoretical constructs of this study regarding gendered communicative cultures and discourse styles.

A norm is a rule that guides behavior and that derives its force from accounts and/or sanctions. A communicative culture exists when a set of norms regarding how to communicate is shared by a group of people (Wood, 1994a, 1994b). Because children are socialized into different gender roles at a very early

age and throughout their formative years (Brooks-Gunn & Matthews, 1979; Chodorow, 1978; Eder & Hallinan, 1978; Eichenbaum & Orbach, 1983; Gilligan, 1982; Goodwin, 1980; Haas, 1979; Lever, 1976, 1978; Maltz & Borker, 1982; Miller, 1986; Miller, Danaher, & Forbes, 1986; Roman, Juhasz, & Miller, 1994; Savin-Williams, 1976; Sheldon, 1993; Wood, 1994a), there exist two different communicative cultures based on gender (Maltz & Borker, 1982; Tannen, 1990, 1993, 1994; Wood, 1994a, 1994b). Differences in these gendered communicative cultures lead to systematic differences in the ways men and women use talk.

The norms of feminine and masculine communicative cultures described below are not to be taken as completely exhaustive. That is, there may well be additional norms that define and constrain either or both communicative cultures. The ones given, however, are sufficient for the purposes of this study.

The Norms of Feminine Communicative Culture and the Feminine Discourse Style

The norms of feminine discourse culture pertain to establishing symmetrical, egalitarian relations with others, connecting with others, and preserving intimacy with others (Aries, 1987; Maltz & Borker, 1982; Tannen 1990; Wood, 1994a, 1994b). The following summary of the literature presented in Chapter II illustrates how these norms can operate in small groups: relations in small groups must be egalitarian (establishing symmetrical relations) in order for women to negotiate (connecting with others) for closeness (preserving intimacy) as they

interact. Women will tend to use talk in small groups to minimize differences between themselves, to negotiate for closeness, to reach consensus, to avoid conflict, to preserve harmony by compromise, to avoid direct confrontation, to avoid appearing better than others, and to avoid being pushed away or isolated by others. Women will be accustomed to using cooperative overlapping when talking with intimates in small groups as a means of displaying egalitarianism, connection, involvement, interest, and closeness. Talk will tend to focus on relationships over outcomes, will tend to reflect a sensitivity to the feelings and needs of others, and will tend to be concerned with seeking or giving affirmation and support. The ways women use talk to conform to the norms of the feminine communicative culture are collectively subsumed under the rubric feminine discourse style, and may be summarily characterized as rapport-talk (Tannen, 1990).

The Norms of Masculine Communicative Culture and the Masculine Discourse Style

The norms of masculine communicative culture pertain to determining one's position in various asymmetrical relations, seeking independence from others, contending for status in well-structured hierarchical activities, and exercising power (Maltz & Borker, 1982; Tannen 1990; Wood, 1994a, 1994b). The following illustrates how these norms can operate in small groups: since men are accustomed to the demands and constraints of participating in hierarchical activities and determining their position in asymmetrical relations, they will attempt to

establish clearly defined and delimited roles for themselves that will give them a measure of independence from others in the group. In addition, they will expect someone in the group to exercise authority and will be inclined to compete for that authority themselves and exercise it if they are successful. Men will tend to use talk in small groups to enable them to preserve independence, achieve status, to maintain control over their own activities, as well as those of others, and to avoid being put in a subordinate position by others. Men will be accustomed to one-speaker-at-a-time turn-taking in small groups as a means by which speakers display control and autonomy in the group and accrue status through conveying information during uninterrupted, extended turns. Their talk will tend to focus on outcomes rather than relationships or feelings. They will tend to favor one-at-a-time turn taking in conversation as a means of exerting control and autonomy, and of accruing status through conveying information in extended turns. The ways men use talk to conform to the norms of masculine communicative culture are collectively subsumed under the rubric masculine discourse style, and may be summarily characterized as report-talk (Tannen, 1990).

How the Norms of Communicative Gender Cultures Work

The following illustrates and expands the definition of a norm given above as it applies to communicative gender cultures.

Suppose a woman in a small group of people who have just met consistently and deliberately interrupts other participants' speaking turns in order to

make points in an argument; that is, she contends for the floor and takes it away from others. Almost immediately, others will begin to render accounts or reasons for her nonconformity to the norms of feminine culture for promoting egalitarian relationships, minimizing differences between people, supporting and affirming others, negotiating for closeness and consensus, avoiding appearing better than others, using talk to reach consensus, and preserving social harmony. She will in all likelihood meet with disapproval and be criticized or talked about when she is not present. At the very least, others will be puzzled by her behavior and try to find plausible explanations (accounts) for it—she is feeling irritable for some reason or perhaps her marriage has gone awry; at worst, she will be considered unfeminine by both women and men. If, on the other hand, the very same discourse moves had been made by a man in the group, there would be no accounts rendered for his behavior as such since such behavior is normative for masculine culture. While people may think his behavior is counterproductive, they will not impugn his masculinity.

On the other hand, if a man in a group of people who have just met were to allow another man in the group to repeatedly wrest the floor from him or to allow another to “walk over him,” people would immediately begin to wonder why he didn’t defend himself, his status in the group would immediately be brought into question, and people very well might treat him condescendingly. If this same thing were to happen to a woman, however, people would not wonder why she doesn’t speak up and fight back vigorously because her behavior does not

violate a norm of feminine culture and is, in fact, quite consistent with it. Therefore, no accounts for her behavior would be rendered.

The Relationship Between Norms, Discourse Style, and Group Discourse

Because discourse style has to do with the ways people talk in order to conform to the norms of their respective communicative cultures, our explanations of gender effects in a group must ultimately rest on the nature and role of the norms of communicative culture. It is, however, through behavior, particularly the verbal behavior of gender discourse, that we are able to detect not only the presence of the norms of gender communicative culture in group interactions, but also their effects on such. But the relationship between norms and style involves more than just a means by which a researcher can understand and analyze gender effects in group interactions. The relationship is truly a reflexive one for the following reason. Since language has so much to do with the shape and form of our thoughts and attitudes, changing the manner in which we use language, that is our discourse style, may well be one of the means by which we ourselves change, in some fundamental way, our normative behavior. Herein lies the possibility for pedagogical intervention in mixed-sex group discourse.

It is important to realize, however, that it is inappropriate to ascribe any particular linguistic feature to one or the other of the sexes without regard to the context in which it occurs (Tannen, 1994). Indeed, sometimes it is difficult to discern any difference between the verbal displays men and women produce in a

particular conversational setting. What may be different, however, is the speakers' intention or purpose for employing those verbal displays. Men and women often interpret the seemingly similar verbal displays they produce in a particular conversational setting in quite different ways due to the underlying differences between the norms of the communicative cultures which give rise to them. Such differences in intent or purpose may become evident to the inquiring observer only during the sequential construction of intersubjectivity between the speakers as they interact together. For example, it was pointed out in the last chapter that research indicates men tend to give out more information and provide more explanations in mixed-sex, formal-task group settings than do women (James & Drakich, 1993). Yet we might observe occasions where the men and women working on a problem in a group seem to give out equal amounts of information and produce an equal number of explanations. We must not assume, however, that there are no gender effects at work in the group just because we cannot discern a difference in discourse styles with regard to these particular linguistic features. What may be different about the giving of information and explanations between the men and women in this case is that the women may be doing so in order to lessen the difference of expertise in the group, thereby conforming to the norm of maintaining egalitarian relationships in the group, whereas the men may be doing so in order to position themselves as having more expertise, and therefore more authority in the group, thus conforming to the masculine norm of contending for status. This functional difference underlying an

apparently similar discourse feature, giving information, may not make itself manifest in the immediate context, but rather in subsequent interactions that reveal the presence of abiding male authority in the group, thus constituting a gender-implicated violation of one of the interaction conditions for good group discourse.

However, we may find upon close investigation of the interactions of the group in the last example that not only does there seem to be no difference between the amount of information and the number of explanations the men and women give but that there doesn't seem to be any abiding authority in the group, either male or female. In this case, we might investigate how the men and women in the group have accommodated their respective discourse styles to the opposite discourse style and how closely their discourse fits the model of good group discourse. Such situations may provide useful information for designing effective intervention strategies for groups that are not achieving good group discourse.

Having discussed the relationship between norms and styles of communicative gender cultures, we turn now to how gender discourse enters into the constitution of a group's discourse. One of the assumptions of this study is that when women and men enter the mathematics classroom and participate in a mixed-sex learning group, they do not leave behind the ways of talking to which they have been habituated all their lives by their respective gender communicative cultures. Moreover, it is to be expected that over a period of time certain regularities in the group's interactions will emerge and stabilize and that these regularities may

come about, in part, as the group participants make various accommodations to one another's gender discourse styles. Tannen cites research that indicates that men and women do indeed accommodate one another's discourse styles when in mixed-sex groups, but there is a difference in the degree to which they make such accommodations:

All these (and many more) studies show that male-female conversations are more like men's conversations than they are like women's. So when women and men talk to each other, both make adjustments, but the women make more. Women are at a disadvantage in mixed-sex groups, because they have had less practice in conducting conversation the way it is being conducted in these groups (Tannen, 1990, p. 237).

Since men and women are capable of adjusting their respective discourse styles in various ways in order to accommodate the opposite gender style, we may inquire in what respects, if any, individual group members have made such accommodations and to what effect. Under the assumption that men and women are conforming to their respective gender cultures as they interact in the group, of particular interest is the effect on group discourse of an individual who has not made accommodations in one or two key respects that are attributable to his or her gender discourse style. On the other hand, It is quite possible that some group participant might not display his or her "appropriate" discourse style in a group, that is, the sex of an individual might not correspond to his or her expected gender role in discourse, as in the example of the woman given in the preceding section. Because of the way norms operate in gender communicative cultures with regard to the accounts and sanctions people give to those who

violate the norms, it is unlikely that such a situation (e.g. when the woman's behavior and talk did not conform to the feminine discourse culture) would go unnoticed by the other group members or by an observer. The effects on group discourse of those persons for which there is a noticeable mismatch between sex and gender discourse culture are of interest and can be analyzed. Therefore, unless there is evidence to suggest otherwise, we may assume that the men and women in a group are attempting to conform to the norms of their respective gender cultures and will display their discourse styles accordingly; any exceptional behavior can be noted.

The Research Question Restated

The central question that has driven this study is the following: How might the gender discourse styles of men and women working in a small, mixed-sex group engaged in learning and applying basic algebraic/statistical concepts and skills be implicated in the failure of the group to achieve good mathematical discourse? We are now in a position to refine our central question.

A group fails to achieve good collaborative group discourse if, during the on-going, moment-to-moment discourse of the group, (a) anyone in the group fails to uphold the dedication, helping, or listening conditions of the model; or (b) consensus and conflict resolution are not achieved through mathematical argumentation (the argumentation condition is not being fulfilled); or (c) a taken-as-shared basis for mathematical communication is not being developed (the

intersubjectivity condition is not being fulfilled); or (d) the group's agenda and interactional patterns are determined on the basis of some group member's authority or unilateral actions (the authority condition is not being fulfilled).

Our research question may now be restated.

For college-level developmental mathematics students working in small, mixed-sex groups:

Is gender discourse implicated in a group's failure to achieve good collaborative mathematical discourse as defined by the model for good group discourse presented above? If so, in what ways and to what effect?

CHAPTER IV

METHODOLOGY

The Ethnomethodological Approach

The central tenet of ethnomethodology is that language is the primary medium through which we negotiate taken-as-shared meanings in our social interactions by way of reflexive accountability. That is, intersubjectivity is "an ongoing accomplishment, a set of understandings sustained from moment to moment by participants in interaction" (Holstein & Gubrium, 1994, p. 263). Moreover, the participants in a group must display their understandings, or lack thereof, to each other and correct/confirm those of others in order to propel the conversation and develop taken-as-shared meanings. Because these displays must be made observable to others in the group, the observer also has access to the participants' sequential development of taken-as-shared meanings. These perspectives, then, have a direct bearing on the kind of methodological approach employed by ethnomethodological studies that would undertake a close scrutiny of group conversation.

Ethnomethodologists gather data that can be analyzed later in minute detail, such as through audio- and videotaping. These tapes are often transcribed and analyzed via an intricate notational system that allows readers to view [conversational phenomena] to within one-tenth of a second (Adler & Adler, 1994, pp. 386-387).

The following overview of this study's methodology, as well the discussion of the specifics that follows it, comport, it seems to me, with the methodology of those studies described above.

General Description

I audio taped the discourse of four groups of developmental mathematics students during the spring semester of 1994. There were a total of 49 class periods during the semester and I began audio taping during the 11th period. In addition, I videotaped the 44th through the 49th periods.

There were 16 students in the class and I formed four groups of four students each. The group were formed randomly, the only consideration being that each group should contain both men and women. I was both teacher and researcher in this study. I collected various writings during the semester to supplement the audio data and conducted post-course interviews with selected students. After the course was over, I read all the collected writing, including my own field notes, and listened to selected tapes from all the groups. As a result of this preliminary analysis, I selected two groups for study and transcribed 32 of their sessions, 15 for one group and 17 for the other (one of these sessions was a group exam that the groups took near the end of the semester on May 6, the 46th period of the semester). I selected these groups, one consisting of two men and two women and the other of three women and a man, because on the basis of the evidence I had examined thus far it appeared that the former group might

be characterized by feminine discourse and the later by masculine discourse and thereby provide an interesting contrast.

After making the transcriptions, I began the process of categorizing various discourse and interactional features according to what I had found in the literature on gender studies and gender discourse described in Chapter II. During this process, I created the models of good group discourse and the gender communicative cultures described in the previous chapter. At the same time I developed codes that enabled me to segment and time various types of group interactions, which I call "floors," (described below) that permitted analysis of who was doing what and when. I coded the transcriptions of the two and a half hours of talk that occurred in the two group exams by floor type, which resulted in a total of 95 timed floors. I analyzed these floors for failed or successful discourse according to the conditions of my model for good group discourse. As a result, I began to discern certain gender effects, the nature of which, though generally consistent with the findings in the literature, seemed particular to mathematical group discourse. I then examined the floors in which the groups did not achieve good mathematical discourse for these gender effects, collaborating, supporting, and augmenting these findings in the context of the discourse I had collected and transcribed throughout the entire semester. The writings I had collected during the course were invaluable in helping me to discover and develop my analytic categories and to enable me to triangulate the data, as well as develop and correct my interpretations.

I chose to focus on the group exam in developing my analysis, in contrast to analyzing isolated episodes that had occurred throughout the semester, because the group exam would afford me the opportunity to demonstrate how the group functioned over a comparatively long interval of time in uninterrupted sequences of interactions. The reader could then more quickly and accurately come to know the participants and how they interacted, which would then provide a more comprehensive context for understanding the analysis. In addition, because the group participants would be more likely to make a focused and concerted effort than they would otherwise, it seemed to me that certain abiding and subtle gender effects might be more discernible than in a non-test situation. I could then examine the gender effects revealed by floor analysis during the group exam in the context of the entire semester, thus affording me the opportunity to demonstrate by way of similar situations and episodes that these effects were present in non-test situations as well. There are, however, certain methodological disadvantages in taking such an approach, which I will discuss in the concluding chapter. I turn now to some of the details of the methodology.

The Students

My subjects were white, college-level developmental mathematics students at Calvin College in Grand Rapids, Michigan. Calvin is a suburban, predominantly white, private, residential, four-year liberal arts institution of about 3800 full-time students. Several sociocultural characteristics of my students (most of

whom entered Calvin in the fall of 1993) can be discerned by comparing them to those of entering freshmen in all four-year colleges that participated in the 1993 freshman survey by the Cooperative Institutional Research Program at the University of California in Los Angeles. This survey is conducted annually and comprises students' self-reported responses to a number of questions. The results I report are found in The American Freshman: National Norms for Fall 1993 (Astin, Korn, & Riggs, 1993).

One of the distinguishing characteristics of entering Calvin students is that 90% of them come from intact families, that is, families in which the parents are living with each other, compared to 72% of all students entering four-year colleges. In addition, the political views of entering Calvin students are markedly middle of the road and conservative compared to all students entering four-year colleges (85% to 68%), though less far right (1% to 3%).

The mothers of Calvin women tend to be better educated at the B.A. and M.A. levels than are those of all entering four-year college women (78% to 68%), though their degrees are taken more in the helping professions, such as teaching and nursing, than are non-Calvin mothers. Entering Calvin women are less likely than are all entering four-year college women to be concerned with receiving recognition from colleagues (41% to 55%), more likely to want to raise a family (81% to 72%), and less concerned about being very well off financially (28% to 68%). Entering Calvin women are strongly opposed to making abortion legal compared to all entering four-year college women (14% to 62%).

The above statistics suggest that the entering class of 1993 of which my students were members was socially and politically conservative and committed to the family. Moreover, it seems likely that they were as comfortable with the traditional gender roles, if not more so, than their non-Calvin peers.

The Research Classroom

Description

The college had determined that my students should be placed in a developmental mathematics course based on their ACT scores, high school work (mathematics courses taken and grades received), and a college-developed placement test. Developmental students' ACT math scores usually range from 16 to 19. All my students had completed at least one year of high-school algebra and one year of geometry (or the equivalent). The content of the course was arithmetic and basic algebra. Although students receive letter grades in the course, the grades are not figured in the students' GPAs. If students fail the course, however, they are subject to dismissal, though students are rarely dismissed solely as a result of failing this course. When students fail the course, they must successfully complete a self-paced computer-aided course.

Class time consisted of brief lectures (also audiotaped) in conjunction with small-group work in which students worked together solving problems that I wrote on the board. There was no text for the course, though students received

handouts on occasion. Each student had a TI82 graphing calculator and used it extensively throughout the course. For about five minutes at the end of each period students wrote in learning logs, which I read, wrote responses in, and returned the following period. Throughout the semester, I talked to the class about how to work in groups and monitored their group work by having the students respond daily in their learning logs as to how their groups were functioning.

A Discussion of Content in the Developmental Classroom

Students discussed and solved a variety of basic arithmetic, algebraic, and statistical problems throughout the semester from the following topics: decimals, percents, fractions, the solution of linear equations and systems of linear equations, slopes, equations of lines, graphs of lines, functions, frequency distributions, histograms, means, weighted means, medians, boxplots, standard deviation, counting problems, probability, and geometric probability. The students used TI82 graphing calculators extensively throughout the semester for each of the above topics.

Although these topics may be considered somewhat typical of developmental courses, it can be argued that the nature of the content in such courses is not, a priori, conducive to good mathematical discussions. Much of this content, with the possible exception of the statistical topics, is normally presented at the pre-college level and, as taught in many courses at the college level, could be considered a condensation of what Richards (1991) calls "school math" (p. 16). The

school math context, says Richards,

does not encourage the student to question, to challenge, and thus to learn anything about real mathematical behavior. In contrast, inquiry-based activities provide ownership of ideas, and allow the student to construct ideas (p. 30).

Based on my experience of having taught these topics over a number of years in a variety of contexts, I would point out that while Richards' assessment may, on the whole, be accurate, I do not believe that the above topics per se preclude good mathematical discussion. Even if the content of the research classroom were entirely procedural, which it was not, procedural moves, such as algebraic manipulations, can constitute genuine argumentation if the participants have negotiated taken-as-shared meanings regarding their use in the development of a solution. In his analysis of mathematical argumentation, Krummheuer (1995) writes that "in such calculational-related activities, the process of getting a conclusion and that of producing a supporting argument coincide" (p. 232). That is, procedural moves constitute supporting arguments for conclusions. Nevertheless, even though procedural moves qualify as argumentation, the question as to whether such argumentation constitutes good or desirable discourse remains to be addressed. My response is that it depends on the microculture of the classroom in which the topics are discussed and how a consensual domain is developed. Again, Richards provides an apt characterization:

In a consensual domain in which communication occurs, each participant must respond to the other. The changes that are required to adjust the participants to each other entail that each participant in the domain must be prepared to learn. This is the real indicator that the nature of the

discussion is genuine" (Richards, 1991, pp. 30-31).

By not using the kind of text that is normally found in developmental classes and by restricting the amount of lecturing I did, my students were encouraged, if not compelled, to communicate with each other and to construct their own mathematical ideas, however falteringly. The resulting discussions were, as Richards would have, genuine. In addition to using group work as the primary mode for establishing communication in the microculture of the research classroom, I also attempted to displace the traditional lecture classroom by having students communicate in writing, both on a daily basis in their learning logs as well as in occasional reflection papers (described below).

In these ways, I hoped to avoid a classroom culture in which I would merely transmit a collection of facts and procedures to which students would respond in some rote fashion. Rather, I sought to draw students into authentic conversations in which they could question and challenge each other. As will become clear, not all students at all times achieved good mathematical discourse for a variety of reasons, some of which I will argue are implicated with gender. Nevertheless, all of the students at various points during the course did act mathematically in ways that demonstrated they were truly, perhaps for the first time, constructing mathematics for themselves. Based on the evidence, it also seemed clear to me that these students welcomed the opportunity to participate in discussions with their group colleagues as they sought to understand the kinds of problems that had been at the root of their frustration and defeat in school

mathematics. Although the details of students' participation of good mathematical discourse are of vital concern to mathematics educators, the purpose of this study is to discern how gender might be implicated in students' failure to achieve good mathematical discourse, which should also be of concern to mathematics educators. As a consequence of the purpose of this study, therefore, it was necessary to focus on students' failed discourse. I will revisit, however, the issue raised above concerning the relationship between the nature of the mathematical tasks in which my students engaged and their failed discourse in the concluding chapter. I turn now a discussion of my roles as teacher and researcher in the study.

My Roles as Participant and Observer

One of the main advantages in being both participant and observer was that I was able to control events in the classroom. Because I was the teacher, I was not only able to determine the organization of the material, but its pacing as well, each of which had direct bearing on the groups' discussions. There were further ramifications, however, to having control as both teacher and researcher. By reading the students' learning logs collected on any particular day, I was able to adjust my lesson plan for the following period in such a way as to accommodate students' concerns and learning needs, which contributed, I believe, to better group discussions that were, in turn, captured in the recordings. In addition, I could make on-the-spot judgments during class itself as to whether I thought the students needed more time in their group discussions or whether it was time to

move on. I could also control the amount of teacher talk in the classroom in order to allow the students' voices to be heard instead of my own voice. Moreover, I could control the frequency and timing of teacher interventions in the groups' interactions and make decisions as to whether the students should work things out for themselves or whether they needed help in order to make further progress. In these ways, it seemed to me, I obtained better and more extended quality talk from the students than might otherwise have been possible.

There were some disadvantages, however, to being both participant and observer. For one thing, it was far more difficult to teach and, at the same time, deal with the mechanics of recording than if my roles had been separate. I lost, on occasion, some of the groups' conversations due to the mechanical failure of the recording equipment, of which I was unaware, due to the demands of conducting the class, until the end of the period (fortunately this happened rarely). Apart from the mechanics of conducting the research, there were also occasions when I was not able to observe the groups as closely as would have been possible if I had been an independent observer. This was due to the fact that I had to attend to teaching matters, my primary responsibility, such as writing on the board, attending to a particular group's needs, or mentally organizing what should happen next. I also felt that it would make the groups uneasy if I, as nosy observer, walked about from group to group with my notebook in hand scribbling down observations of the groups' interactions while at the same time supposedly attending to their learning needs. This meant that I often had to make mental

notes that I would jot down in my teaching notes at opportune moments during class or immediately after class. Although this usually did not pose serious difficulties, I am sure that there were interesting interactions that I was not able to observe as a result.

The Data

My teaching log, students' learning logs, individual exams, group exam, student reflection papers, and interviews supplemented the taped data. These data are described below.

My teaching log contained my lecture notes, problems that I wrote on the board for the groups to work, student writings that I had copied from the blackboard, interesting group interactions that I was able to record as I observed and assisted the groups, and any questions that I had asked the students to respond to in their learning logs. I also made notes of any interesting responses students made in their learning logs as I read them each day.

During the last five minutes or so at the end of the period, students wrote responses in their learning logs to the following questions. All but the second remained the same each day.

1. What did you do today? (material covered, events that took place during class, etc.)
2. A question of the day. Students might have worked a short problem, or I might have asked their opinion as to the pace of the course, or to relate any

specific problems they might be having.

3. How are the groups working for you? (Are your questions being answered or are you being ignored? Are people going too fast, too slow, about right?)

4. Is there anything else I (the teacher) should know about? This question was intended to keep the lines of communication open between me and the students.

Upon receiving their graded individual exams, students were asked to reflect upon their thought processes when they took the exam. They were to address each problem in some way and note any conflicts they had with themselves over a particular problem, or if they had considered any alternate approaches, and to recall, if they were able, anything from their groups that influenced their thinking. They were also to note their successes, as well as any solutions they were particularly proud of. These writings gave me an indication of the way the students thought about mathematics, their concern for it, the way they approached problems, and a sense of their expertise that might provide a useful perspective on their gendered discourse style in their groups.

Similarly, upon receiving their graded group exams, students were asked to reflect upon their perspectives of what had happened as the group moved through the exam, noting any conflicts, disagreements, anything that disturbed them during the process, any personal reservations about the answers arrived at, and whether any particular people seemed to carry the discourse along at various

times or, on the other hand, hinder it.

In their group experience reflection paper, students were asked to give their overall impression of their experience of working in the group over the semester. This provided the opportunity for students to summarize any dissatisfactions or concerns, as well as any positive experiences. This data provided a check on my impressions of how comfortable the students, in general, had been in their groups and, specifically, with the discourse styles of other group members.

After the course was over, I was able to interview two students, a woman and a man, from each group. From these partially structured interviews I was able to ascertain that none of the students had any contact with each other outside our classroom. I also asked them who they considered to be the mathematical and social authorities in their groups.

Defining and Coding of Floors

Since gender effects must manifest themselves during progressions of conversational exchanges, the identification of such progressions is more manageable if there is some way of classifying hundreds and hundreds of conversational exchanges into a relatively few interactional categories. These categories, which I call "floors," are adaptations and extensions of analytic constructs developed by Edelsky (1993) and Cobb (1995).

As mentioned in Chapter II, Edelsky distinguishes two types of floors: singly-developed floors (one speaker at a time), and collaboratively-developed

floors (collaboration in developing conversational themes). Although collaboration in groups should ideally involve collaborative floors, Edelsky's distinction between two types of floors in group talk suggests possibilities for further distinguishing collaboratively developed floors in terms of whose voices are constituting the collaboration on a moment-to-moment basis and what their roles might be in the conversation.

In his analysis of the conversation of pairs of second-grade students working on various arithmetic tasks, Cobb (1995) characterizes certain of their conversational sequences as instances of univocal explanation or multivocal explanation. During the process of repeatedly analyzing the transcripts using my initial categories, it occurred to me that other constructs could be devised that would further characterize all of a group's conversational interactions into sequences of conjoined floors, each conveying information about the speakers and the roles they are playing in the unfolding of the conversation, especially with regard to the group's negotiation of meanings (e.g., someone in the group has a solution and is explaining it to someone else, or no one has a solution but the group members are either singly or jointly developing one, or there is a disagreement in the group resulting in a particular person's viewpoint prevailing in the dispute).

Immediately following is a description of the various floor constructs developed for this study along with their respective codes, after which the "joints," those interactions constituting the transition from one floor to the subsequent floor, are explained. A brief coded example of a conversational segment is then

presented.

Basic Floor Types

The basic floors types are univocal, multivocal, leading voice, equivocal, reluctant responder, group management, working, off task, and no floor. There is a major distinction between univocal and multivocal, on the one hand, and leading voice and equivocal floors on the other. The univocal and multivocal floors occur when at least one member in the group has a solution to, or an understanding of, a particular task or subtask, and articulates it. Leading voice and equivocal floors occur when no one has a solution and group members are engaged in the process of seeking a solution or an understanding. In the discussion below, the letters A,B, C, and D represent the names of various speakers in a group.

Univocal Floor (UVF)

A has a solution or understanding and proceeds to explain it to B, who doesn't have this understanding. This floor may be initiated because: (a) A perceives that B doesn't have the understanding and so A undertakes to fulfill his/her obligation to help others; or (b) B, who doesn't have the understanding, makes a request for an explanation, which A undertakes. This floor does not necessarily terminate because B now understands A's explanation; A may lead B through the understanding of more than one problem in a row, thereby sustaining the floor.

The univocal floor codes are as follows:

- UVF:A-B A is making an explanation to B. Only B's voice is heard in response during the interchanges, or other evidence indicates that A is specifically directing his/her explanation to B. Other people in the group may be participating by listening.
- UVF:A-{B,C} A is making an explanation to B and C. Both B's and C's voices are heard during the interchanges.
- UVF:A-G A is making an explanation to the other members of the group, G. Either all the other members' voices are heard at some point during the interchanges or no other voices are heard to the effect that the A's explanation is directed to the group as a whole.

Multivocal Floor (MVF)

At least two people have different understandings and argue for their positions. This floor commences when a position is advanced that will be contested.

The multivocal floor codes are as follows:

- MVF:A>B A and B are arguing and A persuades B.
- MVF:A>{B,C} A persuades both B and C.
- MVF:{B,C}>A Together, B and C persuade A.
- MVF:A=B A and B argue, but neither persuades the other.
- MVF:A={B,C} A argues against B and C, who hold the same position, but no one persuades anyone else.

Leading Voice Floor (LVF)

No one in the group has a solution, but A leads the inquiry and A's perspective is predominate during the interactions. This floor commences when A assumes leadership or is asked a question that precipitates his/her leadership. This floor does not necessarily terminate because people now have a common understanding or arrive at a solution; A may lead people through the inquiry for more than one task in a row.

The leading voice codes are:

- LVF:A-B As A leads, only B's voice is heard during the exchanges.
- LVF:A-{B,C} As A leads, both B's and C's voices are heard.
- LVF:A-G Either all the other members' voices are heard at some point during the interchanges or no voices other than A's are heard (which has the effect that A's explanation is directed to the group as a whole).

Equivocal Floor (EVF)

No one has a solution and everybody participates in the inquiry. Although the group members may contribute in varying degrees to advancement of the inquiry, nobody's perspective dominates. The floor commences when the first person begins the inquiry. This floor does not necessarily terminate because a solution to a single problem is found; the group may operate with this floor

through more than one task.

The equivocal floor codes are as follows:

- EVF Everybody's voice is heard at least once in the discussion
- EVF:{A, B} A and B are participating and neither voice dominates; the other group members' voices are not heard, but subsequent evidence suggests that they were listening.

Reluctant Responder Floor (RRF)

C has an understanding, or is assumed to have an understanding by at least one other group member, but does not assume leadership in explaining it to anybody. A attempts to further his/her understanding by asking C questions, to which C briefly responds with little elaboration. Since C's answers are not satisfactory, A must ask further questions in order to draw C out. C must be asked at least two questions in the interactional sequence in order to constitute this floor. The floor commences with a question from A to C.

The reluctant responder floor codes are as follows:

- RRF:A->C A is the questioner; C is the reluctant responder.
- RRF:{A,B}->C A and B both question C, the reluctant responder.

Group Management Floor (GMF)

Group members discuss some aspect(s) of managing their interactions, which may involve such things as agreeing what to talk about or dealing with

social discord. This floor begins with the first group management discourse move.

Working Floor (WF)

There is either tape-recorded and/or written evidence that group members are writing in their notebooks or on their group exam papers and/or working with their calculators, all at the same time and on the same task more or less independently. Conversation may not occur or may be restricted to a few desultory remarks as the students work. The floor commences when: (a) statements of intention to work at a specific task are made, the implication being that it will be for a limited time (as contrasted to a declared intention to work independently of the group); or (b) silence is intermittently broken by sporadic asides indicating that all the participants are involved in working out mathematical or calculator operations. The floor terminates when another floor is initiated.

Off Task Floor (OTF)

Group members are not discussing the mathematical task at hand, nor are they making group management moves. Most often the talk may be recognized as "socializing." The floor commences when the first off-task remark is made that is followed by other off-task talk.

The off task floor codes are as follows:

OTF All voices in the group are heard participating in the off-task talk.

OTF:{A,B} Only A's and B's voices are heard participating in the off-task talk.

No Floor (NF)

This floor is the default floor for those interactions that cannot be included under any of the floors above or in any of the variations of the basic floors described below. This is most likely to occur when the interactions of the group participants are not cohesive enough to categorize.

Floor Length

A floor must persist for at least one-tenth of a minute. This minimum duration for a floor was determined as follows. After applying the floor codes to hundreds of lines of transcribed conversation without regard to duration, I found that none of the floors persisted for less than one-tenth of a minute. Apparently, interactions lasting less than .1 min. are not of sufficient duration for patterns to emerge, nor do they seem long enough, in my judgment, to create the psychological sense of a floor. In either case, it is doubtful whether interactions less than .1 min. would prove very useful for interactional analyses in which the units of study are beyond the sentence level. For the two and a half hours of group conversation to which floor codes were applied in this study, there were a total of 95 floors, of which only one persisted for as briefly as .1 min. The average floor length was a little over 1.5 min. and the maximum length was 5.6 min.

Variations of the Basic Floor Types

Before describing variations of the basic floor codes, further notation must be developed.

Further Notation

Let F , F_1 , and F_2 denote different floors.

The notation $F \setminus B\text{-Ind}$ means that B is working independently of those members of the group who are involved in constituting the floor F . Other than the fact that B 's voice is not heard during F , there is clear evidence reconstructed either from recorded statements made by the group members previous to, during, or subsequent to F , or from student writings, that B is not participating in the floor F being constituted by the other members of the group.

The notation $F \setminus D\text{-NON}$ means that as the floor F is being constituted, D makes nonparticipatory remarks.

The notation $F_1 \setminus F_2$ means that two floors are occurring simultaneously. There is clear evidence from the recorded speech that two people in the group are constituting F_1 and the other two are constituting F_2 .

Variations of Floor Codes

UVF:C-{A,D} \ B-Ind	C makes an explanation to both A and D while B works independently.
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MVF:{A,D}=CB-IND	Both A and D are arguing with C while B works independently. A, D, and C do not convince each other before the floor ends.
LVF:C-A->B	While C leads A in an inquiry, B is asked questions to which he gives brief replies but does not participate in the inquiry with C and A.
RRF:{A,D}->C->B-IND	A and D query C, a reluctant responder, and C queries B, who is working independently of everyone, but who responds briefly to C's query.
EVF:{C,D,A}<-B-IND	As C, D, and A constitute an equivocal floor, B, who is working independently of everyone, interjects an inquiry that is unrelated to the topic under discussion in the equivocal floor.
EVF:{C,A,D}<-B	Although B is not working independently of C, A, and D, who are constituting an equivocal floor, B is not participating as an equal with the others, but is asking questions that indicate that he does not understand what is going on and that he is merely copying the others' answers.
LVF:D-A\GMF:{C,B}	D leads A in an inquiry, while C and B are involved in a joint group management floor.
LVF:C-A\OTF:{D,L}\B-IND	In a group consisting of A, B, C, and D, C leads

A in an inquiry, while D engages L, a person in another group, in an off-task conversation. B is working independently of everybody.

EVF:{C,A}\D-NON\B-IND

C and A are engaged in equivocal exchanges concerning a particular mathematical topic while D makes remarks that are unrelated to the topic under discussion and B works independently of A, C, and D.

Joints

A joint is a demarcation between a given floor (the first floor) and the floor immediately succeeding it (the second floor) that separates the speech belonging to the first floor from the speech belonging to the second floor. The following example excerpted from the transcript of the actual conversation of one of the groups illustrates the demarcation of an equivocal floor from the succeeding univocal floor. The joint is denoted by a broken horizontal line: ----. The transcription notation used in this study is given immediately below followed by the example.

- |_ indicates simultaneous speech occurring within the same floor
- \ indicates simultaneous speech occurring from different joint floors
- > indicates that the speaker's utterance will be continued in a subsequent line or that the speaker's utterance is a continuation of his/her speech from a previous line

[] indicates incomprehensible talk

. . . indicates a pause of a second or more

. marks sentence-final falling intonation

_____ underlining indicates that the speaker is emphasizing the underlined words

Example:

EVF

[ETC]

1 Mr. J Why is this? Why do...multiply by...

2 Ms. K That. I don't-uhm-concerning c.

3 Mr. L So we set ca minus c equal to bd minus b . Right?

4 Mr. J Just a minute. I'm still on the first step. I can't do it. I don't understand what you guys are saying. That doesn't make sense to me.

UVF:L-J

5 Mr. L What doesn't make sense?

6 Mr. J You're reading something like ca minus c .

7 Mr. L | _ Okay

[ETC]

In 1-4 above (and from previous conversation not present here), Mr. J, Ms. K, Mr. L, and Ms. M are constituting an equivocal floor while solving an equation. No one has yet solved the equation, though Mr. L suggests a step in the solution process at 3. Although Mr. J expresses his incomprehension at both 1 and 4, it is at 4 that he specifically questions Mr. L's procedural move at 3, at which point Mr. L offers to help at 5. Mr. J's speech occurring immediately above the joint line belongs to the equivocal floor, and Mr. L's speech immediately below the joint line belongs to the univocal floor in which he explains his move to Mr. J.

The Issue of Reliability and Validity of Floor Codes

The coding of floors in this study has not been subjected to an interrater reliability test and, as is the case with any classification scheme, we would expect differences as to how various analysts might categorize certain segments of conversation. If statistical hypotheses tests based on floor codes were being made in this study, it would be important to establish a high interrater reliability index for the floor coding. Such statistical claims, however, are not being made in this study, nor would they be particularly relevant to the kind of claims I will be making. That is, it is not of critical import to this study that I have classified a particularly problematic segment of conversation as an equivocal floor, whereas another analyst might have classified the same segment as a leading voice floor, or that I have classified another segment as no floor, whereas someone else might have classified it as an off-task floor. Floors are constructs through which both researcher and reader can learn something about the complexity of how meanings are negotiated in small mathematics groups as the reader observes and reflects on the available evidence as it is presented and interpreted by the researcher. Not only might there be occasional differences between how the reader might have interpreted a particular segment and the way the researcher has interpreted it, but also that there would be, in all likelihood, a very high degree of overall agreement between their interpretations. The question for the reader is then "What can I learn from this analysis that I can apply to my own teaching or my own

research?" I submit that what can be learned from this study is a way of observing and reflecting on not only the evidence one might collect from one's own research, but also on what one sees daily in the classroom, as to what is good group mathematical discourse and how gender may be implicated in the failure of groups to achieve good mathematical discourse.

I would argue, then, that the central issue with floor coding has not so much to do with reliability, but rather with validity, usually defined as the extent to which an instrument or coding scheme measures or classifies what one thinks it is measuring or classifying. When defined narrowly in terms of a measuring instrument, validity has more to do with testing in quantitative research than it does with my use of floor codes in an ethnomethodological study. Nevertheless, any genre of research must be concerned with validity, the correspondence of what a study does to what it purports to deal with. Ary, Jacobs, and Razavieh (1990) observe:

Validity is a more important and comprehensive characteristic than reliability. It is also more difficult to determine. Published research studies often report much more reliability data than validity data. That is because validity is not obtained so directly as reliability. Much more subjective judgment is required in assessing the validity of a measuring instrument. . . All of these matters involve judgment and the gathering of data from many sources (p. 286).

That is, an analyst often must have some knowledge of how a group has interacted over time in order to understand the nature of a particular sequence of interactions. Moreover, this knowledge is derived not only from listening to the students talk in their groups, but also from other data sources, such as written

comments in learning logs, or from exams and homework, or from face-to-face conferences or interviews. In summary, the issue of reliability of floor codings is embedded in the issue of the study's validity, which is demonstrated by the coder's knowledge of a group's interactions over a period of time derived from many data sources. What is transportable from my study to studies conducted by other researchers/teachers (transportability being one of the primary reasons for concerns about reliability and validity), is not so much the specifics as to how my particular students interacted with each other but rather how group mathematical discourse can be analyzed and interpreted by teachers and researchers similarly immersed in the microcultures of their own particular classrooms and research sites. Although it is to be expected that settings, students, curricula, and even the researchers/teachers themselves will produce variations in observations and findings across various studies and classrooms, it is also to be expected that certain gendered sociolinguistic patterns will, in all likelihood, make themselves manifest across these same sites. It is the recognition of such patterns, or even the recognition of the possibility of their existence, that is the value of studies such as this one.

Indirect Collaboration and Egocentric Speech

As mentioned in Chapter II, indirect collaboration occurs when group member thinks aloud or talks to himself or herself in a lowered, though perfectly intelligible, voice in such a way that there is no obligation for others to listen or

respond. Nevertheless, overhearers monitor the monologue and pick up or comment on what they overhear. Egocentric speech is thinking aloud to oneself in a lowered voice or whisper that often is not intelligible to other groups members or an observer. Egocentric speech is not proffered for the benefit of others, but is a self-regulatory activity.

I documented instances of indirect collaboration and egocentric speech as they occurred not only during the group exam, but also as they occurred in the recorded data throughout the semester. Based on the evidence found in this study, I will argue that indirect collaboration might be one of the ways that men adjust their discourse style in order to accommodate women's speech.

Good Group Discourse and Correctness

Before we begin the analysis of the transcripts of the group exams, it must be pointed out that when we make decisions as to how to segment the transcript into the various floor codes, we are not to take into consideration the mathematical worth or correctness of the various individuals' contributions in furthering the solution process. We are only interested in the nature of the interactions that group members have constituted when we classify these interactions by the various floor criteria. Whether or not the group achieves good mathematical discourse during any particular floor is an issue that must be addressed separately. Moreover, even when addressing the issue of whether good mathematical discourse has been achieved, correctness *per se* is not taken into consideration. That is, we do

not disqualify group discourse from being good group mathematical discourse because it contains mathematical errors. For example, someone may correctly apply a particular procedure in a solution process but make a mistake in executing it, a mistake that no one in the group notices. As a result, the group negotiates taken-as-shared meanings through mathematical argumentation that are incorrect, all the while satisfying the model conditions for good mathematical discourse. There is more than error involved, however, in not ruling out the possibility of good mathematical discourse on the basis of its lack of correctness. Good group discourse involves constituting situations for explanation (cf. Yackel, 1995, p. 150), situations in which someone in the group offers explanations in an attempt to clarify his/her thinking for others and in which the listeners make an attempt to understand these explanations. Based on the evidence from the Cobb et al. study, Yackel (1995) writes:

[C]onstituting a situation for explanation neither requires nor implies the development of a viable solution. Conversely, the development of a viable solution does not imply that a situation for explanation is constituted (pp. 159-160).

Hence good group discourse does not necessarily result in correct mathematical results, though, for the most part, such will be the case, nor do correct mathematical results have to be attained through good group discourse. This position is consistent, in general, with the ethnomethodological approach to the study of social interactions:

[The analyst focuses] on how members accomplish, manage, and reproduce a *sense* of social structure. Analysis centers on the properties of practical

reasoning and the constitutive work that produces the . . . appearance of a stable reality, while resisting judgmental characterizations of the "correctness" of members' activities (Holstein & Gubrium, 1994, p. 264).

Floors and Good Group Discourse

The analysis of a group's success in achieving good group discourse will proceed according to whether or not the group's discourse satisfies the conditions for good mathematical discourse as specified by the model for good group discourse presented in Chapter III. Group discourse that satisfies the conditions for good mathematical discourse should result in all participants engaging in the development of taken-as-shared mathematical meanings between them by means of mathematical argumentation as they interact moment to moment while working on mathematical tasks. Since the development of taken-as-shared mathematical meanings requires progressions of verbal displays, reflexive accountability, and mutual correction/confirmation, floors offer natural constructs by which to analyze a group's success in fulfilling the conditions for good group discourse, particularly with regard to the sequential construction of intersubjectivity. Floors are "natural constructs" for such an analysis because they identify the roles of group participants as they interact together for the purpose of accomplishing various mathematical tasks. That is, floors are designed to characterize various kinds of socio-communicative interactions in which participants engage as they go about negotiating meanings in the sequential construction of intersubjectivity with regard to the mathematical task at hand. Floor analysis captures, then, both the

participants' talk and their interactional roles as they go about shaping and being shaped by their conversation, which is one of the defining characteristics of the ethnomethodological approach to conversation analysis with its "emphasis on talk-in-interaction (rather than talk and interaction) [parentheses in original]" (Holstein & Gubrium, 1994, p. 265).

All floors, with the exception of working floors that evidence no verbal displays, contain within them sequences of utterances that reveal whether or not the participants are engaged with each other, whether or not they are developing taken-as-shared mathematical meanings, and finally, whether or not these taken-as-shared meanings have been achieved through the fulfillment of all the conditions of the model. However, since floors are designed to cover all conversational sequences the group undertakes, and not just those sequences in which group participants further the discussion of mathematical tasks, group talk in certain kinds of floors cannot be considered good mathematical discourse on a priori grounds. These floors are off-task floors, no floors, group management floors, and IND floors (a member working independently of the group). Although participants involved in off-task floors and no floors certainly negotiate taken-as-shared meanings of some kind, they do not negotiate taken-as-shared mathematical meanings and hence the floors constituted by such negotiations cannot be considered as sequences of good group mathematical discourse. IND-coded floors indicate that not all the participants in the group were jointly engaged in developing taken-as-shared meanings, and hence the negotiations in such floors cannot be considered

as qualifying as good group discourse. Since group management floors involve conversation regarding either the handling of the group's interactions or how the group should proceed in its work, the talk in such floors is not directly involved with the mathematical task itself. That is, group management discourse occurs at a level removed from the task itself and hence cannot be considered good group mathematical discourse.

The exclusion of these floors from the attainment of good group discourse on the grounds that all the members of a group must be engaged in the conversational development of meanings concerning the mathematical task at hand is admittedly strict. It is quite conceivable that the constitution of certain of these excluded floors could be considered necessary, in certain circumstances, for the group to function smoothly. That is, a group may need to break away from its work in order to relieve rather serious social tension, or to relax from a particularly intensive sequence of interactions, or perhaps the group needs to find its bearings in a complex procedure, or perhaps its members need to perform some individual calculations in order to work through a procedure. These considerations point up the fact that discourse which is not considered good group discourse cannot necessarily be regarded as useless or irrelevant talk. Although it lies beyond the scope of this study, judgments could be made on a case-by-case basis as to which of these floors might be considered as constructive in the development of good group discourse. Having made these caveats, however, my observation is that, for the most part, such floors do not constitute good group

discourse and are often indicative of a failure to satisfy one or more of the conditions for good group discourse. Therefore, these floors will have to be analyzed with regard to possible gender-discourse related effects.

CHAPTER V

ANALYSIS

Overview

This chapter is organized in the following way. I categorize the interactions that each group constituted during the group exam by floor types, after which I present excerpts from the participants' post-exam reflection papers. I summarize the gender effects that I found in each group in the context of the interactions it had constituted throughout the semester, supporting my analysis with evidence from transcripts, my teaching log, the students' learning logs, the students' reflection papers, and the interviews. I then analyze the floor codes as to the extent of these gender effects during the group exam, how these effects relate to the types of floors the groups constituted, and how these effects relate to the conditions for good group discourse that the groups violated. I present further details below regarding my analytic procedures before undertaking the floor analysis for each group.

Floor analysis must accomplish two tasks. First, it must determine whether or not the group achieved good mathematical discourse during the floor under consideration and, second, whether any gender discourse effects are implicated in the failure of the group to achieve good discourse. I arrived at my conclusions

concerning gender-implicated violations of the conditions for good group discourse (stated below) inductively, that is, through reading the transcripts over and over, both of the group exams themselves as well as those taken over the entire semester's work, and noticing certain gender discourse patterns that seemed to me to be implicated in the breakdown of good mathematical discourse. Accordingly, evidence for my findings is contained in both my detailed analysis of the group exams as well as in my summary analysis of the group's interactions over the entire semester in which I contextualize the group-exam interactions. In order to facilitate my exposition, I have identified those floors in which I am claiming gender discourse is implicated in the group's failure to achieve good mathematical discourse as the floor analysis unfolds, even though not all the evidence supporting my claims has yet emerged, and adequate explanations linking my claims to gendered discourse cultures will have to wait. That is, instead of going through a detailed floor analysis in which I accomplish my first task alone, identification of those floors in which discourse fails, and then going through the entire analysis again, this time separating those failed floors in which gender is implicated from those failed floors in which it is not implicated, I have elected to tag gender-implicated floors as I accomplish my first task, deferring the gender analysis, my second task, to the subsequent sections in which I am able to gather together my evidence from the group exams, relate this evidence to the entire semester's interactions (so that group exam interactions are not seen to be uncharacteristic of the group's normal interactions), and provide a rationale as to why I believe these

patterns are implicated in gender discourse in accordance with my theoretical framework. This procedure will give the reader, I hope, a sense of the inductive nature of the analysis while enabling me to present the results efficiently. At the same time, this presentation underscores the ethnomethodological approach to conversation analysis upon which this study is based. As Adler and Adler write,

Their [ethnomethodological conversation analysts'] end goal has been to build upward from a base of language and communication to understand the nature of roles, relationships, and social norms in settings and thereby discern the underlying structure of social reality (p. 387).

Below is a reiteration of the conditions for good mathematical group discourse, a list of the gender effects I have found that seem to me to be implicated in the failure of a group to achieve good discourse, and three examples of the connection between the two that also illustrate the point above as to how the analysis will proceed.

The conditions for good group mathematical discourse are:

1. Commitment to the group effort and persisting to solve personally challenging problems (the dedication condition).
2. Explaining personal solutions to others (the helping conditions).
3. Listening to and trying to make sense of others' explanations (the listening condition).
4. Attempting to achieve consensus about a proposition through mathematical argumentation (the argumentation condition).
5. Developing taken-as-shared meanings when talking about the

mathematics under consideration (the intersubjectivity condition).

6. The group's agenda and interactional patterns are not determined on the basis of someone's authority or unilateral actions, nor are propositions accepted on the basis on group authority or consensus alone (the authority condition).

The gender discourse interactions that I have found implicated with the failure of a group to achieve good group discourse and that I will further elaborate in this chapter are these:

1. Men's strict adherence to the norms of the masculine discourse culture can give rise to difficulties in achieving intersubjectivity in the group.

2. Adherence to the norms of the feminine discourse culture can give rise to women's avoidance of mathematical argumentation for the sake of group harmony and consensus.

3. Women are more likely to defer to the authority of the group or to the authority of another group member should they avoid mathematical argumentation in the belief that argumentation disrupts group harmony and consensus.

4. Women's avoidance of mathematical argumentation may exacerbate their feelings of helplessness, particularly if these women hold the belief, attributable, in part, to their membership in the feminine communicative culture, that mathematics is a meaningless language game in which outcomes are determined on the basis of authority.

The following examples illustrate my method of tagging gender effects as

I analyze group discourse.

In floor 2 of the group 1 floor analysis, Mr. B begins to withdraw from the women, becoming involved with his own thoughts processes rather than participating in the moment-to-moment joint argumentation of the women led by Ms. C. I write that this floor cannot be considered good group discourse because of Mr. B's gender-implicated violation of condition 5, intersubjectivity. Here I tag Mr. B's actions as gender related without offering any explanations for doing so, though I devote an entire section to this matter after presenting repeated instances of similar actions by Mr. B, along with their effects on the group's interactions, not only during the exam itself but also during the semester. In brief, I will attribute Mr. B's withdrawal (and of the other men in the study as well) to his strict adherence to the norms of the masculine discourse culture.

In floor 13 of the group 1 floor analysis, Ms. D merely copies the steps to a solution without understanding the underlying processes leading to the solution. I write that this floor does not constitute good group discourse and that Ms. D's actions constitute a gender-implicated violation of condition 6, authority. Although I do not at this point explain my reasons for why I associate Ms. D's actions with gender, I present here a brief sketch of the argument that I will more fully develop in the subsequent section when dealing gender effects in group 1: If one believes that mathematics is a meaningless, rule-driven game whose purpose consists solely of obtaining correct answers and if one does not appreciate that mathematics involves processes in which one's convictions concerning

propositions are secured through explanation and argumentation, then one is more susceptible to the sway of various kinds of authority. Moreover, if only the women express such beliefs in this study and if the actions of only the women are found to be consistent with such beliefs, the evidence suggests a gender effect (the explanation for such in terms of the feminine discourse culture I defer at present).

In the subsequent floor, Ms. C And Mr. B dispute the validity of a certain algebraic move. Ms. C does not sustain her argument with Mr. B but concedes the point of contention, though she remains unconvinced, in the interest of maintaining group consensus and harmony. I write that her actions constitute a gender-implicated violation of condition 6, authority. If one avoids mathematical argumentation because argumentation is conflated with dispute, which in turn is perceived through cultural conditioning to be disruptive of harmonious group relations (highly valued in feminine culture), then one is susceptible to accepting results on the basis of either group consensus or someone else's authority. Again, only the women in this study conceded a point on the basis of group harmony, whereas the men never did so throughout the entire semester. The evidence suggests, therefore, a gender effect.

The reader will notice that I repeatedly point out all instances of the use of direct address (e.g., "John, what are you doing now?") in the groups' discourse. I found that direct address was a discourse marker that invariably indicated that a group was experiencing difficulty in achieving intersubjectivity during the exam. Although its use is not associated with gender, it is nevertheless

something that I could not help but noticing and therefore I include it in my study as a secondary finding.

During the analysis, I occasionally state that someone is considered to be the mathematical or social authority in the group. My knowledge of such is based on individual post-course interviews with group participants as well as on their reflective writings. A social authority in a group is one who exerts considerable control over the group's agenda apart from the force of his or her mathematical argumentation, e.g., the person who typically calls the group back to task after the group has engaged in off-task conversation, or the person who alone calls the teacher to the group when the group is having difficulties with a problem. An observer of a group's interactions over a period of time may come to hold a different opinion as to who is the actual (as opposed to the perceived) mathematical or social authority in a group. I have distinguished my opinion from the group participants' opinions when they differ.

As I have mentioned previously, group management floors will not be considered as constituting good group discourse unless there is sufficient evidence to the contrary and working floors will be considered as constituting good group discourse unless there is sufficient evidence to the contrary. Off task floors and no floors will also not be considered as constituting good group discourse. Joint floors will not be considered as constituting good group discourse unless there is sufficient evidence that taken-as-shared meanings are being developed in each of the constituent floors. Therefore, I do not mention the discourse status of the

above-mentioned floors during the analysis unless there is sufficient contrary evidence. In those floors occurring in group 1 in which Mr. B works independently of the women (a gender-implicated violation of the intersubjectivity condition) I analyze whether or not the women's talk (usually the only talk heard on such occasions) constitutes good group discourse. This enables me to analyze the discourse of an all-female subgroup within the larger group, though such a subgroup will not function, as we shall see, in the same way as if the man were never present to begin with.

As I proceed with the analysis of the floors that occurred in each group exam, I present the codes for such so that the reader may refer to the sequential list of floor codes for each group for the entire exam in Appendices A and D as the narrative unfolds. In addition to the floor codes, these appendices contain the running time at the beginning of each floor, the length of each floor, the number of the exam problem the group was working on during the floor (the group exam is contained in Appendix E), whether or not the group achieved good group discourse during the floor and, if not, which condition was violated, as well as whether gender was implicated in the failure. Providing a floor code during the narrative (usually given at the beginning of the analysis of a floor) also enables the reader to anticipate who is doing what and to anticipate the nature of the interactions that will be described during the floor. In addition to the floor codes for group 1 (Appendix A), Appendix B contains the floor codes for group 1 when Mr. B was engaged with the women and Appendix C contains the floor

codes for the women's subgroup when Mr. B was working independently. As I indicated above, this should facilitate the analysis of the two modes in which this group operated.

I need to make one more clarifying remark before undertaking the floor analysis of the exam. I was not present during the exam so as to preclude any interference on my part in the groups' interactions. The period before the exam I publicly designated Mr. L (from group 2) as the class monitor whose responsibilities would be to advise the students when the period was drawing to an end and to take care of collecting the recording equipment and the exam papers. There is no evidence that this affected Mr. L's involvement or status in his group.

Analysis of Group 1 Floors

The group participants are Ms. A, Mr. B, Ms. C, and Ms. D, three women and one man.

The exam is to commence at 9:00 A.M. Ms. D, however, has not yet arrived when the tape recording begins at 9:08. Mr. B thinks that the group should start working without Ms. D. Ms. C concurs: "I do, too. She can catch up, although not copy." Ms. D's tardiness, a not-infrequent occurrence throughout the semester, along with her propensity to copy others' work, initiates Ms. C's annoyance with Ms. D that is to persist throughout the exam. Ms. C has anticipated the latter's behavior in an entry in her learning log on April 29, the day the group exam was announced in class. She writes, "I think a group test will be good, if

we all work together, not having people let others do the work.”

The group, minus Ms. D, begins work at 9:09 with floor 1, a leading voice floor coded LVF:C- $\{A,B\}$ \D-ABS. Ms. C effectively leads in the development of taken-as-shared mathematical meanings toward a solution to the first problem. Ms. A and Mr. B listen and contribute to the development of these ideas, helping to shape them with sound procedural mathematical argumentation. The group achieves good mathematical discourse during this floor. At the end of the floor, however, Ms. C notices that Mr. B has begun to withdraw from the conversation and attempts to draw him back by using direct address:

- 1 Ms. C What'd you get? Wh-Wh-Wh-Wh-what'd you get for your answer, [B]?
----- [joint between floor 1 and floor 2]
- 2 Mr. B What?
- 3 Ms. C What's your answer?

That Ms. C has to repeat her question to Mr. B in line 3 is further evidence that he is becoming involved in his own thought processes rather than participating in the moment-to-moment joint argumentation led by Ms. C.

These exchanges initiate floor 2, a slightly different leading voice floor from floor 1, coded LVF:C-A->B\D-ABS. Although Ms. C again leads in the development of ideas, this floor differs from floor 1 in that Mr. B only volunteers one contribution to the argumentation, his other remarks having been pointedly solicited by Ms. C. Ms. A listens and contributes to the development of ideas. This floor cannot be considered good group discourse because there are clear signs that Mr. B is beginning to have further difficulty with developing taken-as-

shared meanings with the women on a moment-to-moment basis, a gender-implicated violation of condition 5 of the model, intersubjectivity. Problem 1 is completed during this floor and problem 2 just begun when the floor is ended because of Ms. D's arrival at 9:11.

Floor 3, a group management floor coded GMF, is initiated with Ms. C's arrival. She apologizes for being late. Mr. B replies: "No problem--we've only done one problem." Ms. A likewise does not seem very upset with Ms. D, allowing her to begin copying from her paper what the group has done so far. Ms. C makes does not respond to Ms. D's late arrival, but in her post-group exam reflection paper she writes:

Our group did not work well together on our test. One member showed up late after we had already worked through problems 1 and 2. She copied them instead of working them out. This also happened throughout the entire test. I did not mind helping someone, but I do mind doing all of their work.

In defense of Ms. D, we note that she writes in her post-group reflection paper:

I was feeling terribly sick that day and had been up all night with the flu. I believe that effected [sic] me largely on the part of communicating with my group.

Ms. D is also heard complaining about her physical discomfort later on in floor 8.

The group management floor ends and the next floor begins with Ms. A's direct address to Ms. C concerning a procedural move for problem 2. Floor 4 is a reluctant responder floor coded RRF:A->CB-IND,D-IND, in which Ms. A

probes Ms. C, the reluctant responder, and in which Ms. D is busy copying the group's work. Mr. B is now working independently of the women. Ms. A presses Ms. C for the answers to each of the initial steps in the process of clearing off the fractions in the equation in problem 2. The group is not jointly engaged during this floor; hence, the group also fails to achieve intersubjectivity. Even if it weren't for Mr. B's working independently, a gender-implicated violation, the women are not jointly engaged because Ms. D is working independently as she copies the answers.

Ms. C ends the floor with a direct address to Mr. B, asking him for an intermediate result in the solution to problem 2. Mr. B replies that he has not gotten that far yet. These interactions precipitate floor 5, a no floor, in which everyone is focused on something different. Ms. D is still copying, Ms. A is trying to get Ms. C to help her, and Ms. C is trying to get Mr. B to help her. While she is copying, Ms. D addresses Ms. A directly, asking for an explanation for a particular step. Ms. A does not respond to Ms. D, but directly addresses Ms. C, asking if she may see her work. Ms. C fends off Ms. A's request.

- 1 Ms. A [C], can I see your's a minute?
- 2 Ms. C Uhm, but I don't know if I have it right. That's why I have to wait until [B] gets further
- 3 Ms. A |_ But
- 4 Ms. C |_ But what? [spoken rather aggressively]
- 5 Ms. A I just want-I need to []
- 6 Ms. C I don't know if the second one is right.
- [joint between floors 6 and 7]
- 7 Ms. A When you multiplied, you told me the things right [referring to a previous exchange]
- 8 Mr. B I'm not sure about that.

- 9 Ms. C It has to be by 6. 'cause that's the least common denominator [Ms. C's explanation continues from here]

In line 2, Ms. C attempts to engage Mr. B with a bid for his help after a rather testy response to Ms. A's inquiry. After her explanation in line 9 and a brief series of exchanges with Ms. A and Ms. D (who by now has caught up to the group), she again tries unsuccessfully to involve Mr. B in the women's negotiations for meaning with a direct address to which Mr. B gives nothing more than a minimal response. During this floor (6), a rather lengthy univocal floor coded UVF:C-{A, D}\B-IND, both Ms. A and Ms. D respond to or challenge each detail of Ms. C's answers and explanations. If it weren't for Mr. B's lack of engagement, this floor would be considered good group discourse. The floor ends with Ms. C making an indirect bid for Mr. B's attention while talking to the other women, this time successfully:

- 1 Ms. C No, there's no fraction. That's what I have, but you might watch what [B] says.
 ----- [joint between floors 7 and 8].
 2 Mr. B I'm not sure about that one.
 3 Ms. C What aren't you sure about?

3.6 minutes have lapsed between Mr. B's two declarations of uncertainty (floor 7 line 8 and floor 8 line 2) during which the women have jointly elaborated a partial solution process to the problem and during which Ms. C has made both an indirect and a direct bid to get him to attend to their negotiations. Now that she has his attention, Ms. C explains her solution in detail to him in floor 7, a joint univocal and equivocal floor coded UVF:C-B\EVF:A,D, while Ms. A and

Ms. D can be heard collaborating on writing out the details. Mr. B contributes significantly to Ms. C's explanations by working through the steps with her and verifying her results. The floor ends with the conclusion of the discussion of problem 2. All during this floor Ms. C is very cheerful and upbeat, in contrast to her tone in previous floors. This floor constitutes good group discourse, even though there are two subgroupings of people, for the reason that each of the constituent floors constitutes good group discourse and each contributes to the group's arriving at taken-as-shared meanings.

Floor 8, a no floor coded NF, begins with Ms. D describing her illness. The floor proceeds with a mix of talk concerning problems similar to problem 3 interspersed with Ms. D's continuing talk of her illness. The floor ends with the commencement of floor 9, a group management floor coded GMF, initiated by Ms. A's direct address to Ms. C in line 2 below:

1 Ms. C I don't like this kind of problem 'cause I don't know how to do it.
----- [joint between floors 8 and 9]

2 Ms. A [C], you can't do this problem?

3 Ms. C I'm stuck.

Ms. C turns to Mr. B, addressing him directly, trying to get him to help. His response at line 4 is strikingly irrelevant:

1 Ms. C [B], we're on the next problem.

2 Mr. B Right.

3 Ms. C Are you working on that one?

4 Mr. B Good.

Mr. B's comment occasions an unintelligible remark followed by a soft laugh from one of the women. If Mr. B had been engaged with the women, this particular floor would not have occurred. It is, then, a gender-implicated floor.

In floor 10, an equivocal floor, coded EVF, everyone participates, including Mr. B. This floor is notable because both Ms. A and Ms. D contribute significantly in carrying the problem forward, something they have not done before. Nevertheless, despite the fact that the floor constitutes good group discourse, the group gets stuck, thereby terminating the floor and precipitating floor 11, a group management floor coded GMF, in which the group discusses whether they should continue on and then come back to it later. The floor terminates with Mr. B's offer to work on it by himself:

- 1 Mr. B I'll work on that on for a while 'cause I know what to do with it.
----- [joint between floors 10 and 11]
- 2 Ms. C Okay.

This is first instance in which the group splits up by agreement, or at least with the concurrence of Ms. C, the mathematical and social authority of the women's subgroup (Mr. B considered himself to be the mathematical authority in the group). Since Mr. B knows what to do with the problem, he should, from the perspective of good group discourse, lead the women in a collaborative effort. But Mr. B's interactional style, a result of his adherence to the norms of the masculine communicative culture and a gender-implicated violation of condition 5, intersubjectivity, is to work independently on a problem and then intermittently report to the group what he has found, what I call his "reportorial style." Ms. C, as we shall see, becomes resentful of Mr. B's way of working, but defers to his way of working (social authority) for the sake of group harmony, which is a gender-implicated violation of condition 6, authority.

If it weren't for the fact that Mr. B is disengaged in the next floor (12), a leading voice floor coded LVF:C-A,D\B-IND, it would constitute good group discourse for the women. Although Ms. C leads the discussion, Ms. A and Ms. D verify each of her steps as she works toward the solution of problem 4. The floor ends when Mr. B interrupts with his announcement that he has solved problem 3.

In floor 13, a univocal floor coded UVF:B-G, Mr. B reports his results by reading the steps in his solution. Ms. A and Ms. C participate and respond to each step, often anticipating the step in advance. Ms. D, on the other hand, is not involved in this development of taken-as-shared meanings. Of the first 44 turns in this floor, Ms. D takes only 3, each of which concerns what she should write on her exam. The 45th turn is Ms. D's direct address to Mr. B:

- 1 Ms. D [B], what do I put on this side?
- 2 Mr. B The other side is negative b plus c.
- 3 Ms. C Times c [writing] Oh, then you
- 4 Ms. D [_ take away on b and take away-is that a one? or c?
- 5 Ms. A Where?
- 6 Ms. D Right here where I just scratched out.

Ms. D's question in line 4 comes after Mr. B's lengthy and careful explanation. If she had been actively engaged in negotiating for meaning, as were Ms. C and Ms. A, she would not have had to ask this question. Her direct address points up her failure to develop taken-as-shared meanings because she has been merely writing down the steps to the solution without understanding the process. Therefore, this floor cannot be considered good group discourse because Ms. D

has accepted the mathematical authority of the group without understanding the underlying argumentation, which is a gender-implicated violation of condition 6, authority.

The group works down to the final step $a = (-b + c)/(c - b)$, at which point Ms. C wishes to cross out the c's (a classic student algebraic error) and Mr. B disagrees.

- 1 Mr. B Uhh. Yeah but I think we're supposed to keep the c's in there.
----- [joint between floors 13 and 14]
- 2 Ms. C They come out.

This precipitates floor 14, a multivocal floor coded MVF:B>C, in which Mr. B correctly argues that the answer is one (the result of correct cancellation). Ms. D also argues that the c's cannot be canceled. Ms. C is not convinced. Ms. A reminds the group that it is now 9:30, implying that they should move on. Mr. B decides to avoid the issue by not reducing the expression at all:

- 1 Ms. C So we can cross them out now?
- 2 Mr. B No. Just keep them in
- 3 Ms. D | _ Leave it.
- 4 Mr. B Yeah.
- 5 Ms. C Okay [tunefully, indicating "Have it your way"]

This floor cannot be considered good group discourse because the conflict is not resolved by mathematical argumentation, but rather on the basis of authority, a gender-implicated violation of condition 6 of the model made in the interest of avoiding conflict.

While Mr. B works independently to catch up, the women now return to problem 4, precipitating floor 15, a multivocal floor coded MVF:C=D\B-IND.

This floor is a rare example of the women participating in a multivocal floor in which the contrary views of Ms. C and Ms. D are unresolved, yet each employs good mathematical argumentation. Although the women achieve good mathematical discourse, this floor cannot constitute good group discourse because Mr. B is again working independently. He makes only one utterance during the middle of the floor: "Are you doing number 4?", an unnecessary question had he been jointly engaged with the women.

Leaving their dispute unresolved, the women move on to problem 5, thus initiating a new floor (16), EVF\B-IND. In this floor, the women are jointly engaged and achieve intersubjectivity in that they talk as if they are developing taken-as-shared meanings. They do not achieve good group discourse, however, because none of them attempts to make sense of one another's meanings through mathematical argumentation, a violation of condition 4, argumentation. As a result, underlying differences in their apparently taken-as-shared meanings are not brought to light.

Floor 17, a reluctant responder floor coded RRF:{D,A}->C->B, is initiated by Mr. B's report of his results for problem 4. Mr. B hands his paper to Ms. C, who reads it and checks it against her own. She and Mr. B have arrived at the same answer for problem 4, but they have not collaborated to get this answer. Moreover, they have used different methods to solve the linear system, Ms. C using elimination and Mr. B using substitution. From the nature of her question, "Did you multiply it by a negative 2 on the bottom?" it is clear that Ms. C does

not understand what Mr. B has done, nor does Mr. B does explain his approach. Since Mr. B's answer concurs with her own, Ms. C does not pursue the matter any further. Meanwhile, Ms. A and Ms.D ask Ms. C, a reluctant responder, what Mr. B has written, while Ms. C probes Mr. B, who reluctantly responds to her. Although the group is jointly engaged, it does not achieve good groups discourse because the participants are not negotiating together to arrive at taken-as-shared meanings. Conditions 2 and 5 (helping and intersubjectivity) are violated.

A new reluctant responder floor (18), RRF:{D,A}->C\B-IND, begins with Ms. D's direct address to Ms. A:

- 1 Ms. D Did you catch that, [A]?
- 2 Ms. A No

Here Ms. D employs a direct address in order to ally herself with Ms. A because neither Mr. B nor Ms. C has responded adequately to her or Ms. A, a violation of condition 2, helping. Mr. B is again working independently, while Ms. C will only confirm or deny the inquiries of the other two women. Ms. D and Ms. A collaborate together to the conclusion of problem 4. This floor, even apart from Mr. B's working independently, does not constitute good group discourse for the women because Ms. C does not participate in the negotiation for meanings with the other two women, thus violating condition 5, intersubjectivity. Ms. D then makes bids to resume collaboration on problem 5:

- 1 Ms. D 'Kay. How are we doing on this one here? Has anyone got to it yet?
- [No response]
- Oh! You got 2 for this?

----- [joint between floors 18 and 19]

2 Mr. B Yeah.

3 Ms. D [B], are we on question 6 then?

[No response]

After receiving no response to these bids for collaboration and being thrown together by necessity, Ms. A and Ms. D collaborate well with each other in floor 19, EVF:{D,A}\C-IND,B-IND, on problem 5 (though neither the group as a whole nor the women's subgroup achieves good group discourse because both Mr. B and Ms. C are unengaged, a violation of condition 5, intersubjectivity). Ms. A and Ms. D come to an impasse in their collaboration, however, whereupon Ms. A initiates a new floor with an indirect bid for Ms. C's attention:

1 Ms. A Let's see what [C] has.

----- [joint between floors 19 and 20]

2 Ms. C You've got negative two-fifths?

Ms. A's move initiates a reluctant responder floor (20), RRF:D->C\B-IND. Ms. C looks at Ms. D's work (Ms. D sits closer to Ms. C than does Ms. A) and points out that Ms. D has inverted the slope formula in problem 5. After making this observation, however, Ms. C responds only minimally, if at all, to a series of Ms. D's questions as to what to do next. This floor does not constitute good group discourse because Ms. D is not able or willing to make sense out of Ms. C's responses (violation of condition 3) and Ms. C is not willing to elaborate (violation of condition 2), and hence negotiation of meanings cannot take place. After receiving no response from Ms. C to the last of her questions, Ms. D directly addresses Mr. B, initiating floor 21, a no floor:

[no response to Ms. D's question]

----- [joint between floors 20 and 21]

1 Ms. C [B], how are you doing on this?

2 Mr. B I'm doing all right.

3 Ms. C How far are you?

4 Mr. B I'm not that far yet, hold on.

Mr. B fends off Ms. D, something he does repeatedly throughout the exam when the women make bids for his attention, a gender-implicated violation of condition 5, intersubjectivity. His fending-off moves and his nonresponsiveness seem to stem from a different source, however, from that which gives rise to Ms. C's reluctance to engage the other women. Ms. C is upset with Ms. D, whom she feels isn't pulling her weight, thus dampening her interactions with Ms. A, also, whereas Mr. B wants to be left alone to think his own thoughts. Mr. B's lack of intersubjectivity, however, is an abiding gender-implicated effect that has carried over from his previous independent actions and is the principal reason for the failure of discourse in this floor.

During this no floor (21), Ms. D repeatedly states that she has no idea what to do with problem 5. When Ms. A asks Ms. C what she is coming up with, Ms. C replies that she doesn't know how to do the problem either. Ms. D attempts to get things going again by turning to Mr. B with a direct address:

1 Ms. D [B], do you want to keep working on it?

2 Mr. B Yep

----- [joint between floors 21 and 22]

3 Ms. D Okay.

Although Ms. D's move ends the no floor and initiates floor 22, a reluctant responder floor, RRF:A->C\B-IND, it also marks (but cannot be said to cause)

the most costly action in terms of time of the entire exam. Mr. B will spend a total of 35.2 minutes of the total 87.5 minutes of the exam on this one problem alone, 13 minutes of which will be spent by himself. Moreover, his reporting back to the women will account for many of the twenty or so minutes they also spend on the problem.

The women begin problem 6 in floor 22 with Ms. C stating that she knows how to do it, whereupon Ms. A begins probing Ms. C, who responds reluctantly. Mathematical meanings are not negotiated sufficiently between the women to constitute good group discourse, a violation of condition 5. Moreover, Ms. C has created the expectation in the other two women that she will help them when she announces that she knows how to do the problem, something that she does, however, only with reluctance, a violation of condition 2, helping.

Ms. D joins in with Ms. A's questioning of Ms. C, thus constituting a new reluctant responder floor (23), $RRF:\{A, D\} \rightarrow C \setminus B\text{-IND}$. Ms. A and Ms. D continue working out the solution to problem 6 between the two of them, asking Ms. C to confirm each step. Because Ms. C does not attend to the other women's development of ideas, nor participate in their negotiation of taken-as-shared meanings, good group discourse is not achieved (violations of condition 3, listening) for the women's subgroup.

After the women have arrived at an answer to problem 6, they begin to collaboratively discuss how to round the answer, which initiates an equivocal floor (24), $EVFB\text{-IND}$. Their collaboration continues as they return to problem 5.

If it weren't for Mr. B's working independently, this equivocal floor would constitute good group discourse. After the women reach an impasse in problem five, Ms. C successfully engages Mr. B by using a direct address. This move initiates a multivocal floor (25), MVF:B>C, in which Mr. B and Ms. C disagree as to what the slope should be in problem 5. After Ms. C makes a series of queries as to whether Mr. B had made certain procedural moves, which he had, Mr. B tells her the results of his substitution (which are correct) in the slope formula and then withdraws from the conversation without explaining why Ms. C's results are incorrect. The floor ends with Ms. C's acceptance of Mr. B's answer, though she does not have a mathematical reason for doing so. This floor cannot be considered good group discourse because Mr. B reports his results without providing adequate explanations, a consequence of his lack of involvement with the women, which is a gender-implicated violation of condition 5, intersubjectivity. On her part, Ms. C does not press him for explanations, but accepts his results on the basis of authority, which is a gender-implicated violation of condition 6, the authority condition.

These two gender-implicated violations of good group discourse, Mr. B's lack of involvement and the women's acceptance of his unexplained results, will prove to be costly, for now they will have to spend a great deal of time trying to verify Mr. B's result, beginning with the next floor (26), an equivocal floor coded EVF\B-IND. The women achieve good group discourse during this floor as they confirm and correct one another's moves in finding the slope. Ms. A ends the

floor by asking Mr. B to confirm the women's next move in problem 5 in their attempt to find the y-intercept of the equation of the line.

During the next floor (27), a reluctant responder floor coded RRF:{A,C,D}->B, the women question Mr. B with regard to finding the y-intercept. Mr. B's responses are indicative of his lack of involvement and intersubjectivity with the women: "Yeah", "Where are you?", "5 over 2", "on here?", "yeah", "right", "yeah", "Uhm. . . what?", "no", "right", "yep", "yep". Although the women negotiate a high degree of intersubjectivity amongst themselves during these interactions, this floor does not constitute good group discourse because of Mr. B's involvement with his own thought processes, which is a gender-implicated violation of condition 5, intersubjectivity. The difficulties that the women are experiencing arise from an unusual operational slip. In solving the equation $3 = \frac{5}{2} + b$ for b , the women wrote $b = -\frac{5}{2} \times \frac{3}{1}$ instead of $-\frac{5}{2} + \frac{3}{1}$. The change of sign of the fraction $\frac{5}{2}$ from positive to negative indicates that they were thinking of adding $-\frac{5}{2}$ to both sides of the equation (a correct move), but they inadvertently wrote \times instead of $+$, an error that Mr. B, had he been intersubjectively involved in the construction of the solution process, might have caught. This is the sequence during which the error slips by Mr. B's scrutiny:

- 1 Ms. C But when you move the 5 over 2 to the other side it should go back to the negative 5 over 2, right?
- 2 Mr. B Right.
- 3 Ms. C Then you times it times 3 over 1? [the incorrect multiplication occurs here]

- 4 Mr. B Yep.
 5 Ms. C It's-so it's negative 15 over 2?
 6 Mr. B Yep.
 [time lapse of 20 seconds]
 7 Mr. B [egocentric speech]
 8 Ms. D For sure?
 9 Mr. B I'm trying to think.

Had Mr. B been intersubjectively involved with Ms. C and still not caught the error in line 3, the group would have negotiated an incorrect, taken-as-shared meaning for the y-intercept ($-15/2$), a meaning the group would have agreed upon and that would have allowed them to move ahead with other problems. Again, had Mr. B been intersubjectively involved in the conversation, he might have caught the error when offering an explanation in response to Ms. D's challenge in line 8. Instead, Mr. B fends off Ms. D in line 9 instead of making his thought public. The degree to which Mr. B feels compelled to eschew joint argumentation in this exchange is evidenced by his use of egocentric speech, a rare occurrence for him, in order to sustain his train of thoughts. But Mr. B is not the only one at fault here. Had Ms. C listened and responded to Ms. D's query in line 8, the error might also have been caught. Ms. C, however, is upset with Ms. D and only selectively attends to her talk, which has its origins in Ms. D's gender-implicated helplessness, a violation of condition 1, personal dedication, that is a result, I will argue, of her beliefs in the nature of mathematics.

Floor 28, a reluctant responder floor coded RRF:{A,D}->C\B-IND, begins immediately after Mr. B's fending-off move. During this floor, Ms. A and Ms. D again go over the steps involved in solving the equation for the y-intercept by

questioning Ms. C, the reluctant responder. At the beginning of the floor, Ms. A has to resort to a direct address in order to get Ms. C to respond. Toward the end of floor, the women have completed problem 5 and begun problem 7b, skipping for the moment problem 7a. Again, Ms. A uses a direct address in order to involve Ms. C, asking her to confirm Ms. A's graphing procedure, but Ms. C will only respond to short, well-formulated questions directly put to her. Even apart from Mr. B's working independently, this floor does not constitute good group discourse because of Ms. C's lack of intersubjective involvement with the other women, a violation of condition 5, intersubjectivity.

The next floor (29) is a working floor, coded WF\B-IND, in which the women graph their answer to 7b. This floor is followed by a group management floor (30), coded GMF\B-IND, in which Ms. D suggests that they summarize the problems they have done so that all their answers will be the same, a gender-implicated violation of condition 6, authority, that would place group consensus above mathematical argumentation. Ms. C flatly rejects this idea (recall her remarks in her learning log and reflection paper regarding people who just copy answers without doing the work), which precipitates a few yes-no interchanges between Ms. C and Ms. D. The floor is ended with yet another direct address from Ms. A to Ms. C, asking if Ms. C is working on problem 7a.

Ms. A's ploy successfully ends the discordant floor and initiates another reluctant responder floor (31), RRF:{A,D}->C\B-IND. Ms. C reluctantly responds as she lapses into egocentric speech. The other women are at a loss as

to what to do next and so Ms. D addresses Ms. A directly in order to initiate collaboration between the two of them on the next step. Ms. A suggests solving the equation for y (a move in the solution of question 7a), which Ms. D undertakes. Ms. D then uses the discourse marker "right" emphatically in an attempt to compel Ms. C to collaborate, who, in turn, fends off Ms. D with a minimal response:

- 1 Ms. D Make this $2x$ take away 1. Right?
- 2 Ms. C mm-hmm

Although all of the women have derived the correct slope-intercept form of the required equation by Ms. C working more or less independently, none of them is certain as to how to plot it and each proceeds to draw the graph incorrectly on her exam paper. During these exchanges, Ms. A tries to engage Ms. C by stating that she doesn't know how to graph the equation, to which Ms. C responds, "I'm just picking at it-- I'm not sure I'm right . . . See what you guys come up with." Even apart from Mr. B's working independently, this floor does not constitute good group discourse because Ms. C's unwillingness to negotiate meanings with the other women, a violation of condition 2, helping, and condition 5, intersubjectivity.

After Ms. A's second declaration that she doesn't know how to graph the line, the floor disintegrates into floor 32, a no floor, coded NF\B-IND, in which Ms. C tells Ms. A and Ms. D, in effect, to work the problem on their own, otherwise they won't be able to contribute anything. She then gives them a starting point for the graphing. Ms. C is again signalling that she is not willing to carry

people along without their contributing. What is doubly unfortunate about this situation is that an observer can hear that Ms. A and Ms. D have been working at developing taken-as-shared meanings in a way that could contribute significantly to the success of the women's subgroup, if Ms. C would only listen and respond to the other two women. On the other hand, it has been clear from the beginning that Ms. C is upset with Ms. D's helplessness and freeloading, which in turn colors Ms. C's relationship with Ms. A. Therefore, I attribute the failure of the women's subgroup to achieve good discourse to Ms. D's helplessness, a gender-implicated violation of condition 1, personal dedication, which is based in part, I have claimed, on her beliefs in the nature of mathematics.

After Ms. C's rebuff, Ms. D begins to lead Ms. A in the graphing of 7a, whereupon Ms. C makes a direct address to Mr. B, creating a joint floor (33), LVF:D-A\GMF:C,B.

- 1 Ms. C [B], are you still on that one . . . way down there? I don't know why you're down there.
- 2 Mr. B Yeah.
- 3 Ms. C 'cause I went negative-I mean 2x-I went 2 down
- 4 Mr. B |_ I'll get it . . . I'll get it.
- 5 Ms. A Wait, we're coming.

Mr. B interprets Ms. C's question (conveyed with a slight, but unmistakable, hint of irritation) in line 1 as a challenge (line 4) to his competence or thoroughness, rather than as a move on her part to get the group through the test. In line 5, Ms. A makes a successful move to head off a direct conflict between Ms. C and Mr. B. This joint floor does not attain intersubjectivity for either the

group as a whole or for the women's subgroup, a gender-related outcome of Mr. B's lack of intersubjectivity with the women, a violation of condition 5. Ms. A and Ms. D finish their collaboration in a few more exchanges, whereupon Ms. A makes an indirect address to Ms. C that will precipitate the next floor.

- 1 Ms A Is that what [C] had? [Here Ms. A is ostensibly talking to Ms. D but her intent is to draw Ms. C into the conversation.]
----- [joint between floors 33 and 34]
- 2 Ms. C What?
- 3 Ms. D You didn't get that right here, did you?
- 4 Ms. C |_ It's gotta be a negative

Although the women do not achieve intersubjectivity in this new floor (34), $MVF:\{D,A\}=CB-IND$, it is nevertheless notable for Ms. D's and Ms. A's participation in a multivocal dispute with Ms. C. Ms. D and Ms. A employ mathematical argumentation to back their contention, while Ms. C backs up her contention by appealing to her memory of what the teacher had done with a similar problem, a violation of condition 6, the authority condition.

After the women come to an impasse in their dispute, Ms. C appeals to Mr. B with a direct address, thereby precipitating a socially discordant group management floor (35), GMF.

- 1 Ms. C [B], what problem are you on?
----- [joint between floors 34 and 35]
- 2 Mr. B Number 5.
- 3 Ms. C We've only got 20 minutes left.
- 4 Mr. B Go on . . . I want to get it right, though. You can't just leave them all just 'cause you don't know about them. Might-might as well get something done, you know.
- 5 Mr. C And leaving no answer?
- 6 Ms. D What do you think, guys. Should-I think we should go to the end so
[]

7 Ms. C |_ No, I don't! [sharp]

Here Ms. C confronts Mr. B about time. Mr. B is unwilling to give up or turn away from the challenge ("You can't just leave them all just 'cause you don't know about them"). Although Mr. B has a point about not giving up, Ms. C also has a point about finishing the exam. But Mr. B is taking an uncompromising position in his refusal to remain engaged with the women, a gender-related violation of condition 5, intersubjectivity, thereby jeopardizing the group grade in order to satisfy his personal goal. That is, there is a real conflict here that should be negotiated, as Ms. D begins to do in line 6. Ms. C, however, is too angry at this point to negotiate, as indicated by her not-unjustified, peevish retort in line 7.

Immediately after Ms. C's retort above, Ms. D resumes her disagreement with Ms. C's graph in problems 7a. As Ms. C begins to point out an error Ms. D has made, Ms. A intervenes:

- 1 Ms. A Would it be okay if we put what [C] has?
- 2 Ms. D [very softly] Yeah
- 3 Ms. A [unintelligible]
- 4 Ms. C That's why
- 5 Ms. D |_ Okay. Let's do that. That's cool.
- [join between floors 35 and 36]
- 6 Ms. A So is this your line, [C]?

Ms. A feels she must rescue a deteriorating social situation by moving to accept whatever solution Ms. C has for 7a in order to keep Ms. C collaborating, thus cutting off the argumentation over 7a by accepting Ms. C's authority for the sake of group harmony, a gender-implicated violation of condition 6. Ms. D

recognizes Ms. A's ploy and immediately concurs, full well realizing, if her soft tone of acceptance is any indication, exactly what is happening. When Ms. C attempts to further justify her answer in line 4, Ms. D cuts her off with another statement of concession in line 5, employing the phrase "That's cool," code for "It's okay with me--I'm not going to argue the point."

Ms. A follows up Ms. D's last utterance with a direct address to Ms. C in line 6 in order to immediately engage Ms. C in the problem. Ms. C shows her work to Ms. A and Ms. D, in turn, makes some brief inquiries as to what Ms. C has done. Ms. C does not elaborate, but only responds briefly. The same kind of pattern that concluded the previous floor(35) and initiated the current floor (36), a reluctant responder floor coded RRF:{A,D}->C\D-IND, now concludes floor 36 and initiates floor 37, a leading voice floor coded LVF:C-A,D\B-IND:

- 1 Ms. D That's it?
- 2 Ms. C It's gotta be 'cause that's
- 3 Ms. D |_ Cool. We got another two points for that one.
- [joint for floors 36 and 37]
- Okay. [Ms. D reads problem 8a] What percent of the data lies between Q1 and the max?

As Ms. C begins to explain her solution in line 2, once again Ms. D cuts short the explanation with her second use of the word "cool" in line 3, again indicating that she will accept whatever Ms. C has written (these were the only occurrences of this word in either group). Again, floor 36 cannot be considered good group discourse, even apart from Mr. B's working independently, because the women do not achieve intersubjectivity, as evidenced by Ms. D's and Ms. A's

acceptance of Ms. C's solution without even hearing the explanation or negotiating for taken-as-shared meanings, their concern for group harmony having taken precedence over mathematical argumentation, a gender-related violation of conditions 6, authority.

Floor 37, LVF:C-A,D\B-IND, is precipitated with Ms. D's reading of problem 8a. Ms. C is in the process of analyzing the problem aloud to Ms. A and Ms. D when Mr. B breaks in with his report of his work on problem 5. The women have not yet negotiated taken-as-shared meanings in this floor and hence do not achieve good discourse, though they might have if it had not been for Mr. B's interrupting their collaboration. That is, the women fail to achieve good group discourse not because of their own failure to achieve taken-as-shared meanings but because of the gender-implicated effect of Mr. B's working independently, a violation of condition 5.

- 1 Ms. C Has to be what?
- 2 Mr. B Point five is-uh-the end. [referring to $y = -5/2 x + .5$ in problem 5]
----- [joint between floors 37 and 38]
- 3 Ms. C What?
- 4 Mr. B Point five.
- 5 Ms. C Point five what?

The above exchange illustrates Mr. B's reportorial style of working in a group. It is clear from this exchange that he assumes that the women should be attuned to what he has been doing and it is also clear that they have absolutely no idea of what he is talking about. In fact, floor 38, a group management floor coded GMF, consists entirely of the efforts of the women to orient themselves to

what he is saying. This gender-related effect is a result of Mr. B's previous violation of condition 5, intersubjectivity.

The next floor (39), a multivocal floor coded $MVF:B>\{C,A,D\}$, is one of the few floors in which Mr. B fully participated. During this floor, Mr. B argues that the y-intercept is one-half (which is correct) and the women argue that it is $15/2$ (recall from above how this error came about). Mr. B says that he is not sure why $15/2$ is incorrect (the women multiplied, instead of adding the two fractions), though he eventually offers the following:

- 1 Mr. B Negative 5 over 2 is right but . . . I think . . . like if you put . . . if you had . . . then you've got to make the other one the same. So you have 6 over 2 instead of 3 [he means $-5/2 + 6/2$, instead of $-5/2 + 3$]
 - 2 Ms. C Oh, so . . . oh, so we have to have the least common denominator the same. You have to find the least common denominator.
 - 3 Mr. B Right.
- [joint between floors 39 and 40]
- 4 Ms. C So it's 6 over 2.

Mr. B's rather incoherent explanation is sufficient to start Ms. C on her way in the ensuing floor to working out the correct arithmetic steps in getting Mr. B's answer. Mr. B has not arrived at his solution through a straight-forward algebraic process, but rather through a more unconventional and imaginative method. He graphed equation $y = - (5/2)x - 15/2$, the solution the group had negotiated at the end of floor 27, on the calculator and found that the resulting line did not pass through the points $(1,-2)$ and $(-1,3)$ as required. He then modified the y-intercept of the equation until the graph of the resulting line passed between the two points, thereby arriving at the correct the y-intercept for the equation of the

line.

In order to determine whether the group achieves good mathematical discourse in floor 39, the initiation of which was occasioned by Mr. B's announcement of his result, it is necessary to examine the negotiations occurring in the sequence of floors from 39 through 42. The reason why this must be done is that although it is clear that Mr. B and Ms. C are negotiating meanings between them it is not clear whether Ms. A and Ms. D are likewise doing so. The sequence of floors from 39 to 42 constitute a process in which there is the possibility for meanings to emerge for the participants, making it necessary for us to know whether at the end of the process the participants have arrived at taken-as-shared meanings negotiated through sound mathematical argumentation. That is, we have to know how things turn out at the end of the process before we can make judgments about the discourse occurring in the individual floors constituting the process.

During the multivocal floor (39), Mr. B's result is challenged by both Ms. C and Ms. A. As we have seen, at the conclusion of lines 1-4 above Ms. C begins to see how her algebraic approach might yield the same result as Mr. B's graphical approach. The entire sequence of floors 39-42 will be concerned with this reconciliation. In floor 40, a leading voice floor coded LVF:C-G, Ms. C leads the group through the step-by-step process of adding $-5/2 + 3$. Although each of the group participants had correctly solved similar arithmetic problems previously in the course, it is as if they are truly reconstructing the operations for themselves

all over again, almost as if they are reasoning through the individual steps for the first time. It takes the entire floor before Mr. B can make the adjustment in his thinking to Ms. C's approach, even though he had intimations of how to go about it in line 1. Ms. A carefully attends to the steps and backings Ms. C gives by asking questions and working out the steps for herself. Ms. D, on the other hand, does not follow what is happening, her concern being how to change her answer on her exam paper. The following is a list of her comments made during this floor:

"Where-what do we change on our p-paper that we write down?"

"3 over 1 you have to change?"

"So it's 5 over 2 and then 3 . . . over what?"

"I don't know-what-I don't know what you're talking about."

"Then what? Are you-are we making 2 or something?"

Either Ms. C or Ms. A responds appropriately to each of Ms. D's questions, except for her last question, which receives no response because the group is moving into floor 41, a group management floor, GMF, occasioned by the announcement of the classroom monitor, Mr. L from group 2, that there are 15 minutes left for the exam. During this floor, however, Ms. A comments, "Oh, I get it, for once!" The group then discusses whether or not they will get done in time before moving into floor 42, a reluctant responder floor coded RRF:D->{A,B}\C-IND. A list of Ms. D's probings, to which Mr. B and Ms. A give correct, unelaborated answers, follows:

"I don't know how you got that."

"So it turns out to be one-half?"

"Negative one-half or just one-half?"

Ms. D then writes answers on her exam that do not follow from her written work, indicating that she has not made sense of the explanations of her questions. Thus, as we come the close of floor 42, the group as a whole fails to achieve good discourse in floors 39, 40, and 42 (floor 41 is a group management floor) because of Ms. D's violation of condition 3, making sense of others' explanations, as well as her acceptance of group authority in floor 42.

Discussion of problem 8a occasions the inception of floor 43, an equivocal floor coded EVF, in which all the group members, including Ms. D, participate and arrive at taken-as-shared meanings through mathematical argumentation. Hence, floor 43 constitutes good group discourse. This floor closes with Mr. B's request to see the women's previous work. What he says offers insight into his style of working in a group:

- 1 Mr. B Can I see what you guys did over here? Can I see what you did over here, 'cause I trusted that
----- [joint between floors 43 and 44]
- 2 Ms. D | _ [reading problem 8b] Will the mean be less than [etc]

Mr. B feels justified in looking at someone's work on past problems without fear of being accused of freeloading because he trusted that if he were to stay behind and work by himself on getting the answer to a problem that the group could not solve he then should have a right to the work of the group on those

problems in which he could not participate.

Ms. D opens floor 44 (line 2 above), an attempted equivocal floor, coded EVF:{D,C,A}<-B-IND, by reading problem 8b (it is interesting to note that Ms. D takes the lead in opening the discussion on problems 8a, 8b, 8c, and 9a, and is involved in initiating 6 of the 8 floors the group constitutes between floors 43 and 50). Floor 44 fails to achieve intersubjectivity (condition 5) not because of the discourse of the women, but because of a series of three questions Mr. B asks pertaining to the copying of problem 2. Even apart from his acting independently, the women cannot achieve intersubjectivity in this floor, though they all participate, because Mr. B disrupts their development of taken-as-shared meanings with his report, a gender-implicated violation on Mr. B's part of condition 5, intersubjectivity. Immediately after one of his questions, Ms. A has to resort to directly addressing Ms. C in order to reestablish the sense of the floor the women are constituting. Mr. L, the class monitor, also interrupts this floor, in effect terminating it, by making an announcement about writing in their learning logs, a signal that the period should be drawing to an end fairly soon. Ms. D once again reads problem 8b, in order to reestablish collaboration, thereby launching floor 45, a univocal floor coded UVF:C-{A,D}\B-IND. Ms. C has the solution to the problem and provides an appropriate backing for it that Ms. A and Ms. D are able to follow and understand. Apart from Mr. B's working independently, this floor constitutes good group discourse.

In floor 46, a working floor coded WFB-IND, the women write down their

explanations for their response to problem 8b. This floor ends with Ms. D's reading of problem 8c and the subsequent initiation of floor 47, a no floor, coded NF\B-IND. After a period of silence, Ms. A makes a direct address to Ms. D, unintelligible on the tape, to which Ms. D responds (likewise unintelligible). After a relatively long silence of 30 seconds, Mr. B interrupts, "How'd you guys get this?" His question, launching floor 48, refers to the women's incorrect graph for problem 7a that Mr. B had been copying in order to catch up.

To this point, Ms. C has always been the one in the group to respond to Mr. B. In this floor (48), however, a multivocal floor coded MVF:{A,D,C}=B, Ms. A immediately replies and she and Ms. D jointly attempt to justify what they had written. When Mr. B tries to point out their error (the women had worked with the x-intercept instead of the y-intercept in drawing the graph of the line), Ms. D attempts to cut the argument short, which is understandable given that time is running out:

- 1 Mr. B Look at where your-uh-y intercept is.
- 2 Ms. D We better just keep going. Uh-[starts reading problem 8c again] If there are 60 data points

But when Mr. B persists, giving a sound step-by-step explanation as to how to graph the equation using the slope as rise over run starting at the y-intercept, the women argue that their solution resembles (which it does not) one the teacher had given when solving a similar problem. This floor cannot constitute good group discourse, not because of the disagreement, but because of the women's achieving intersubjectivity by appealing to an outside mathematical authority

rather than through argumentation, a gender-related violation of condition 6. The following series of exchanges sets the stage for Mr. B's withdrawal from argumentation in the next floor. Ms. C initiates the series with a direct address to Mr. B:

- 1 Ms. C [B[, we have to get done! [urgent and exasperated]
- 2 Mr. B Okay
- 3 Ms. D I know. We're only half-way done.
- 4 Mr. B |_ Yeah, but we gotta get it done. Right. Okay.
[markedly rapid, melodic, high-pitched, breathless whisper]
- 5 Ms. C No. These things are right.
- [joint between floors 48 and 49]
- 6 Ms. D Okay, how do we do number c [referring to problem 8c]

In line 4, Mr. B uses prosodic elements that neither he nor anyone else in the group has used at any time during the recorded portions of the semester's interactions. Immediately after I had transcribed this passage, I wrote in the margins of the transcription that it seemed to me that Mr. B was being sarcastic and that he was mocking the women's voices. This is the only instance of overt sexism I heard in this group during the entire semester. Such marked prosodic elements would not be remarkable in group 2, however, where the men frequently used such devices in a self-deprecating way or as a form of mock aggression, but never with serious intent as is the case here. One likely explanation, in light of his remarks above and those made in his learning log during the semester, as well as in his group-test reflection paper, is that he feels that one of the purposes of group collaboration, the production of quality work, is being undermined, and that this is one more instance of women's, or at least these women's, lack of

attention to careful mathematical argumentation.

Ms. D immediately moves to defuse the tension by reading problem 8c, which induces floor 49, a leading voice floor coded LVF: C-G. Although Ms. C leads the discussion, Ms. D interacts so closely with her that together they create one of the more closely-knit sequences of joint argumentation heard during the exam for this group. This is particularly notable in the light of the distance that Ms. C has placed between herself and Ms. D. Ms. D's unusual degree of participation may be due, in part, to her continuing effort to restore group harmony and collaboration after the discord in the previous floor. There is something even more notable about this floor, however. Ms. C and Ms. D make two errors during the course of their joint argumentation, during which Mr. B asks two questions to which Ms. C responds briefly. It is difficult to discern whether Mr. B is asking rhetorical questions in order to point out their errors or whether he is really seeking information from them for his own understanding (or both). Nevertheless, had he pushed Ms. C for further explanations, or had Ms. C or Ms. D attended to the implications of his questions, the women's errors most likely would have been detected. The fact is that the women (including Ms. A) answered problem 8c incorrectly, whereas Mr. B answered correctly. That is, he knew the women's answer was different from his own, as evidenced by his questions, yet he chose not to argue the point. Most likely, Mr. B's behavior is a response to the women's refusal to use mathematical argumentation to resolve the differences in answers in the previous floor and he has intentionally distanced

himself from the women.

Despite the good discourse between Ms. C and Ms. D (errors notwithstanding), this floor cannot be considered good group discourse because there is clear evidence that Mr. B and the women have not negotiated taken-as-shared meanings, as evidenced by their differing answers. Mr. B has violated condition 5, intersubjectivity, as a reaction to the women's achieving intersubjectivity through consensus in the previous floor, a violation of condition 6, authority.

As the group begins work on problem 9a, Ms. A asks a question to which no one responds. She then makes a direct address to Ms. C in order to elicit a response and initiate collaboration, thereby initiating floor 50, a leading voice floor coded LVF:C-{A,D}\B-IND, in which the women achieve good discourse. From this point on, Ms. A is the most active member of the group in trying to maintain group collaboration. Ms. C makes a critical error at the end of the floor, which the other women do not detect, by deciding to sort the leg press data in ascending order of magnitude (the correct order is descending). The floor is terminated by the initiation of floor 51, LVF:C-A\OTF:C,L\B-IND, occasioned by Ms. D's off-task conversation with Mr. L, the class monitor(although group 2 has completed the exam and departed almost 15 minutes ago, Mr. L has remained behind to collect group 1's exams). While Ms. D carries on a conversation with Mr. L about another class, Ms. C leads Ms. A through the ordering operations on the calculator. After Ms. D has stated in the previous floor that she doesn't know how to do problem 9a, her turning away from Ms. C and Ms. A while they

are working through that very same problem and engaging in loud, off-task conversation astounded me. I wrote in the margins of the transcription immediately after I heard this, "No wonder [C] got mad--this is very irresponsible!" The women's subgroup fails to achieve good group discourse because of Ms. D's lack of commitment to the group effort, a violation of condition 1.

Ms. D breaks off her conversation with Mr. L just as Ms. C and Ms. A finish their collaboration and begin to write down the columns of figures from their calculator screens. Floor 52, a group management floor coded GMF, is initiated by Ms. D's demand to see Ms. A's work. Her request is not immediately granted, however, since Ms. A and Ms. C are engaged in comparing calculator screens. The following exchanges occur at the end of the floor:

- 1 Ms. D You guys, we better just skip down to the next problem.
- 2 Ms. A We're on the next one.
- 3 Mr. B If we keep skipping, we won't get it done
- 4 Ms. C |_ This is the last problem.
- 5 Ms. D Oh.
- 6 Ms. C [B], we're done through this. [referring to the test]
- 7 Mr. B Are we? [bewildered]
- 8 Ms. C |_ We're on the last problem.
- [joint between floors 52 and 53]
- 9 Mr. B Let's do it.

From lines 1 and 2, we learn that Ms. D is not even aware what problem is being worked on. Upon hearing Ms. D say something about skipping another problem, Mr. B, who has been working independently (probably copying previous problems), protests any skipping. Using a direct address in line 6, Ms. C pointedly informs Mr. B as to where they are in the exam. This floor fails to

achieve good discourse because of Mr. B's lack of intersubjectivity, a gender-implicated violation of condition 5, and Ms. D's lack of commitment to the group effort, a violation of condition 1.

Floor 53, coded EVF: {C,A,D}->B, is the longest floor (5.6 min.) constituted by either group during the entire exam. In this floor, the women's collaboration constitutes an equivocal floor, but Mr. B does not participate as an equal, though there are interchanges between him and the women, and he does not achieve intersubjectivity with the women, a gender-related violation of condition 5, intersubjectivity. The floor begins with Ms. C and Ms. A noticing that some of the columns of their sorted data do not agree. Ms. D offers the data in her calculator to check against. Ms. C and Ms. D decline when they realize that Ms. D has not yet sorted her data. All the women then turn to Mr. B for his results, Ms. A and Ms. C each referring to him indirectly by name in consecutive turns before Ms. D and Ms. A overlap each other in separate direct addresses to him. Mr. B responds, "What?", which clearly indicates that he has not been intersubjectively involved in the women's conversation. If he had been, neither of the two indirect addresses nor the two direct addresses would have been necessary, nor would he have needed to ask what was going on. Ms. C and Ms. A then overlap each other in their separate commands to Mr. B to sort his data. When he asks how, Ms. C instructs him as to which columns to sort, after which we hear the following:

1 Mr. B All right. And do what there?

- 2 Ms. A Sort it!
 3 Ms. C | _ Sort it . . . according to what you think it says.

Between the three of them, the women command Mr. B to sort his data four times. Under the pressure of time (the room must be vacated for the next class in a few minutes), the women finally lose their reserve about intruding into Mr. B's solitude. During the next 30 seconds in which the women leave Mr. B alone to do his sorting, Ms. D and Ms. C make two soft, unintelligible utterances after which Ms. A directly addresses Mr. B in order to get him to collaborate:

- 7 Ms. A Did you sort it? What are you doing, [B]?
 [No response]
 8 Ms. C How are you sorting it?
 9 Ms. A He's graphing it! [incredulous]
 10 Mr. B Uh-I don't
 11 Ms. A | _ He's graphing it! [dismayed]
 12 Ms. C Just-what numbers did you get for sorting it?
 13 Ms. A Yeah!
 14 Ms. C For the []
 15 Ms. A | _ []
 16 Mr. B How-how do you sort it?

The lines above reveal Mr. B's difficulty in achieving intersubjectivity with the women. Rather than admit after line 3 above that he does not know how to sort the data, he tries to solve the problem by graphing a boxplot, which has nothing to do with the sorting problem that concerns the women, much to Ms. A's distress. Time is very short (students for the next class can be heard in the hall) and the women are desperate to resolve their sorting discrepancy. Mr. B is desperate to find the answer, also, but his notion of cooperating in the group is to withdraw from it and work at the task by himself, thereby fulfilling his

1 Ms. D Let's just call it quits. it's 10:20 . . . []
2 Mr. B [] We all screwed up our data, didn't we?
Sorting it.
----- [joint between floors 53 and 54]
3 Ms. C No, it's just that one comma won't change.

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L demurs. This floor cannot be considered good group discourse, even apart from Mr. B's working independently, because of Ms. D's lack of commitment to the group effort, a violation of condition 1.

In floor 55, a working floor coded WF, the group is engaged in writing down their responses, during which Ms. D again suggests that they turn in their papers. Ms. D's lack of commitment to the group, a violation of condition 1, disqualifies this working floor from being considered good discourse. Ms. A ends the floor by directly addressing Ms. C:

- 1 Ms. A [C], did you do L1, L2, L3, L4?
----- [joint between floors 55 and 56]
- 2 Ms. C Where? [wearily]
- 3 Ms. D When you were going to plot it.
- 4 Ms. C No.
- 5 Ms. D No, what? [rather aggressively]
- 6 Ms. C No, I did it.

During the last floor (56), reluctant responder floor coded RRF:{A,D}->CB-IND, Ms. A and Ms. D question Ms. C as to what she is writing on her paper. Ms. C responds briefly and distractedly, a violation of condition 2, helping, and Ms. D again suggests that they leave, a violation of condition 1, dedication to the group. The floor ends without taken-as-shared meanings having been negotiated:

- 1 Ms. D Oh, [C] got []
- 2 Ms. C But I don't have it why I did it.

Group 1's Reactions to the Exam

The following reactions to the group exam are excerpted from the post-exam reflection paper each student wrote and submitted two days after the exam. These comments are rendered as nearly as possible in the form they were written by the students themselves and therefore I have omitted "sic" notations following any misspellings or incorrect grammatical constructions.

Ms C:

Our group did not work well together on our test. On member showed up late after we had already worked through problems 1 and 2. She copied them instead of working them out. This also happened throughout the entire test. I did not mind helping someone, but I do mind doing all of their work. Another problem arose when another member spent 10-15 minutes per problem. We would finally work ahead or else we would have never finished the first page. As you can tell I am not happy about this test. When having a group, everyone needs to contribute and take notes, and also be responsible . . . My first complaint was 2-25 and things have only grown worse.

Mr. B:

The group exam didn't go so well for our group. We finished it and did okay but I think we could have done much better. . . I would be double checking a problem and making sure I understood it. Meanwhile the other people were working ahead making sure we had all the problems finished on time. Basically what happened was our group split up. I was taking my time trying to get quality work and the others were rushing ahead to get it done. The result was that we didn't get anywhere very fast. . . [Ms. C] was frustrated because she wanted to get it done but things were slow because [Ms. D] wanted to copy the problem down. . . . Our group was basically confused and separated. I think things would have done better if we worked more as a group. We should have been all focusing on the same problem through the whole exam. It would be slower but the results would be better.

Ms. D:

Our group worked OK throughout the test. It seemed like [Ms. C] and [Mr. B] kinda did there own thing & [Ms. A] and I kinda worked more together. I was feeling terribly sick that day and had been up all night with the flu. I believe that effected me largely on the part of communicating with my group. We did on the most work well and communicate together. Most of the time we each did the problem separately and then compared the answers & talked them through. This worked out well.

Ms. A:

Overall our group exam went fine. There were some times when we disagreed. There were also times when some people wanted to jump ahead leaving problems unfinished, while others wanted to spend too much time on a limited time schedule. There were some disagreements on a few problems, but when this happened people just left things how they wanted to. When people started to get frustrated with each other I tried naturally to be the mediator. I didn't want things to get out of hand because then the group work wouldn't be of any use to anyone.

All four participants mention that the group split up and all acknowledge the problem they had with collaboration. The only person not implicated either by name or by his/her clearly identifiable behavior for the failure of the group to collaborate is Ms. A, who says she tried to mediate the growing frustration in the group (which I have pointed out previously) before things got out of hand and the group became completely dysfunctional. Ms. C is angry with Ms. D for showing up late and for copying others' work throughout the exam (recall Ms. C's statement about not allowing Ms. D to copy when the group decides to begin work without her). Mr. B mentions also Ms. D's copying, attributing Ms. C's frustration to the resulting slowdown; Ms. C, however, is clearly more frustrated with Ms. D's lack of personal responsibility (recall my own reaction when transcribing concerning Ms. D's irresponsibility). Moreover, it is Mr. B with whom Ms. C is

frustrated so far as loss of time is concerned. Mr. B acknowledges his role in the splitting up of the group, which is almost entirely due to his lack of engagement, justifying his actions for the reason that he wanted to get quality work done (recall he mentioned this when the women were pushing him to join them). Nevertheless, we shall see that his behavior was not untypical of him. Ms. D claims the flu affected her communication with the group, which cannot be reasonably held accountable for very much of her inconsiderate behavior during the exam. She also mentions that she and Ms. A worked together, whereas Ms. C and Mr. B did their own thing.

The group members have accurately identified all the major interpersonal difficulties that occurred during the exam: Mr. B's working independently, the strained relations between Ms. C and Ms. D and between Ms. C and Mr. B, and the subgroups that formed as a result of these problems. I will return to these issues when I contextualize the events of the exam in relation to the group members' interactional behaviors over the entire semester, some of which appear to be gender-implicated.

Analysis of Group 2 Floors

The group participants are Ms. K, Ms. M, Mr. L, and Mr. J, two women and two men.

In the passage below, the group is quipping with each other just before starting work on the exam. The women give encouragement and Mr. J begins:

- 1 Ms. S . . . Fun.
- 2 Mr. J Good! Want to help us out any more, K?
- 3 Mr. L [laughs]
- 4 Ms. M [softly] Go for it.
- 5 Ms. K Go for it.
- [joint into floor 1]
- 6 Mr. J Okay. So subtract the $3x$?

In floor 1, an equivocal floor coded EVF, constitutes good group discourse because the participants are intersubjectively involved in developing shared meanings, all the while employing good mathematical argumentation. After Mr. J starts the solution to problem 1, he makes an algebraic error, however, that Ms. M catches and corrects; Mr. L supports her. Mr. L picks up the argument and Ms. K supports him by providing the steps. Mr. J concurs and problem 1 is completed. Ms. K begins the first step in solving problem 2. Everybody participates in building a joint argument. Ms. M makes an error that Ms. K catches and corrects. Mr. L provides an explanation and then makes an algebraic error. Ms. M catches it, but instead of being a simple error-correction move like those that have just occurred (Ms. K and Mr. L do not accept the correction), her correction leads to floor 2, a multivocal floor coded MVF:M>{K,L}:

- 1 Mr. D Should be a minus 12, right? [error]
- [joint between floors 1 and 2]
- 2 Ms. M No. It's minus 2. You don't do anything with that.
- 3 Mr. J |_ So what . . . what is-what is the equation that you're gonna look for?
- 4 Ms. K |_ Yeah, you do.
- 5 Mr. L You have to!

In the ensuing argument, Ms. M provides an explanation that convinces her contestants. This ends the floor, which constitutes good mathematical

discourse, and precipitates the longest floor (3) for this group, a 4.5-minute equivocal floor coded EVF, in which the group finishes problem 2 and begins problem 3. During this floor, Mr. J skillfully manages the conversational flow, keeping the argumentation organized and summarizing agreed-upon steps, as the following individual excerpts illustrate:

- Mr. J Okay. The next step being?
 Mr. J [L], why not now? [Mr. L has just reversed a previous claim]
 Mr. J That becomes y equals minus 2, right?
 Mr. J 'Kay. So our final answer is y equals $11x$ over 9 minus 2.
 Mr. J 'kay. We're cruising much better today.
 Mr. J It's your [Ms. K's] problem now.
 Mr. J So. Okay. What do we come up with now?

This floor, which constitutes good mathematical discourse, ends when Mr.

J does not understand an algebraic move made by Mr. L:

- 1 Mr. J Just a minute. I'm still on the first step. I can't do it. I don't understand what you guys are saying. That doesn't make sense to me.
 ----- [joint between floors 3 and 4]
 2 Mr. L What doesn't make sense?

In floor 4, a univocal floor coded UVF:L-J, Mr. L explains the operation of the distributive law in his move. Mr. J follows closely, carrying out several of the steps by himself. The floor ends when Mr. J and Mr. L have negotiated taken-as-shared meanings of the procedure. Therefore, this floor constitutes good mathematical discourse. Mr. L resumes with the solution, initiating floor 5, an equivocal floor coded EVF. A goodly portion of this floor is concerned the group's completion of problem 3, which they accomplish through joint argumentation. Although they make an error in factorization that no one catches, the floor

nevertheless constitutes good mathematical discourse because the group negotiates taken-as-shared meanings, correcting and then agreeing on the steps in the solution, as the following excerpt illustrates:

- 1 Mr. L a times
- 2 Ms. K |_ equals cb
- 3 Mr. L |_ No. It's be one minus
- 4 Ms. K [egocentric speech]
- 5 Mr. L [egocentric speech] . . . should be a times one minus c, right? [error]
- 6 Mr. J Right.
- 7 Mr. L So now the a times one gives you-gives you the a.
- 8 Ms. K mm-hmm [affirmative]
- 9 Mr. L a times one minus c equals bd minus b
- 10 Mr. J [indirect collaborative speech] a times b minus c . . . bd minus []
- 11 Mr. L Everybody agree?
- 12 Ms. M mm-hmm [affirmative]

After completing problem 3 and shortly after beginning problem 4, Ms. M urges Mr. J to take the leadership with one of many of her motivational exhortations, "Go for it," thus initiating floor 6, a leading voice floor coded LVF:J:G:

- 1 Mr. J Actually, we could just go with the y and []
----- [joint between floors 5 and 6]
- 2 Ms. M Okay. We'll follow you. Go for it. 'cause you know how to do this one.

Mr. J leads the discussion of the solution for problem 4, during which Mr. L and Ms. K fill in the steps. This floor, which constitutes good group discourse, comes to an end with a challenge from Ms. M, which initiates floor 7, a multi-vocal floor coded MVF:M>{J,K}:

- 1 Mr. J Then we have $2x$ plus $4y$ equals 20. Then we have $3x$ minus $4y$ equals 2. [error]
----- [joint between floors 6 and 7]
- 2 Ms. M So it does. You don't have to add the 8-er-multiply the 8 times the 2 and the 8 times the 5?

3 Mr. J Hmmm? Eight?

Ms. M convinces Mr. J and Ms. K of the correct procedure that accounts for the above error in the ensuing disagreement. This floor (7), then, constitutes good group discourse. Mr. J assumes leadership in floor 8 through the completion of problem 4, a leading voice floor coded LVF:J-G, during which all the group members follow each step closely, making sure that everybody understands. This floor, therefore, constitutes good group discourse.

The group begins problem 5 by constituting an equivocal floor (9) coded EVF. Again, this equivocal floor constitutes good group discourse. I would like to take note of four things that occurred during this floor.

The first is a comment by Ms. M concerning her relationship with her calculator:

Ms. M: I need to get my calculator. So I can make a whole person.

This comment is consistent with those she wrote in her learning log (see Appendix G):

Feb. 18: I enjoy and find it very interesting using the calculator.

April 4: Graphing is cool, I like it. I find it very interesting [the graphing was done on the calculator].

Although Ms. M's feelings about her calculator do not seem to have a direct bearing on the group's discourse at this point, they do have something to do with Ms. M's affinity for and competence with the calculator that will have a bearing on how gender is implicated in certain her subsequent interactions..

The second and third things I would like to note in the following passage are the men's need for certainty in mathematical argumentation and Ms. M's inclination to being persuaded by authority rather than making sense of mathematical events for herself:

- 1 Mr. J Negative one minus . . . so it's 3 plus 2 over negative one minus one.
Okay. Now what?
- 2 Mr. L Are you sure about this?
- 3 Mr. J [softly, indirect collaboration] That doesn't seem right.
- 4 Ms. K Like what? . . . That'd be negative 2 on the bottom.
- 5 Mr. L No . . . []
- 6 Mr. J [] The thing is we have to find the equation. Not the substi-digit.
- 7 Ms. K I know. You have to-you go [] in this.
- 8 Mr. L Maybe.
- 9 Ms. M She [Ms. K] did it last night. We'll just follow her. Keep going.

As we shall observe subsequently, in contrast to when the women express similar doubts as to the validity of a statement, the men stop the flow of argumentation from proceeding further, as we have seen at the end of floor 3, until they are convinced of its soundness, which must be based on some mathematical principle or explanation. Ms. M, on the other hand, wants the flow of conversation to continue because Ms. K had previously announced that she had studied the material the night before. Ms. K's argument, however, will build upon the very step the men are contesting and her result will be incorrect if this particular step is itself incorrect. This means that Ms. M is more concerned with getting the answer than with taking care to ensure that she understands all the steps leading to it. In this instance, she is violating conditions 4 and 6 (the argumentation and authority conditions) of the model for good group discourse. If it were not for

the fact that the men do not allow the group discourse to continue without convincing themselves of the correctness of the step in question, this floor would not constitute good group discourse because intersubjectivity would not have been achieved. As it turns out, Ms. M is convinced along with the men and so taken-as-shared meanings do actually develop.

The fourth observation from floor 9 involves the contrast between Mr. L's indirect collaborative speech and Ms. K's egocentric speech. Below is another excerpt from floor 9 that shows the contrast between these two modes of discourse:

- 1 Mr. L [INDIRECT] Two and then . . . you have y equals mx plus b . . . y equals . . . y equals . . . 5 over 2x plus b
- 2 Ms. M | 5 over 2 x equals . . .
what happened to the negative?
- 3 Mr. L _ [INDIRECT] 'twould be negative 2x
. . . plus b . . .
- 4 Ms. K | Oh, sorry.
- 5 Ms. K And then . . . 'Kay, then you take y . . . [EGOCENTRIC] First y two . . . see, that's . . . okay. Then this would be y two [whispers, self-involved] this is the only part I don't understand 'cause then you-you times-you put in for the x you have x negative two and then put in . . . uhm negative one see I want to do two []
- 6 Mr. L What are we doing?
- 7 Ms. K I'm thinking.
- 8 Ms. M [laughs softly] So what number are you putting in for y?
----- [joint between floors 9 and 10]
- 9 Ms. K I put positive one just because it's easier.

I have previously pointed out that the main difference between indirect collaborative speech and egocentric speech has to do with other group members being able to pick up on what the speaker is saying, that is, indirect collaboration is both private and public (Ms. M is able to pick up on Mr. L's thoughts), whereas egocentric speech is private (neither Mr. L nor Ms. M is able to

understand Ms. K's self-directed speech). More evidence will be brought forth later concerning Ms. K's difficulty in thinking private thoughts aloud in public.

At line 9, Ms. M brings Ms. K out of her egocentric speech with a question that precipitates floor 10, a leading voice floor coded LVF:K-G. Although Ms. K leads in this floor, she is questioned closely at every step and corrected five times. In addition to these five error-correction moves, Ms. M attempted another error correction in line 1, which Ms. K does not accept (line 2):

- 1 Ms. M So what'cha take for y_2 ? So it'd be negative 2 or 2
- 2 Ms. K | _ No, it'd be 3 for y_2
- 3 Ms. M So that was a 3. I think [tuneful, uncertain] . . . Okay. So it'd be 3.
- 4 Ms. K So you get 3.
- 5 Ms. M mm-hmm [affirmative]

Ms. M's acquiescence in line 3 and her allowing herself to be carried along by Ms. K contrasts to the way the men refuse to be carried along with the flow of discourse when they are uncertain about correctness, Ms. M responds differently. After having asserted that y_2 should be either -2 or 2 in line 1 (it should be - 2), she remains doubtful at line 3 of Ms. K's counter-statement that it should be 3, no less doubtful than Mr. J's expression of doubt previously quoted, "[softly] That doesn't seem right." In contrast to the way the men stopped the flow of argumentation until they had made sense of it, Ms. M does not clarify the issue by pushing Ms. K for an explanation, but seems to have simply accepted Ms. K's assertion rather than making sense of it. Since It is not clear, however, whether or not Ms. M has accepted the statement on the basis of authority, she must be given the benefit of doubt, though she should have asked for clarification.

Therefore, this leading voice floor constitutes good group discourse.

A new floor (11) begins just after the last of Ms. K's errors. Although this floor, an equivocal floor coded EVF, is replete with corrections and disputation, it does not constitute a multivocal floor because the nature of the argumentation is based on inquiry rather than being centered around two or more persons holding strong contrary positions. At one point during the floor, we again see Ms. M deferring to authority at line 5 below, rather disputing with the men and making sense of their explanations:

- 1 Mr. J Equals
- 2 Ms. M | _ 3
- 3 Mr. J Why is y the 3 again? Because we got rid of that.
- 4 Mr. L Oh, you can []
- 5 Ms. M | _ No. I just-it's up to you to decide.

Nevertheless, this floor constitutes good group discourse because the men continue the dispute begun in lines 3 and 4 above, and the group, including Ms. M (as we shall see), develops taken-as-shared meanings through argumentation over the next three floors. During the men's debate, Mr. L again displays his unwillingness to let the discussion continue when he is uncertain of the soundness of an argument:

- 1 Mr. L We got rid of the negative 2 on the bottom, it seem like.
- 2 Mr. J [] Is that correct?
Okay. So then it becomes . . . 3 equals 5 plus b.
- 3 Mr. L [softly] Are you sure? We're supposed
- 4 Mr. J | _ I have to find the equation.

Mr. L's challenge in line 3, though soft, is effective in instigating a joint explanation from Ms. K and Mr. J (not presented here). Ms. M, however, is not

able to follow their explanation, but this time she is not content to accept others' formulations without understanding them, which precipitates a univocal floor (12) coded UVF:J-M in which Mr. J attempts to explain:

- 1 Mr. J We have negative 2 equals 6.
- 2 Ms. M I lost you. Where do we go after we . . . last thing I have is negative 6 equals 5 plus b. [error]
 ----- [joint between floors 11 and 12]
- 3 Mr. J Neg-negative 6? [puzzled]
- 4 Ms. M See, I don't know what happened. That's why I said I'm lost.
- 5 Mr. J Okay [ETC]

Ms. M's insistence on clarification (note that she makes two requests in consecutive turns) is quite unusual for her. Such a strong demand for an explanation on her part occurred only rarely during the semester. As Mr. J explains his procedure, Ms. M either questions or verifies each step until the floor concludes with Ms. M and Mr. J having negotiated taken-as-shared meanings. This floor, then, constitutes good group discourse. Before the solution can proceed, however, Mr. L has doubts about a particular step, which initiates floor 13, a multi-vocal floor coded MVF:J>L,M:

- 1 Ms. M So it's be 6 over 2 equals 5 plus b.
- 2 Mr. J Yeah.
 ----- [joint between floors 12 and 13]
- 3 Mr. L Hmm. Wait a minute now. The slope in for-what are we solving for here? Aren't we solving for b?
- 4 Ms. K mm-hmm [affirmative]

Mr. L is thinking of an alternate procedure in which the next step does not involve solving for b, which the group is working on at the moment. Mr. J, not realizing what Mr. L is proposing, continues with his own solution. Ms. M takes

Mr. L's side in the questioning, but Mr. J continues on, stating the intermediate result in his solution:

- 11 Mr. L Where'd you get that? [directed to Mr. J]
 12 Ms. M Where do you get negative 2, then?
 13 Mr. J Subtract 5 from 3.
 14 Ms. M Okay [spoken irresolutely]
 [Pause]
 ----- [joint between floors 13 and 14]
 15 Mr. J Okay. What-ah-what do you do next then, [K]? So we have b.
 16 Ms. K b. Then you plug into the problem-the mx.

Although Mr. J prevails in floor 13 in this argument, this floor does not constitute good group discourse. Neither Mr. L nor Ms. M is convinced by Mr. J's explanation, which in itself is valid. Since he cannot convince Mr. L, Mr. J closes off the discussion by appealing to Ms. K, who has agreed with him (line 4), by means of a direct address. Mr. J has violated condition 3 of the model (listening and making sense of others' explanations) and condition 6 (authority) by enlisting Ms. K's support, thereby leaving the point of contention unaddressed. This floor also illustrates a rare lapse on Mr. L's part, i.e. pressing for explanations and resolving conflicts through mathematical argumentation, a violation of condition 4 of the model. Perhaps Mr. L felt he had carried the argument as far as he was capable under the circumstances.

In floor 14, an equivocal floor coded EVF, the group lets bygones be bygones and achieves good group discourse after the following interesting exchanges (picking up at line 16 from above):

- 16 Ms. K b. Then you plug into the problem-the mx.
 17 Ms. M That doesn't help, dear.

- 18 Mr. L Do you subtract the 5
 19 Ms. M | _ Speak up. [directed to Ms. K]
 20 Ms. S Oh, I'm sorry.
 21 Ms. M [laughs softly]
 22 Mr. J y equals [ETC]

This passage is notable because of Ms. M's urgings (lines 17 and 19) for Ms. K to take a more commanding leadership role in what has been for the past few minutes a male-controlled discussion, though she hedges her demands with a term of endearment and a soft laugh, as well as for Ms. K's apology for not asserting herself more. This pattern will repeat a few floors later.

The group winds up problem 5 and begins problem 6 with this announcement from Ms. K:

- 1 Ms. K Oh, I know how to do this one! Shoot, this one's free 'cause we had this problem on the review.
 2 Ms. M mm-hmm
 3 Ms. K It's right there, baby. Okay. The bug is on a line at 4 . . . nine. Displacement is 2.34 over . . .

As Ms. K begins work on the problem, Mr. L works by himself while Mr. J and Ms. M engage in off-task talk about a social event. The floor (15) they constitute is an off-task floor coded OFT:J,M\K-IND,L-IND. This floor ends with an exchange between Mr. L and Ms. K and another urging (line 3 below) from Ms. M for Ms. K to take the lead in the discussion:

- 1 Mr. L I didn't get that finished. [Mr. L is referring to the set of review problems for the exam]
 2 Ms. K | _ You didn't get that far?
 3 Ms. M Okay, [K], go for it.
 ----- [joint between floors 15 and 16]
 4 Ms. K Well, you have m equals 4 over 9, which is the slope

Ms. M uses a direct address (line 3) to Ms. K in order to bring the group together again and to elect Ms. K as the leader of the discussion, thereby ending the off-task floor and initiating floor 16, a leading voice floor coded LVF:K-G. Ms. M again acts as the group encourager (line 3), using her oft-repeated phrase, "go for it."

Ms. K is challenged many times during this floor as she leads the group, but all the challenges are concerned with surface mechanics. Although there were several opportunities to do so, no one challenges Ms. K's formulation of the proportion that underlies the solution of the problem. She is following a similar problem that had been given in the set of review problems, but there is one important difference between the review problem and the exam problem, which everyone overlooks. The review problem had asked for the horizontal displacement, whereas problem 6 of the exam (see Appendix E) asks for the vertical displacement. Ms. K is filling in numbers appropriate for the pattern pertaining to the review problem. The group accepts Ms. K's formulation on the basis of her assumed competence at working this problem since she was the only person in the group to have worked the review problem before the exam (for example, see Mr. L's comment in line 1 above). Although the group will negotiate taken-as-shared meanings with regard to the solution procedure and the solution itself, it fails to achieve good mathematical discourse in this floor because it accepts Ms. K's formulation on the basis of authority, rather than mathematical argumentation, a violation of condition 6 (authority).

During this floor, Ms. M continues in her role as group encourager when

Mr. J becomes a bit overwhelmed:

- 1 Mr. J Wait a minute!
- 2 Ms. K [laughs]
- 3 Mr. J Wow! This is a little much!
- 4 Mr. M [softly] Are you losing your grip?
- 5 Mr. J I dunno [brushing off Ms. M's question]. I-don't know how you got to that [referring to Ms. K's cross multiplication of the proportion].

Ms. M has not participated in the many challenges and explanations concerning procedural moves occurring in this floor. Her concern is that Mr. J is going to panic and that the group will fall apart. While her participation as encourager may be helpful in maintaining group interactions, it may not be good for her own learning.

The floor ends when the group has agreed on the solution. A group management floor (17), coded GMF, is initiated when the group agrees to let Ms. K lead the discussion of problem 7a. The following passage illustrates the emotional support the women provide the group and the men's use of mock aggression and leads into floor 18, a leading voice floor coded LVF:K-G:

- 1 Ms. K [softly] 'kay [conclusion of problem 6]
----- [joint between floors 16 and 17]
- 2 Ms. K Oh! I know the next one too-I'm so excited!
- 3 Ms. M Okay!
- 4 Mr. J If you're wrong, you are the one we're going to get.
- 5 Ms. K Well, you guys could have done them, too [referring to the review problems]-it's not all my-my fault-just because I know how to do it.
- 6 Mr. J You just better be right. That's all I have to say.
- 7 Ms. K Shut up. [softly, light-heartedly]
----- [joint between 17 and 18]
- 8 Ms. K Okay. Now. We have this equation [EGOCENTRIC SPEECH] er-it's $2x$ minus 2. 'Kay. [EGOCENTRIC SPEECH] plus one . . . y

- 9 Mr. L |_ Talk a little louder.
 10 Ms. K [laughs] 2x-'kay-one, two-uh negative 2 plus one is a what? Would that be a- negative one?
 11 Mr. L |_ negative 2 plus one is negative one
 12 Ms. M Negative one.
 13 Ms. K 'kay.
 14 Ms. M So there's your first equation.
 15 Mr. L Where's our first equation?
 16 Ms. M [laughs]
 17 Ms. K [laughs] Sorry . . . Okay. You have y equals [ETC]

Here we see the second instance of Ms. K's lapsing into egocentric speech when she is attempting think through a problem while at the same time contributing to the joint argumentation of the group (the first instance occurred in floor 9). In the previous floor (17), much has been made of Ms. K's responsibility for leading the group through this problem and, moreover, she has expressed her competence to do so in lines 2 and 5. She starts off confidently at line 8 in an assured voice but almost immediately lapses into egocentric speech. She then makes her voice more public but again lapses into private speech. Mr. L is forced to ask her to talk a little louder (line 9) in order to follow her. In floor 14, we had a similar circumstance in which she was called upon to lead the group and where Ms. M had to command her to speak up. Ms. K is being held accountable by the group in its development of intersubjectivity, which she herself feels compelled to account for in floor 9, "I'm thinking," floor 14, "Oh, I'm sorry," line 10 above in which laughs in embarrassment, and in line 17, "Sorry."

As we have already seen, Ms. K is not at all reticent about speaking up in the group nor, as we shall see in a later section, has she been hesitant about

publicly confronting people, nor leading the group when that function evolves naturally out of the conversation. She is uncomfortable, however, when her leadership has not arisen spontaneously as is the case during floor 18. We notice in line 10, for example, that she immediately invites collaboration from the group by turning a simple addition of signed numbers into a question, which she then answers herself in the form of another question. It is when she is publicly called upon to lead the group by herself when thinking through a problem that she has difficulty combining her inner thoughts with her public speech in a way that is intelligible to others. I will argue that the elevation of egocentric speech into indirect collaboration is a modification of the male discourse style that women in this study do not habitually employ. The consequence of this difficulty in floor 18 is the gender-implicated failure of the group to achieve good discourse because the participants not able to arrive at taken-as-shared meanings, a violation of condition 5 (intersubjectivity).

There are two other observations I would like to make as we leave floor 18 and begin floor 19. The first concerns Ms. M in the following excerpt where Mr. J and Ms. K have seemingly come to an agreement concerning a step in the procedure for graphing the equation in problem 7a (lines 1 and 2), whereupon Mr. J has second thoughts at line 3:

- 1 Mr. J Okay.
- 2 Ms. K Okay.
- 3 Mr. J There's no . . . [puzzled]
- 4 Ms. M |_ No, no, no, No, NO! [increasing volume, alarm]

As soon as she hears Mr. J begin to bring into question what he and Ms. K have just agreed upon, Ms. M picks up Mr. J's "no" and repeats its in a crescendo of negatives that becomes itself a denial that Mr. J has found something amiss, a way of saying, "don't stop us--let's keep going on!" That is, she wants to cut off Mr. J's potential challenge. This is another instance where Ms. M places a higher value on group consensus and harmony than on sense making and mathematical argumentation.

Mr. J demurs, for the moment, and Ms. K resumes leadership with her emphatic "Okay" and "now" in the passage that follows, which marks the end of floor 18 and the beginning of floor 19, an equivocal floor coded EVF:

- 6 Ms. K Okay. Now. If you graph this you put one, two, three, four-one, two
three
----- [joint between floors 18 and 19]
- 7 Mr. J | _ Wait a minute-wait a
minute!! Don't graph it. We've got b which is for all the lines
- 8 Ms. K | _ Yeah, man.
- 9 Mr. J Graph them all?
- 10 Ms. K Yeah!
- 11 Mr. J Okay. Them lines are equal, what?

The second observation concerns yet another instance where Mr. J is unwilling to let something go by that he does not understand, that which was bothering him in line 3 above. In spite of Ms. M's attempted intervention (albeit hidden behind a verbal mask) in line 4, it takes only two more turns before he calls a halt to the proceedings. Although Mr. J enjoys group interactions as much as anyone in the group, he is unwilling to let group consensus take precedence over his own understanding, as does Ms. M, even in spite of her friendly

admonition.

After Mr. J is satisfied with her explanation of his difficulty in line 7, Ms. K continues with the solution to problem 7a in floor 19. In this equivocal floor, intersubjectivity is jeopardized because, for the third time, Ms. K's lapses into unintelligible egocentric speech. We pick up in the middle of the floor:

- 12 Ms. K So two doesn't have anything . . . so it goes down here . . . on this.
This is negative one-it's right there [EGOCENTRIC SPEECH] $2x$
 [EGOCENTRIC SPEECH] So I plug this into . . .
 [Ms. M and Mr. L burst out laughing heartily]
 13 = I'm sorry. I'm tired [she laughs] Okay. [louder] This looks like
 a . . . and then you have two [EGOCENTRIC SPEECH] I have to
 switch [EGOCENTRIC SPEECH]
 14 Mr. J | _ So that makes it out a negative two, right?
 15 Ms. M I have negative two.
 16 Ms. K Treat x as a constant [EGOCENTRIC SPEECH]
 17 Mr. J Where's negative two coming from?
 18 Ms. K Negative two?!? Positive two-my fault.
 19 Mr. J Okay. You get . . .
 20 Ms. K [soft, inward] | _ Get two-that'd be negative one [EGOCENTRIC
 SPEECH]
 ----- [joint between floors 19 and 20]
 21 Mr. J And where-what do we do with the negative one?
 22 Ms. M Whooo! Look ahead there [flipping the pages of the test]
 23 Mr. J Wait a minute. Let me check that.

Pronouns are lexical indicators of Ms. K's lapse into the egocentric speech of her private world. When she begins to speak with public authority at the beginning of floor 18, line 18, she uses the first person plural, we, an inclusive pronoun. Similarly, in line 6 above she uses the second person pronoun, you, just after having projected her authority by emphatically announcing "Okay. Now. If you graph this you put . . .", in the same public sense that she might have used the word "one". In line 13, however, she lapses into egocentric speech and shifts

to the personal pronoun "I", at which point Ms. M and Mr. L burst out laughing. They laugh because Ms. K has behaved inappropriately by excluding them from her talk, thereby violating one of the cardinal principles of conversation. Once more Ms. K apologizes, as she has done previously under similar circumstances, and elevates her voice into public speech, this time using the inclusive second person pronoun "you". She then promptly lapses back into egocentric speech and once more uses the personal pronoun, "I".

Repeatedly, Ms. K is not able settle comfortably on a voice located somewhere between her group conversational voice and her private voice, shifting, as we have seen, between one and the other in a space of a few words, her use of pronouns often signaling the switches.

Mr. J and Ms. M have to resort to seizing upon anything they can hear or make sense of from Ms. K's egocentric speech. In line 14, Mr. J attempts to infer what Ms. K is talking about and tries to get her to confirm his inference. Ms. M supports him in line 15, but Ms. K does not respond, continuing in her self-absorbed speech in Line 16, whereupon Mr. J demands an explanation from her in line 17. Startled, Ms. K responds, corrects herself, and, once more, apologizes (I should note that throughout the semester Ms. K has made few apologies to anyone). In line 19, Mr. J attempts to maintain the normal volume level of speech just uttered. Ms. K latches on to Mr. J's "get" in a soft, but intelligible voice in line 20 and then promptly lapses back into egocentric speech. But just before her voice goes inward, Mr. J seizes on her last phrase, "negative one," and

- 3 Mr. L |_ [INDIRECT]
 'twould be negative $2x$. . . plus b . . .
- 4 Ms. K |_ Oh, sorry.
- 5 Ms. K And then . . . 'Kay, then you take y . . . [EGOCENTRIC] First y
 two . . . see, that's . . . okay. Then this would be y two [whispers,
 self-involved] this is the only part I don't understand 'cause then
 you-you times-you put in for the x you have x negative two and then
 put in . . . uhm negative one see I want to do two []
- 6 Mr. L What are we doing?
- 7 Ms. K I'm thinking.

In contrast to the group's inability to achieve intersubjectivity in its attempt to follow Ms. K in floor 19 above, here we see Mr. L, Ms. M and Ms. K develop taken-as-shared meanings in lines 1-4. Ms. M not only repeats Mr. L's words "5 over $2x$ " in line 2 but she also makes a correction (negative $2x$) which Mr. L attends to (unlike Ms. K in floor 19, lines 14-16), smoothly incorporating the correction into his on-going, indirect collaborative voice. Moreover, Ms. K picks up on Mr. L's words " $2x$ " in line 3 and apologizes for having omitted the coefficient (2) of x in her previous argumentation. During Mr. L's indirect collaboration, Ms. M has corrected Mr. L and Mr. L has corrected Ms. K, the three participants achieving intersubjectivity. The situation is quite different, however, when Ms. K lapses into egocentric speech in line 5. When Mr. L calls on her to account in line 6 for the interruption in their development of taken-as-shared meanings, Ms. K explains that she is "thinking." Mr. L was also thinking aloud, a form of semi-public thinking, as he spoke in his indirect collaborative voice, whereas Ms. K's thinking aloud is private. It is only when Ms. K is drawn out of her private thoughts (line 8) just before the close of the floor that the group resumes its

development of taken-as-shared meanings.

As we have seen, floor 20, a multivocal floor coded MVF:S=L, begins with Mr. J's challenge (floor 19, line 21). Mr. L and Mr. J try to get Ms. K to clarify her steps in graphing the equation in problem 7a. Ms. K has reversed the roles of rise over the run in the slope formula and is using the x-intercept instead of the y-intercept as she graphs. Mr. L tries unsuccessfully to point out the intercept error while Mr. J asks for clarifications, whereupon Mr. L resorts to plotting the equation on his calculator. Part of the reason for Ms. K's failure to detect her error may be due to the fact that she does not attend closely to what the men are saying. She had worked a similar problem correctly with Ms. C, a member of group 2 whom we have met, the night before (the answer had been provided) and based on their success Ms. K is convinced that she is working the exam problem correctly, though she has not discerned the difference between the problems.

- 1 Ms. K That's what we did. [Ms. C] and I did this problem last night and that's what we did.
- 2 Mr. L Yeah, but you're-if you're over 2 and then down, you go down from this point, not from here.

Ms. K does not attempt to make sense of Mr. L's objection in line 2, nor his succeeding arguments. Ms. K violates condition 3 of the model (failing to listen to or make sense of others' explanations). Here again is another instance where a man does not accept a claim based on authority. The floor ends in a standoff without the group having developed taken-as-shared meanings and hence cannot constitute good discourse.

Mr. L's work on the calculator initiates floor 21, a working floor coded WF, in which he continues on with his calculator while the rest of the group works with paper and pencil using a numerical chart. Floor 22, a group management floor coded GMF, begins when the group realizes that the calculator and paper and pencil graphs are different. The group decides to check their work, initiating floor 23, a working floor coded WF, but this time Mr. J decides to use the calculator also. Together, Mr. J and Ms. M make a move to end the working floor by calling for the group members' individual results.

- 1 Mr. J Okay. So
- 2 Ms. M |_ What'd we come up with?
- [joint between floors 23 and 24]
- 3 Mr. J [L], you're just going-like this?
- 4 Mr. L I'm just going with the calculator. This is what the calculator says.

Since intersubjectivity has completely broken down, Mr. J resorts to a direct address to Mr. L in order to reestablish the development of taken-as-shared meanings. This initiates floor 24, a multivocal floor coded MVF:L>G, in which Mr. J shows his calculator to Mr. L, who has a different result. The men confer together using indirect collaboration, after which the women accept Mr. L's result without further discussion, a violation of condition 6, authority. The women do not present their paper-and-pencil results nor do they speak at all during the entire floor. This floor does not constitute good group discourse because the women have arrived at a different graph using pencil and paper from Mr. L's calculator graph and the women do not press the men to account for the difference. This is a gender-implicated failure of condition 6, authority. In particular, the

men do not attempt to listen to or make sense of the women's position, nor do the women listen to or make sense of the men's indirect collaboration, all of which is a violation of condition 3 of the model. The floor ends with the group's completion (Mr. L was correct, by the way) of problem 7a.

Floor 25, a leading voice floor coded LVF:D-J, is initiated as the group moves on to problem 7b. In this floor, the men collaborate together on the calculator with Mr. L leading the discussion. Again, the women do not speak during the entire floor. This is another example of where the women let, or even request that, as we shall see later, the men handle the crucial decisions involving the calculator. This withdrawal from argumentation involving the use of technology is not attributable to the women's dislike of the calculator. Ms. K reacted positively to the calculator throughout the semester and, as we have already noted in the analysis of floor 9, Ms. M embraces its use enthusiastically and, in particular, with regard to graphing--the very kind of problem situation in which the group has been involved. There are two possible, perhaps interrelated, explanations for this incongruity. First, the women might regard calculator use as a "male" prerogative or as belonging to the male domain of activity (another instance of this will occur in floor 36). Second, when the group is in an uncertain situation, is stumped, or has come to an impasse (as in floor 24), it will follow the lead of a man, as it will in floor 36. Although it is not clear in the current situation that Mr. J quite understands Mr. L's comment in line 1 below, he has developed taken-as-shared meanings with Mr. L concerning the mathematical argumentation

developed through the calculator operations. It is clear, however, that Ms. M is more interested in moving ahead than listening to or making sense of Mr. L's explanations (see line 3 below):

- 1 Mr. L That's what the calculator said. It's not quite on the one. It's one before-on the axis.
- 2 Mr. J Mmm?
- 3 Ms. M Let's just go on. That's another one.
- [joint between floors 25 and 26]
- 4 Mr. J [reading problem 8a] What percent of the data lies between Q1 and the max?
- 5 Ms. K 75
- 6 Mr. J You sure?

Floor 25 ends when the group has completed problem 7b. This floor does not achieve good discourse because Ms. M, and most likely Ms. K as well (based on her previous and future behavior involving calculator-based argumentation), have not listened to or tried to make sense of Mr. L's explanation to Mr. J, nor have the men made an effort to break out of their close collaboration and make sure that the women are included in the development of taken-as-shared meanings concerning their calculator-based argumentation. So the women violate condition 3 of the model, listening and making sense of others' explanations, due to the fact that they just want the answer ("That's another one") without understanding the underlying rationale, which is partly attributable to their beliefs in the nature of mathematics. The men violate condition 2, the helping condition, because of their exclusive intersubjective involvement. Each of these violations is gender implicated.

Floor 26, a multivocal floor coded MVF:J>S, which I present in full

below, begins with Mr. J's reading of problem 8a.

- 1 Mr. J [reading] What percent of the data lies between Q1 and the max?
- 2 Ms. K 75.
- 3 Mr. J You sure?
- 4 Ms. K Unless it's a 100.
- 5 Mr. J That's what I was thinking. 'Cause I know-'cause this is Q1.
- 6 Ms. K Yeah? [not affirmative, but rather, "go on"]
[silence for 5 seconds]
- 7 Ms. M So now what?
- 8 Mr. J But between Q1, not that []
- 9 Ms. M What do you mean?
- 10 Ms. K That's what I'm saying. It's either 75 or 100. I'm assuming-I think it might be 75--to choose. He gave us this problem last night, too-so. It's 8 [the number of the problem she is referring to]
- 11 Mr. J You guys remember this?
- 12 Ms. K He [the teacher] said, 'what percent of the data lies between the min and Q3?' and that was-and that answer was 75.
- 13 Mr. J But that's between Q3 . . .
- 14 Ms. K But that's basically the same thing.
- 15 Mr. J No. Because the same thing would be between the min and Q4, which is [EGOCENTRIC] 'cause Q3 is right here. Q4 is over here. That's more equal to . . .yeah, 100.
- 16 Ms. M [laughs and makes a joke, unintelligible]
[Ms. M and Mr. L laugh]
- 17 Ms. K Okay, you guys, we have 10 more minutes to finish the test. So let's get moving here.
- 18 Mr. J Okay. We've got uh-I think it's a 100. What do you guys think?
- 19 Ms. M I say it's 100.
- 20 Mr. L [softly] Where does the 4 tie in? [referring to Mr. J's use of the notation Q4]
[silence for 25 seconds]
- 21 Mr. L [slowly] Seems right to me
- 22 Mr. J Hundred? [to the group at large]
- 23 Ms. M mm-hmm [affirmative]
- 24 Mr. J [softly] That should be 3 [referring to Q3 as he labels the diagram on his exam paper]
- 25 Ms. K [softly] That should be 3.

Ms. K promptly gives the correct answer to the problem at line 2, which Mr. J questions in line 3. Ms. K had worked a similar problem (an answer key

had been provided) the night before (line 10) in her learning log (which I have examined and found to be correct), but after Mr. J's expression of doubt she has second thoughts at line 4. Ms. M, in her role as group encourager, tries to break the silence, as well as the deadlock, in line 7. Mr. J starts an explanation in line 8, but his voice trails off, whereupon Ms. M tries to draw him out in line 9. Although Ms. K hedges in line 10, ("it's either 75 or 100"), she tries to support her claim (75%) by appealing to the fact that she had worked the problem the previous night and by adding the word "so," an inferential connective whose implication is "so I know what I'm talking about." We have seen a similar situation in floor 20, in which Ms. K had backed up her claim by announcing that she had worked a similar problem the night before. At that time, Mr. L tried, unsuccessfully, to point out her error (she had not discerned the difference between the review problem and the exam problem). Here, by way of contrast, Mr. J makes an appeal to the group for support (line 11) in order to weaken Ms. K's authority. In line 12, Ms. K recalls the statement of the review problem and states the answer to it was 75. Mr. J begins to point out the differences between the problems in line 13. Ms. K interrupts him by pointing out that the two problems are basically the same. Ms. K is quite correct in her analysis. The two problems have symmetric structures, that is, they are mirror images of each other. So they are, indeed, basically the same and their answers are identical. In line 15, Mr. J attempts to refute Ms. K by pointing out the differences between the two problems, which are merely surface differences. Moreover, Mr. J is mistakenly

thinking of Q1 and Q3 as geometric sections within the plot, instead of thinking of them as numbers defining the first and third quartile. In addition, Mr. J invents the notation Q4, which has never been used in this class and which causes Mr. L's puzzlement in line 20. After Ms. M attempts to restore social harmony in line 16, Ms. K points out that there is little time left to finish the exam and urges the group make a decision. Mr. J puts the question to a vote in line 18. Ms. M votes with Mr. J in line 19 and, by so doing, once again places group consensus above mathematical argumentation. It is now up to Mr. L, who continues to try to make sense of the problem at line 20. His hedge in line 21, "Seems right to me," spoken after the longest pause in dialogue during the exam, is delivered slowly and without a falling intonation after "me," indicating that although he is not really convinced, he cannot think of a reason that either confirms or denies Mr. J's assertion. Over the semester, Mr. L has been most tenacious in his insistence on accepting results solely on the basis of mathematical argumentation, and so his judgment, rendered only after his obviously careful consideration, carries a great deal of weight in the group. Ms. K has abandoned argumentation several turns ago and accepts the group's decision, as evidenced by her participation in it in line 25.

The group fails to achieve good mathematical discourse in this floor because the conflict between Ms. K and Mr. J is not resolved through mathematical argumentation, but through authority, which is a gender-implicated violation of condition 6 of the model. Ms. K should not have backed away from confronting

Mr. J. She attempted to use her work the previous night as a means of persuading the group on the basis of the authority she has thereby accrued, rather than elaborating and explaining what she has learned. Rather than yielding to Mr. B in the interest of group harmony, she should have convinced the group of her position through argumentation, especially since Mr. J's refutation of her result is not very coherent.

Floor 27, an equivocal floor coded EVF, is initiated by Mr. L's reading of problem 8b in an indirect collaborative voice.

- 1 Mr. L [INDIRECT] Will the mean be less than, equal to, or greater than the median?
- 2 Mr. J Anyone come up with an answer for 8b?
- 3 Ms. M I'm thinking greater than. But I don't know why.
- 4 Mr. L [INDIRECT] Let's see here.
- 5 Ms. M The mean would go here?
- 6 Ms. K Is the median and the mean the same thing?
- 7 Ms. M mm-hmm [affirmative] So it'd be right here. So it's be right there.
- 8 Mr. J The median . . . is
- 9 Ms. K | _ It's-can't be the same thing 'cause
- 10 Ms. M | _ No. It's because the median is this.
- 11 Mr. L | _ It's because the median should be less than the mean, I think . . . so the mean would be greater than.
- 12 Ms. M Then we have to explain why. [the question specifically requests an explanation]
- 13 Mr. L Because . . .
- [joint between floors 27 and 28]
- 14 Mr. J [L]?
- 15 Ms. M [softly] Okay, go for it. Here we are []
- 16 Mr. L Okay. The mean takes into account the size of each piece of data [ETC]

Mr. J, continuing in his role as moderator (recall that control over group interactions indicates the exercise of social authority) from the last floor (see lines

18 and 22 in the previous floor), assumes management of the group by explicitly calling for a response, whereas Mr. L's indirect collaborative reading of the problem invites a response by implication. Lines 1 and 2 exemplify two forms of male control, one covert through indirect collaboration, in which one can affect the flow of conversation indirectly and make his presence felt without dominating the interactions, and the other overt, by acting as moderator, or chair, and directly controlling events. Ms. M promptly gives an answer, an irresponsible move since she has no reason for her response. This is not unusual for Ms. M (recall her prompt response, "I say it's a 100," after Mr. J's incoherent explanation in the previous floor); throughout the entire semester she gave answers for which she had no backing, which may account for why she was the most often ignored person in the group. While it might be argued that she has responded to an intuition based on underlying reasons that she cannot, as yet, articulate, such is not the case here for the following reason. In line 6, Ms. K asks if the median and the mean are the same, to which Ms. M, in line 7, responds in the affirmative. This means that while Ms. M has asserted that the mean is greater than the mean, her understanding is that they are identical. When Ms. K realizes that they cannot be identical in line 10, Ms. M reverses herself, apparently realizing for the first time the distinction between the two, which means that it is most unlikely that she had understood the nature of the question, let alone having a reason for her answer. In contrast to Ms. M's unreflective reaction, we hear Mr. L's thoughtful engagement of the problem in line 4, characteristically spoken in his semi-public

voice.

By the end of the floor, the group has agreed to proceed with Mr. L's conjecture (line 11) that the mean should be greater than the median, the very same proposition that Ms. M had asserted in line 3. He arrives at his conjecture not out of the blue, as did Ms. M, but by way of inference from another proposition, "the median should be less than the mean . . . so the mean would be greater than." This suggests that he has something in mind upon which to base his greater-than proposition. Moreover, Mr. L emphasizes the word "less" in order to strengthen his less-than proposition and, as mentioned above, he does not habitually make strong assertions, as does Ms. M or Ms. K, unless he has a reason to support them. So it is not surprising that his more-than assertion carries more weight in the group than Ms. M's, though he, as yet, had not developed a suitable account for it.

Everyone in the group participated in this equivocal floor (27), which contains conjectures, disagreements and then subsequent agreements, and although there are these disputes occurring in the floor, they do not persist long enough to constitute a multivocal floor. Furthermore, the nature of the floor is characterized by inquiry rather than advocacy (as would be required in a multivocal floor). A judgment cannot be made at this point as to whether the inquiry conducted in this floor amounts to good discourse until it can be determined whether or not subsequent developments lead to taken-as-shared meanings negotiated through mathematical argumentation with regard to the more-than conjecture. For

reasons given below in floor 28, it turns out that the group does not subsequently develop intersubjectivity while attempting to provide an explanation, and hence this floor does not constitute good group discourse.

Floor 27 ends just as Mr. L begins to articulate an explanation supporting his conjecture. Mr. J calls floor 28 to order by "recognizing" Mr. L, using a direct address. I have chosen these words quite deliberately because Mr. J's voice is that of a chairman moderating a meeting and as I was transcribing this exam I had the distinct impression that at times Mr. J was playing the role of moderator, a display of social authority. But this impression is based on force rather than frequency. An examination of the text itself reveals that control of the group's interactional agenda passes back and forth quite freely between the various members, though its nature seems to depend on the leader's particular role in the group at the moment. Moreover, an analysis of who begins the work proper on each problem yields the following summary: Ms. K initiated work on six of the problems, Ms. M none, Mr. L four, and Mr. J only three. By way of accounting for this finding in terms of authority, it might be argued that initiating work on problems is evidence of mathematical competence and authority, not social authority. But such is not the case because Mr. J was regarded by everyone in the group as the mathematical authority (known through personal interviews with group members) and we have already seen that Ms. K was not always regarded as a mathematical authority, even with regard to those problems (for example, 6 and 7a) for which she could legitimately claim mathematical authority

- 3 Mr. L Okay. The mean takes into account the size [ETC.] [Mr. L begins dictating as he writes]

In line 1, Mr. J attempts to follow the argument, but then begins to ask Mr. L if he would speak aloud as he writes his answer. Before Mr. J can even finish his request, Ms. M interrupts him, imploring Mr. L to wait until she can catch up writing what he has just said and to speak up as he writes so that she, as well as Mr. J, can write down the answer. It would appear that Mr. J and Ms. M are simply copying down what Mr. L dictates. Here and subsequent talk, there is not sufficient evidence to indicate that Mr. J, and particularly Ms. M, have made sense of Mr. L's explanation, a violation of condition 3, the listening condition, of the model and therefore it is not likely that they have negotiated taken-as-shared meanings, a violation of the intersubjectivity condition (5). Therefore, this floor (28) does not constitute good group discourse.

Ms. K confidently explains problem 8c to the group in floor 29, a univocal floor coded UVF:K-S. No other voices speak to the problem during the entire floor. Because other members do not question or verify the steps in her explanation, an error in the way she sets up the proportion goes undetected. This floor does not constitute good group discourse because group member do not negotiate for meaning, a violation of condition 5, intersubjectivity.

Floor 30 is a group management floor, coded GMF, during which the group discusses where problem 9a has occurred in the course.

In floor 31, a univocal floor coded UVF:L-G, Mr L sorts the data with his

calculator, mistakenly finding the first quartile of the female leg press data instead of the upper quartile. Everyone follows along, questioning and supplying some of the steps, as Mr. L goes through the ascending sort on the calculator by himself. Although no one catches Mr. L's incorrect sorting order, this floor constitutes good group discourse.

Floor 32, coded OTF\L-IND, commences when Ms. S, Mr. J, and Ms. M begin engaging in off-task talk, while Mr. L continues to work independently with his calculator. Mr. L realizes his mistake and makes the following announcement, which precipitates a group management floor (33) coded GMF:

- 1 Mr. L All right. I gotta think, now. Oh, we've gotta . . . this is going to take a while. You guys []
 - 2 Ms. K Okay.
- [ETC. (Banter about Mr. L's working by himself)]

After having caught his sorting error, Mr. L realizes that he will have to resort (line 1). He discourages the group from participating with him in his reorganization of the data, "I gotta think, now," and "You guys [unintelligible]." As we shall learn upon examining the comments from the post-exam reflection papers, the group will make much of Mr. L's disengagement, not only here but also in floors 37 and 38. As I have mentioned previously, any floor in which someone works independently of the group does not constitute good group discourse because negotiation of meanings on a moment-to-moment basis is not possible.

The group then engages in off-task talk while Mr. L works with his calculator, initiating a long off-task floor (34), coded OTF\L-IND.

I submit that Mr. L's independent actions are a consequence of his membership in the masculine discourse culture and that the effects of his actions constitute gender-implicated violations of intersubjectivity, condition 5, in the failure of the group to achieve good group discourse in floors 32-34.

Floor 35, a univocal floor coded UVF:L-G, begins with Mr. L's detailed explanation of the steps he undertook on the calculator in an descending sort. He then recites the various statistics associated with the top quartile of female leg-pressers. The other members of the group attend to his explanations, contributing to his explanation. This floor, then, constitutes good group discourse.

Floor 36, an equivocal floor coded EVF, begins with Ms. K's reading of problem 9b. The group discusses the implications of the height- and weight data of the upper quartile leg-pressers with respect to the entire class and negotiates the wording of their responses. Although this floor constitutes good group discourse, the group does not realize that they are to make box-and-whiskers plots of the heights and weights of the entire class and then locate, respectively, the heights and weights of the upper-quartile leg-pressers within (or above) the plots in order to locate the heights and weights of the best leg-pressers in relation to the entire class. This statistical information would provide the backing for the group's verbal description of the heights and weights of the upper-quartile leg-pressers with respect to the heights and weights of the entire class (the group had worked problems similar to this one in previous class periods, but does not now associate them with this particular context). After writing down their verbal

descriptions (without having the two appropriate plots to support their argument), the group realizes that it should draw a plot of some kind and wonders what to do next:

- 1 Ms. K 'kay . . . what does this boxplot look like? I don't know how to do boxplots. So this is where you guys can come in.
- 2 Ms. M Okay, then.
- 3 Ms. K Okay, dudes. What's happenin'?
- 4 Ms. M |_ We're depending on you [the men]!
- 5 Mr. D Aaaaahh!

Here is another instance in which the group is uncertain what to do and in which the calculator must be used, and where the women abrogate all their responsibility for solving the problem to the men. As I have mentioned previously, one possible explanation for their behavior is that they believe that work with technology belongs in the male domain and therefore men are going to be more competent at it. But I believe there is much more involved here. While it is true that Ms. K has just expressed her incompetence with graphing box-and-whiskers plots (line 1), the situation is not the same for Ms. M. As we have seen, Ms. M has expressed on a number of occasions during the course, and even during this exam, her enthusiasm for using the calculator. Moreover, earlier in the exam Ms. M had helped Mr. L clear up a problem (not presented here) he had with box-and-whiskers plots appearing on his screen that required familiarity on her part with all the operations involving these plots. It is not out of aversion to or incompetence with the calculator nor fear of fear of working with men in their supposed area of competence that causes Ms. M to call on the men to take

exclusive charge of answering the problem. She has, given the pressure of finishing the problem and the exam, not only the motivation but also the technical wherewithal to at least participate with the men in solving the problem. Ms. M's puzzling action has less to do with her relationship to the men regarding her demonstration of competence, I submit, than with her relationship to Ms. K regarding a display of competence. That is, there is something in the history of the relationship between these women that I believe is implicated in Ms. K's behavior, the story of which I will relate in a later section, "Group 2 Gender Issues in Context."

Before leaving this floor, I would like to point out yet another example of Mr. J's assertion of social authority in the group that occurred earlier on in the floor:

- 1 Ms. K So basically we're looking at that, the information that you get in L2 and L3, seeing that they are . . . heavier and the tallest girls.
- 2 Ms. M |_ taller
[silence interspersed with Mr. L's egocentric whisperings]
- 3 Mr. J So what have we got here? Read them off! [commanding voice]
[no response, silence]
- 4 Mr. J Oookay. I've got that written down.
[the women laugh]

After Ms. K explains that by examining the weight and height information of the class stored in lists L2 and L3 in the calculator they can see that the best leg pressers appear to be the heavier and taller female athletes, the group lapses into silence. Mr. J once again steps into the role of chairman in order to get things going again in line 3 by commanding Ms. K to read off the information in

her lists, to which he gets absolutely no response. Mr. J cleverly saves face by continuing his role as chairman as if his demand had been fully complied with, the humor of which is heightened by the fact that, in truth, he has indeed written down what Ms. K has read—precisely nothing. This is not only another example of Mr. J's on-again, off-again assertion of social authority, but also of how the men have mitigated social tension all during the semester through role playing, exaggeration, voice masks, and mock aggression.

In floor 37, a joint off-task and univocal floor coded OTF:M,K\UVF:L-J, Mr. L leads Mr. J through the graphing of a plot while Ms. M and Ms. K engage in off-task talk. This floor fails to constitute good group discourse because the group is not engaged in negotiating taken-as-shared meanings. Mr. J apparently is not attending very closely to Mr. L's talk and he abruptly breaks away from Mr. L and joins the women in off-task talk in the middle of Mr. L's solution. Mr. J's action precipitates floor 38, coded OTFL-IND, an off-task floor in which Mr. L works independently with his calculator while Mr. J, Ms. K, and Ms. M chat about clothes, top hats, and wedding apparel. This is the second occasion on which Mr. L undertakes the responsibility for solving a problem while the others socialize.

Floor 38 ends with the initiation of floor 39, an univocal floor coded UVF:L-G, when Mr. J directs a question to Mr. L about his plot. The group copies Mr. L's plot, asking questions and jointly participating in completing the drawing. Although the group's participation in this particular phase of the problem would constitute good group discourse in itself, the floor, when examined in

a larger context, cannot constitute good group discourse. The group has not negotiated the meaning of what is being asked for in the problem. Mr. L has plotted the leg-press data and, working together, the group has correctly located the upper-quartile female athletes in the plot. This is not, however, what the problem asks for. Mr. L made the crucial decision as to what to plot when he was working independently. If the group had jointly participated in making that decision, albeit an incorrect one, then their discourse in this floor might have qualified as good group discourse. However, the group did not arrive at taken-as-shared meanings because it was not jointly engaged in taking the fundamental conceptual step in the problem's solution and therefore has no mutually shared understanding of what was done. This failure to achieve intersubjectivity is due to the abiding effect of Mr. L's gender-implicated, independent actions.

This is how work on the exams ends:

- 1 Mr. L Is that it?
- 2 Ms. M That's it.
- 3 Mr. L I like that.
- 4 Ms. M We did it, guys!

Group 2's Reactions to the Exam

The following reactions to the group exam are excerpted from the post-exam reflection paper each student wrote and submitted two days after the exam. These comments are rendered as nearly as possible in the form they were written by the students themselves (I omit the use of "sic.").

Ms. K:

Sometimes when people get into groups not a lot is accomplished, however, in some cases there is a group of people who just want to get done as soon as they can. My group was like that. We tried not to dwell on one question for too long.

We got the test and we looked over it at a glance. Each question we looked at with a new objective to get it finished. Some questions, certain people remembered how to do it better than others and other questions we fought on how to get it done. I do remember on one question that we were fighting on the right answer. I put down an answer that I totally did not agree with. However, on getting the test back I found out that my answer was the correct one. [Ms. M] always encouraged not fighting between us (Mr. J, Mr. L, and I). But she did tend to agree on the right answer sooner or later. [Mr. L] always thought that he knew what he was doing and in some cases he did, however in other cases he was completely wrong and was too stubborn to see it. [Mr. J] was that logical one and tried to solve everything in a hurry but having done it well.

Ms. M:

The group exam proved the bond formed by and through our study group. We worked very well together and managed to have a good time also. On this assessment we had very few disagreements and the answers seemed to come about easily and correctly. We were all pleased w/ the results.

On the first two questions we breezed through each step very quickly and unfortunately we worked so fast that we made a simple and silly mistake. However we still agreed. This fast rate continued through the rest of the first page because of our confidence on this style of problems. Although there was still no disagreements within the group we again must have overlooked a simple miscalculation. The first question of the second page began to slow us down a bit, but after a minute or two, [Mr. L] had an idea of what to do, so we followed his leadership. Unfortunately he was wrong. But from that point on we gained back some confidence and cruised through the rest w/out much of a struggle, until the final problem. On this problem we were all clueless and wondered what to do. Then, once again, [Mr. L] had an idea and we followed his leadership. Too bad it was wrong. Thus, this test ended, approximately 10:10.

Mr. J: [copied Ms. M's paper above word for word, apparently not realizing that he was to submit his own reflections]

Mr. L: [although Mr. L addresses how the group dealt with each question on the exam, I present only excerpts]

Question 2: This one we worked on together as a group, [Ms. M] being most influential in solving the problem. All group members came to same conclusion on the answer with no conflict.

Question 3: Again, worked on this question together, [Ms. M] being most influential. This seemed to us to be a logical conclusion for the answer (similar to a review problem we had in which we solved the same way).

Question 7: There were some minor disputes over this one as well. I figured the problem on the TI-82, [Ms. K] and [Mr. J] [note: Ms. M, not Mr. J] tried it P/P [pencil and paper]. Their initial graph was different from the TI-82 in 7a). We all decided to go along with the calculator. 7b) was easy to graph without the calculator.

Question 8: I seem to recall that [Ms. M] and I [note: it was Ms. K, not Ms. M] believed the answer to 8a) was 75%, but Ms. K [correction: Ms. M] and [Mr. J] believed it was 100%. We debated it for a while, and went along with [Ms. K] [correction: Ms. M] and [Mr. J]. Looking back at my notes now, I see that [Ms. M] [correction: Ms. K] and I were correct. . .

8c) Somehow, we must have missed the question here. We only took 25% instead of 75% in setting up the problem. We'll just call it encoding failure!

Question 9: 9a) Took the information in the calculator and SORTD(L4,L1,L2,L3) to get the answer. I spear-headed this problem, & read off my answers to the group. We all agreed this was correct.

9b), we were getting pressed for time. I got in a hurry and did not read the question appropriately. Because the other group-members thought I knew what I was doing, they all went along with me on it. This was my failure.

Ms. K's comments provide insight into her beliefs about the nature of mathematics, her feelings about mathematical argumentation, and the high value she places on group consensus. In particular, she believes the purpose of mathematics is to obtain correct answers as quickly as possible (this was true even for non-test situations) and she equates mathematical argumentation with "fighting on the right answer." Moreover, she sees Ms. M's contribution to the success of

the group as reducing the fighting between the group members and always accepting the consensus of the group. Mr. L, on the other hand, was "too stubborn" to see when he was wrong. Since analysis of the transcripts reveals that Mr. L never arbitrarily asserted his will over the others but attempted to use mathematical argumentation to support his claims, it would appear that Ms. K views mathematical argumentation as disruptive of group consensus and harmony. It is ironic that Ms. K regards Mr. J as the "logical one" in the group when it was Mr. J who asserted his authority over her in floor 26, the very floor during which she allowed herself to put down an answer that she "totally did not agree with." Recall that she declined to argue for her initial correct response, which she could have done since she had successfully worked a similar problem the night before, yet another indication that she regards mathematical argumentation as disruptive.

Ms. M values group harmony, having a good time, and getting answers quickly and easily. Even when the group worked so fast that it made a mistake, nevertheless "we still agreed," further evidence of the value Ms. M places on group consensus. Although Ms. M gives some credit to Mr. L for his leadership in coming up with ideas when the rest "were all clueless," her beliefs about the nature of mathematics and her high regard for group harmony and consensus are quite similar to Ms. K's.

Mr. L's narrative stands in sharp contrast to those of the women in its focus on the details of each problem. His criterion for accepting an answer does not involve group consensus, but rather what "seemed to us to be a logical

conclusion for the answer.” He also points out the one occasion in the exam in which he could not reach a conclusion based on argumentation (floor 26), though the transcript shows that he attempted to do so.

There are two further observations I would like to make concerning Mr. L’s remarks. First, Mr. L was the only person in the group to give Ms. M credit for anything other than being a group facilitator. Second, Mr. L assumes full responsibility for the group’s failure to get the last problem correct. What I want to point out concerning these observations is my reactions to them as the teacher/researcher.

After having completed the transcription of the group exam, I was unwilling to grant Ms. M very much credit for anything, and so I was puzzled when I read Mr. L’s reflections, which were obviously written with some care and deliberation. It was not until I had made transcriptions of the entire semester that I caught a glimpse, but just a glimpse, of a different Ms. M of whom Mr. L may have had a better sense of than I (I will write of this further in the section titled, “Group 2 Gender Issues in Context”). When I asked Mr. L who he considered to be the mathematical authority in the group throughout the semester (post-course personal interview, May 24, 1996), he replied that Mr. J was, though Ms. M was fairly close. This substantiates his regard for Ms. M’s contributions during the exam. Overall, the evidence does not support Mr. L’s view, yet I do not take his opinion lightly and I must address this matter later.

After listening to just how “clueless” the group was as it engaged the last

problem and seeing how Mr. L tried to pull the group through, I was astounded by Ms. K's accusation that Mr. L was "too stubborn" to see when he was wrong and that she should lay at his feet the responsibility for the group's failure with these problems when she (nor anyone else) made any effort to help him or themselves. After reading Mr. L's remark, "This was my failure," I made the note, "No, it wasn't his failure, but theirs!" Now, after many months of analysis of the gender effects in this group, which I had not as yet understood, I am no longer as convinced as I was that Mr. L was not, indeed, at fault and that Ms. K's negative reaction was unjustified. I mention my own reactions regarding these two issues because it seems to me that they constitute, in some sense, findings that may be of interest to teachers and researchers.

Findings From Floor Codes

The percents used in the findings below are based on the summary times (rounded to the nearest tenth of a minute) tabulated in Appendices A-D. Appendices A and D list the floors that occurred during the group exam for each group, respectively, along with the running time when each floor was initiated, the length of the floor, whether good group discourse was achieved during the floor, and, if not, the model condition(s) that was violated (and by whom), any gender effect(s) implicated in the failure (by whom and which effect), and the problem each member of the group was working on during the floor.

One of the most striking results of the floor analysis is that the women

worked independently of their group for 3.7 min. of the total combined group test times (147.1 min.), or 2.6%, whereas the men worked independently for 52.4 min. of the combined times of both groups, or 36%, of which Mr. B's independent actions constitute 32% (i.e. 32% from group 1 and 4% from group 2). This underscores the importance of looking at group 1 more closely.

Since Mr. B's disengagement from the women in group 1 was so pervasive, Appendices B and C list the floors that were constituted when Mr. B was engaged with the group, titled "G1 Floors Wholly-Engaged," and when Mr. B worked independently of the women, titled "G1 Floors Women's Subgroup," respectively.

Appendix D provides a summary of floor types that occurred in group 2, the time the group constituted each floor type, any discourse conditions violated, and any gender effects implicated in failed discourse. Appendices B and C provide the same information for when group 1 was wholly engaged and for when the women constituted a subgroup, respectively.

Group 1 spent a total of 87.5 min. on the exam during which Mr. B was engaged with the group for 39.8 min. (45%) and 47.7 min. (55%) when he was not, thereby causing the women to function as a subgroup without his participation. Moreover, even when the women functioned as a subgroup, Mr. B's independent actions still had an effect on the women's discourse. Although it is almost impossible to determine the full extent of this cross-over effect, the analysis of floors 37 and 44 of the women's subgroup, as we have seen, revealed that Mr. B's actions had a direct bearing on the women's failure to achieve good

discourse. In fact, this carry-over effect accounts for 50% of the gender-implicated failure of the women's subgroup to achieve good discourse even though he was not participating with the women.

Combining the effect of Mr. B's disengagement with the effect he had on the group when he was engaged with the women, Mr. B's gender-implicated behavior contributed to 74% of the gender-implicated failed discourse in the group. Mr. B's only violation of the conditions for good discourse other than intersubjectivity occurred during floor 17, which lasted 1.4 min., and involved his violation of condition 2, helping. This means that Mr. B contributed to 72% of all the failed discourse in the group, 98% of which was gender implicated due to his failure to achieve intersubjectivity with the women. Even during floor 17, however, Mr. B was not solely responsible for the group's failure to achieve good discourse since Ms. C likewise violated condition 2 and the group as a whole violated condition 5, intersubjectivity.

When we examine the times when Mr. B was engaged with the women, we see that the group failed to achieve good group discourse 89% of the time, 71% of which was gender implicated, breaking down to 24% feminine effect, 39% masculine effect, and 9% both effects (rounding errors account for the 1% difference) compared to 53% of the time for failed discourse in the women's subgroup, 20% of which was gender implicated, breaking down into 10% feminine effect and 10% masculine effect (recall, however, that Mr. B was not even involved in the subgroup). The percent of failed discourse in the women's subgroup (53%) is

comparable to that of group 2 (47%), though there is twice as much gender-implicated failed discourse in group 2 (21% compared to 10%). It is questionable, however, to assert that the women's subgroup enjoyed less gender-implicated difficulty than the mixed-sex group for at least two reasons. First, Ms. D's helplessness and lack of dedication had a profound negative effect on the women's interactions on the women's subgroup, very little of which I felt I could safely ascribe to her membership in the feminine communicative culture. Second, Mr. B's gender-implicated actions were so pervasive that they may have prevented other gender-implicated effects from occurring that could be attributed to the feminine discourse culture.

Analysis of Gender Effects

Summary of Gender Issues From the Group 1 Exam

There are three major interactional difficulties with regard to the group's achieving good discourse during the group exam: (1) Ms. C's not-unjustified irritation with Ms. D, (2) Mr. B's working independently of the women, and (3) the women's valuing group consensus and harmony above mathematical argumentation. I will argue that: (1) the source of friction between Ms. C and Ms. D, much of which could certainly be due to the personalities of the two women, can be partially attributed to Ms. D's beliefs about the nature of mathematics, which in turn can be accounted for in terms of enculturation into the feminine discourse

culture; (2) Mr. B's independent behavior can be attributed to his strict adherence to the norms of the masculine discourse culture; and (3) the women's avoidance of mathematical argumentation can be attributed to their acting in conformity to the norms of the feminine culture. I am not arguing, however, that every failure of a group to achieve good mathematical discourse is gender related; I am attempting, rather, to point out that many such failures at the interactional level can be explained in terms of the theory of gender communicative cultures and that each of the above interactional difficulties illustrates how the norms of the gender discourse culture might adversely affect good mathematical discourse. In addition, these gender issues are not confined to this group alone, but manifest themselves in group 2 as well, the evidence for and the effect of which I present in the section in which I deal with group 2 gender effects. I am led to explain these effects in terms of gender cultures because the evidence for each of the effects seems to be so clearly drawn along gender lines, e.g. in contrast to the women in both groups, none of the men in either group at any time during the semester ever expressed beliefs similar to Ms. D's nor acted in a manner consistent with someone holding these beliefs, nor did any of the men ever place group harmony or consensus above mathematical argumentation.

Because Mr. B's difficulty with intersubjectivity was implicated so extensively in the group's interactional dynamics during the exam, I have not dealt with gender issues separately in this group, as I have done with group 2, when considering them in the context of the semester. I have, however, dedicated a separate

section to my explanation of Mr. B's difficulty with intersubjectivity in terms of the masculine discourse culture.

Group 1 Gender Issues in Context

Mathematics Beliefs, Intersubjectivity, and Argumentation in Context

The first thing I would like to establish is that the interactional patterns evidenced in the group exam emerged early on in the semester. This is necessary in order that analysis of gender effects can be based on interactional patterns that had been regularized over the semester and hence can be taken as representative of the group's discourse habits. I present for evidence a summary analysis of three class periods, the earliest occurring during the 12th period of the semester and the latest occurring during the 15th period. These analyses comprise between them most of the patterns of interest that will occur for this group during the exam.

The following is a summary of the 12th period of the semester (the class had been working in groups from the second period). Immediately after I had given the groups their assignments and they had begun working, Ms. D announces, "I'm lost." My transcription notes read, "Helplessness. She doesn't try to engage the problem. [Ms. D] gives up unless an answer occurs to her immediately, or unless someone gives her an answer, or at least a start on the problem." Ms. D turns to Mr. B for help. Mr. B is already working independently and fends

Ms. D off with, "I gotta finish the first steps first." Ms. D turns to Ms. A (Ms. C is absent today), addressing her directly. It is here that I first made the connection between the use of direct address and interactional difficulties in the group. I note, "Yes, I have found a problem in group collaboration in every single instance direct address was used in this group." A few minutes later, Ms. A asks Mr. B to look at her calculator screen. Mr. B fends off Ms. A, "Hold on a minute-I'm still checking this out." A few minutes later, Ms. A asks Mr. B, "What's the answer supposed to be?" After Ms. A receives no response, she uses a direct address, "What'd you get, [Mr. B]?" This time Mr. B reports that he had figured out the first problem. I note:

This is a pattern for B. He works alone and behind the others and then announces his answer. Reportorial style. This is not a good way for the group to build a consensual domain or develop taken-as-shared meanings (notes taken during the 2/21/94 transcription).

Ms. D expresses her helplessness and frustration repeatedly:

"I'm lost, once again."

"I can't figure out method two."

"Oh, I'm so frustrated."

"How are we supposed to turn all this old . . . mumble-jumble []?"

"I can't even get my button to work."

"I can't figure it out."

"I can't get it-I'm []" (from transcription, 2/21/94)

I had noticed the breakdown in the group talk, which I only subsequently realized was due to Ms. D's sense of helplessness and Mr. B's independent actions, and had intervened in an attempt to facilitate the collaboration. I was further alerted to communication difficulties because I had also been called over

to the group twice, once by Ms. A and once by Mr. B.

The pattern of Mr. B's working independently and then reporting his results (what I call his "reportorial style") continued throughout the period, just as it did on the group exam. At one point while Ms. A and Ms. D were constituting an equivocal floor, Mr. B interrupted the women's collaboration, his first utterance in many minutes, with a question that was completely irrelevant to the women's discussion, just as he did on the group exam. I noted, "[This is] not problematic for B because his idea of group work is to work independently and then ask others for help when he needs it" (note taken during the 2/21/94 transcription).

The following 20-minute episode (the fourteenth of the term) occurred two classes later on 2/23. All the group members were present. The most notable thing about this day was that the women collaborated well and developed a consensual domain amongst themselves. Mr. B, on the other hand, did not join in the building of this consensual domain nor participate in establishing taken-as-shared meanings. Rather, he worked independently of the women and was always behind them. Other than contributing two brief remarks toward the building of taken-as-shared meanings, his interaction with the women consisted of six interruptions in their collaboration, in each case to check with the women about answers to problems they had completed some time ago or to ask where the women were in the problems. This pattern of interaction led to missed opportunities for learning for both the women and for Mr. B. The women did not come

to understand the algebraic generalizations of a series of numerical patterns, which had consequences for group discourse in a subsequent period and which was the point of the current exercises. Mr. B, however, made the generalization correctly, though he was not able to finish the entire set of assigned exercises, which the women did. If he had been engaged the women from the beginning, the women would have participated in the development of the generalized results for which the sequence of problems had been designed. On the other hand, one of the things that slowed Mr. B's progress was that he wasted time writing down every calculator keystroke in his learning log, which was not required and which none of the women had done. In an effective collaborative group, Mr. B's superfluous work would have been noticed and, over the course of the semester, he might have learned from the women how to respond more efficiently and appropriately to written assignments, a problem with which he contended all through the course and which showed up in the group exam itself.

The following 20-minute episode (the fifteenth of the term) occurred during the next period on 2/25. All the group members were present. The group is continuing with the set of exercises from the previous period, the point of which was to establish the effect on the mean of various linear transformations of the data. The particular problem they are attempting to solve in this segment is the following:

The mean of a set of data is 375.96. 263.74 is subtracted from each piece of the data and then each piece of the data is divided by 24.63. What is the mean of the transformed data?

The women begin collaborating immediately:

- 1 Ms. A Are you working on number 4?
- 2 Ms. C Yeah . . . [] All I did was subtract one from the other
and divide. That's what seemed [].
- 3 Ms. D What did you subtract from each other?
- 4 Ms. C the 375 minus 263 divided by 24.63. But I don't know how you do
it. I just was trying it that way.
- 5 Ms. A That's what I was thinking of doing . . . thinking of doing something
like it . . . but I don't know.

Ms. C has responded correctly, but neither she nor Ms. A can support her answer for the reason that each lacks an understanding of the algebraic generalization that the women failed to develop during the last period (see 2/23 above), due largely to Mr. B's inability to collaborate with the women. Because the women do not have a mathematical reason to support their answer, they come to doubt it:

- 6 Ms. D Okay. So-but I don't think that's correct. 375 and then take 263
away and divided by 24.63
- 7 Ms. A [] That's right. That seems a little too easy.
- 8 Ms. D Yeah, it does.
- 9 Ms. A I-I don't think it can be right.

After obtaining various answers on the calculator for the above operations, Ms. C asks the teacher for help. Before the teacher can respond, Mr. B, who has not said a word for several minutes, suddenly chimes in (line 12):

- 10 Ms. C Oh, I think that-we don't
- 11 Ms. D [] we don't know what to do
- 12 Mr. B [] You don't understand it? I do.
- 13 Ms. A You do? Well, say something [laughs]

Mr. B explains his answer, which is an incorrect, though quite sophisticated, response. He thinks that 375.96 is the mean of the transformed data (not

the original data) and so he is beginning with what he takes to be the mean of the transformed data and then applies inverse operations to get back to what he thinks is the mean of the original data. Mr. B explains his reasoning, which is none too clear and which none of the women understands, before actually calculating it, which Ms. C undertakes, obtaining an absurdly large answer. She doubts the correctness of the result. Nevertheless, the women do not ask for any further explanations or backings and despite their expressions of doubt, they allow themselves to abandon their own answer, which is certainly more reasonable than Mr. B's. When the teacher explains the correct procedure to the whole class, there are no comments from the group about Mr. B's incorrect procedure. When the group begins work on the next problems, Ms. D, after having just asked a question of the group, begins a conversation with someone in another group, even raising her voice above the persons responding to her question so that she can carry on her off-task conversation. Immediately upon finishing her socializing, she asks (again) for someone in the group to answer her question. She does this twice during the period. Recall that she did the very same thing weeks later on the group exam.

At this point, I would like to pause to make a couple of observations based on the excerpts above and then to propose an explanatory link between the women's feelings of helplessness and dependency, along with their beliefs about the nature of mathematics, and their membership in the feminine discourse culture. Although I will provide more evidence that the women in both groups share

these feelings and beliefs, I now offer an explanation for such based on the norms of the feminine discourse culture, along with an account of why the men do not exhibit these same feelings and beliefs either in their discourse or in their interactional patterns because of their membership in the masculine culture. It is my intention that by establishing an explanatory link at this point between feelings, attitudes, and beliefs and gender discourse cultures my argument will be more intelligible than if I were to wait until I have presented all the evidence, some of which occurs in excerpts from dialogue supporting other points. My aforementioned observations are these:

First, Ms. D's frustrations seem to be linked to her beliefs about the nature of mathematical activity. To her, mathematics is "mumble-jumble" out of which one is supposed to somehow find answers, some of which may even conflict with each other. As she herself puts it, "[exasperated sigh] See, this is how-why I get so frustrated because I always get these different answers" (from the transcript of 2/28/94). Yet despite Ms. D's low tolerance for working through mathematical difficulties and her unwillingness to engage a problem for more than a few seconds, she demonstrated on more than one occasion throughout the semester that she could engage in highly productive joint argumentation in the group, though usually only when Mr. B actively participated with the women. Moreover, her remarks were often more insightful than those of the other women.

The second observation also has to do with the nature of mathematical explanation or the psychological role explanations play in persuasion. Ms. D, Ms.

C and Ms. A know that there are supposed to be reasons for why one gets a particular answer to a problem but rather than seek out an explanation for an answer or rely on mathematical argumentation when they find themselves in an uncertain situation (see lines 2-9 above), they change their correct answer without reason; they also fail to push for clarification or elaboration of the rather incomplete explanation Mr. B subsequently provides. In contrast, none of the men in either of the two groups throughout semester ever changed his answer without a mathematical reason for doing so.

Although both the men and women in this study experienced frustration with mathematics during the semester and although both the men and women may even have believed that mathematics is a rule-driven game, the effects of such on the discourse and interactional behaviors of men and women appear to be different, as evidenced by the women's expressions of helplessness and personal inadequacy and by their resignation and lack of persistence, whereas the men made no such expressions of helplessness or personal inadequacy, nor is there any evidence of men's resignation or lack of persistence. This may be explained in part, I submit, by recalling the research on sex-segregated games (Brooks-Gunn & Matthews, 1979; Eder & Hallinan, 1978; Goodwin, 1980; Lever, 1978; Maltz & Borker, 1982; Savin-Williams, 1976), findings that undergird the theory of the formation of the norms of gender communicative cultures. According to this account, boys are accustomed to playing games in which competition and vying for individual power are played out within the constraints of externally

imposed rules and to appealing to and arguing over the applications of those rules to their team and individual efforts. Accordingly, boys cannot express feelings of helplessness without loss of status, nor can they decline to persist in the face of personal challenging situations in which they find themselves without, in effect, withdrawing from the game, which could result in a near intolerable loss of face as well as possible social ostracism. Externally imposed rules of the game, then, constitute the arena in which boys' social and psychological development takes place and in which men are accustomed to act and have their being. For boys or men to allow themselves to be rendered helpless or ineffectual by the very rules that constitute the basis for their actions is to be sidelined, not only from a particular game but even from life itself, a theme developed by Walter Ong (1981) in his study, Fighting for Life: Contest, Sexuality, and Consciousness. This means that even though a boy may not be adept at particular game, his experience of participating and surviving in the masculine communicative culture has conditioned him to avoid being overcome by feelings of helplessness and dependency, not only in this particular game but others as well, even when he does not particularly enjoy playing them. If mathematics is regarded as a highly specialized language game (Bauersfeld, 1995) in which argumentation assumes a preeminent role, we can expect, if my argument has some validity, that even though men may not be successful at mathematics they will be less inclined than women to be rendered helpless by it and, moreover, will be more accustomed to seeking out reasons and explanations, rather than appealing to group consensus, for making

various moves or plays in the game, including those that involve changing answers.

The research cited in Chapter II reveals that historically most girls' games do not have preset, fixed, externally-imposed rules. Often girls will negotiate or create the rules as the game proceeds, which requires collaboration and reaching group consensus while at the same time avoiding alienating the players through disputation. As was mentioned in Chapter II, Lever (1979) found that girls could not deal with open conflict in a group without the breakup of the group. As girls grow up, they learn increasingly subtle ways of dealing with potential arguments before they erupt because of the threat that open dispute poses to community. Women may associate, then, mathematical argumentation with the kind of conflict that they as girls had eschewed as disruptive when it occurred during the negotiating- and consensus-seeking activities involved in formulating the patterns of their childhood games. Men, on the other hand, may view mathematical argumentation as not dissimilar to the kind of argumentation they habitually employed in their childhood games when they felt compelled to defend their actions as being in compliance with the prefixed rules defining these games, which is, by way of contrast to girls' perceptions, a way of holding the group together. If mathematics is viewed as an example of a language game with which women have had little cultural experience compared to most men, it should not be surprising that some of these women should feel helpless, display a lack of persistence when confronted with challenging problems, avoid conflict, and appeal to group consensus when in small mathematics groups.

I have argued that the feelings of helplessness evidenced by the women in this study may stem from their beliefs about the nature of mathematics as a rule-driven game and that although the men may hold similar beliefs about mathematics they are not rendered helpless by them; further, the differing reactions of the sexes can be explained, in part, by their membership in their respective communicative cultures whose development, in turn, has been influenced by their differing perceptions of the role rules and dispute play in sex-segregated games. This explanation, however, based as it is on the theoretical framework I have developed for this study, does not, I feel, wholly account for why some women act helplessly and lack persistence when faced with personally challenging mathematical problems in small groups. I will address this issue again in the concluding chapter.

The three episodes I have provided above occurred in the first half of the semester and demonstrate that the patterns found in the group exam, as well as their effects on the group's discourse and interactions, emerged fairly early in the semester. I was alerted to the problems of communication in the group because of my observations during class as well as Ms. C's learning log entry written at the end of the 2/25 class period, "the group seems to want answers w/o solving anything." Moreover, during the group work on 2/28, Ms. D called me over to the group and expressed her frustrations, part of which were due to the fact that she had been absent during the period when I had introduced the concepts, notation, and associated calculator operations and menus under current discussion. Later

that day we had an office conference during which she told me that she had only four hours sleep the previous night as well as a test and two papers due that day, all of which could only partly account for her frustration as I pointed out above. She also stated that Ms. C and Mr. B weren't working with the group, though Ms. A was. She repeated this comment in her post-exam reflection paper many weeks later, "It seemed like [Ms. C] and [Mr. B] kinda did there [sic] own thing & [Ms. A] and I kinda worked more together." After this conference, it seemed to me from my classroom observations and from the learning log entries that group relations had improved--until Ms. C wrote the following entry in her learning log on 3/14 (the 24th class period):

My group skipped around. For the second half of the semester, I would like to change groups. [Recall that the groups also "skipped around" considerably during the exam.]

I considered complying with Ms. C's request, but before I could take any action she informed me that she had to miss several class periods because of urgent family matters at home. I determined that it would be too disruptive to change groups at this late date after her return. Subsequently, she wrote the following, "I would still like to change groups" (learning log entry of 3/29, the 26th class) and "My first complaint was 2-25 and things have only grown worse" (post-exam reflection paper).

I have taken time to draw out Ms. D's behaviors and attitudes as well as Ms. C's dissatisfaction with the group because they provide the background necessary, it seems to me, to distinguish larger societal gender influences from

8 Mr. B What do you mean? . . . What's your question?

Mr. B does not let the women's tendency to follow rules without understanding how they are constituted (lines 2,3,and 7) go by unchallenged. This was typical behavior for Mr. B throughout the semester. That is, despite his tendency to work independently of the women, he often responded to I-don't-know-why statements he overheard as they talked to each other as a subgroup apart from him. When he questions the women as to what they don't understand, Ms. D produces a backing for the moves the women had previously made on the basis that "you just do." After these exchanges, Ms. D continues to participate as an equal in the women's collaborative effort. Mr. B, however, withdraws and does not speak for 7.2 minutes, an extremely long time for one person to be silent in a group. When the women come to an impasse and fall silent, Ms. A initiates the conversation with a direct address to Ms. C (line 9) and then redirects the conversation with another direct address to Mr. B (line 11):

- 9 Ms. A [Ms. C], what are you doing?
- 10 Ms. C Squaring them all.
- 11 Ms. D What are you doing over there? . . . [Mr. B]?
- 12 Mr. B Writing.
- 13 Ms. D You're always working and you never tell us what you're doing.
- 14 Mr. B Because . . . if I'm wrong then I don't want you to be . . . to be way off track then.
- 15 Ms. D But that's okay. We all have to be wrong.
- 16 Mr. B Okay. You . . . uhm what I got it down to now is [ETC]

I happened to overhear this exchange while walking about from group to group. I wrote in my teaching log that day:

[Ms. D] confronted [Mr. B] about working on his own. But did it nicely.

Mr. B is very deliberate but very nice (teaching log, 3/4/94).

What I have noted is that Ms. D's voice is very kind and reasonable, not at all antagonistic. Mr. B's response in line 14 will have significance for the analysis in the next section of the way he interacted in the group. Mr. B continues to collaborate with the women, even providing wrong answers and causing cognitive conflict in the group, as Ms. D urged him to do. Ms. D continues participating as an equal in the group, pushing for explanations and asking perceptive questions. This episode shows what the group was capable of achieving when Mr. B was genuinely engaged in the collaboration, even if intermittently. On her part, Ms. D seems like a different person when Mr. B is engaged, more assured and capable, compared to how we have seen her in other circumstances.

I have now identified all the major interactional patterns that occurred throughout the rest of the semester. Ms. D would at times participate fully, more often than not leading the group, and at other times she would unscrupulously freeload from other group members. She also was the person who instigated almost all the off-task social talk in the group. Ms. A acted as the buffer between Ms. D and Ms. C, and was the person with whom Ms. D collaborated when Ms. C refused to respond to Ms. D. I could find only one occasion on which Ms. A led the group discussion, though she often asked for explanations. For the most part, Mr. B continued his reportorial style of working in the group; that is, he would work independently of the women and then report his results. Mr. B was always willing to help others so long as he wasn't preoccupied with figuring things

out on his own. On the whole, his explanations were far and above the clearest, the most precise, and the most complete that were given in the group. But these explanations were after-the-fact reports, and the meanings and processes that the explanations referred to were not developed through joint argumentation. I, as teacher and observer, often misinterpreted what I intermittently overheard of the group's conversation. I would hear snatches of Mr. B's explanations to the group, which he had developed independently of the women, and would think that good collaborative discourse was taking place when, in fact, collaboration all too frequently had not taken place at all. Nonetheless, the transcriptions reveal that there were times when Mr. B did participate with the women in developing taken-as-shared meanings on a moment-to-moment basis and, more often than not, it was during these times that Ms. D was fully engaged with the group and acted mathematically competent.

Collaborative Discourse and the Masculine Discourse Culture

In order to attribute Mr. B's behavior to his adherence to the norms of the masculine discourse culture, we must first put ourselves in his shoes and attempt to understand his thoughts and feelings about group work. The following compilation of excerpts from his talk in the group and his writings should serve this purpose.

Because . . . if I'm wrong then I don't want you to be . . . to be way off track then [in response to Ms. D's query as to why he does not tell them what he is doing] (from transcript of 3/4/94 period).

groups are still helpful. I work slowly [sic] to figure things out. Other people work ahead and don't understand what they are doing (from learning log 2/21/94)

Groups are working very well today, no one got ahead of anyone else and questions were asked when something was not understood (from learning log 3/1/94).

the groups went okay today. I understand what to do but still like to do things slow to make sure I did it right. Meanwhile others were jumping ahead and they were frustrated when I wasn't able to explain something to them right away or didn't know how to explain something really simple to them (from learning log 3/8/94).

Groups were okay but frustrating. They didn't care to try and understand different answers (from learning log 4/19/94).

Group went pretty good today. I thought it was frustrating to explain what to do on the last problem (from learning log 4/27/94).

I would be double checking a problem and making sure I understood it. Meanwhile the other people were working ahead making sure we had all the problems finished on time . . . I was taking my time trying to get quality work (from post-exam reflection paper).

It is manifestly clear that Mr. B is concerned about taking one's time to understand things, taking care that things get done correctly, that it is his responsibility to explain things clearly and well to his group, and that he is afraid of participating in group conversation until he has carefully worked things out so as not to lead the group astray. Mr. B was dedicated to learning the material and persisted in solving personally challenging problems. He often stayed after class, working problems that he had not solved during class. My teacher's log and his learning log have several entries concerning our after-class mathematical conversations. Furthermore, Mr. B was helpful to others and was concerned that the

group understand the mathematical principles he himself understood. Upon reading his learning log entry of 3/8 (see above) after he had talked to me about his concern after class, I listened to segments of the tape recording of the period because I thought there might be something that I should be concerned about or attend to. Immediately after I listened to it, I jotted down the following in my teaching log:

Great [meaning "interesting"] comments by [Mr. B]! Talking about how the group pushed him (speed as well as explanations). But on listening to the tape, he is calm and very precise. Wonderful stuff (from teaching log 3/8/94).

When he was engaged with his group, he listened to what they had to say and tried to make sense of it. My transcription notes are replete with instances in which he consistently used mathematical argumentation in the group as the basis for developing mathematical meanings as well as instances in which he attempted to resolve differences between himself and the group through mathematical argumentation.

But there is much more involved with Mr. B's relation to his group than the reactions I have listed above. The excerpts from his group-experience reflection paper revealed how strongly Mr. B believed he had benefitted from his group work, and in what ways. There is no doubt that he enjoyed working in his group. A perusal of group 1's learning log excerpts (see Appendix F) shows that Mr. B was as consistently upbeat and positive about the group's work as anyone in the group, if not more so.

What I hope to convey by the recitation above is that Mr. B tried to be helpful to others and that he sincerely believed that he was contributing significantly to the success of the group. It is important to establish Mr. B's good intentions and positive feelings about the group because his actions had a devastating effect on the group's effectiveness (the extent of the damage will be analyzed later). I will now argue that his well-intentioned, but destructive, behavior can be attributed to his faithful and consistent adherence to the norms of the masculine culture.

According to the norms of masculine discourse culture, men contend for status in well-structured hierarchical activities in which the participants play clearly defined and delimited roles where independence and exercise of authority are valued. As a result, men tend to use linguistic strategies in small groups that enable them to achieve status, preserve independence, maintain control, and to avoid being put in a subordinate position by others. They will attempt to establish clearly defined and delimited roles for themselves that will give them a measure of independence from others in the group and will, moreover, expect someone in the group to exercise authority. When a man thoroughly enculturated in the norms of masculine culture enters a collaborative group in which the participants are to create a singular psychological space where, through the mediation of language, each individual's thoughts, intentions, and meanings are more accessible and susceptible to those of others than would be possible apart from the group, he may sense a lack of structure, a power vacuum. He then has several

courses of action open to him, some of which he may be unaware. He could decide to undertake a leadership role in order to fill the vacuum, which is contrary to the authority condition for good group discourse; he could withdraw and not participate at all, which would violate the intersubjectivity condition stipulating that meanings must be negotiated on a moment-to-moment basis; or he could modify his linguistic strategies in some way so as to accommodate the demands of collaborative discourse. Mr. B, however, does not appear to want to dominate the conversation and he appears to want to participate, to be helpful, and to cooperate. But he does not know, on the other hand, how to modify his discourse style in order to accommodate the conflicting demands between not taking over the group, on the one hand, and still remaining engaged with the group on the other. Acting in conformity with the norms of masculine discourse culture and yet being desirous of contributing to the group, Mr. B does what he can under the circumstances in which he finds himself: He acts cooperatively instead of collaboratively.

In this study, collaboration is taken to mean that the group participants work together on the same task at the same time in such a way as to create a state of intersubjectivity. Cooperation, on the other hand, is taken to mean that the participants work independently on the same problem, checking their results from time to time, all the while giving or receiving help upon request. This is a familiar mode of group participation to those enculturated in the male discourse culture when undertaking a joint project, i.e. divide up the task, each person per-

forming his own specialty, each going off and doing his own thing, and then rejoining the group and coordinating his actions with the team effort. In a cooperative group, after procedural matters have been settled, either openly or by tacit understanding, individual group members are then free to work independently of the will and authority of others. This gives a man in whom the norms of masculine culture hold sway the feeling of freedom from the randomly intrusive moment-to-moment thoughts and demands of others, that is, freedom from the demands of intimate intersubjectivity. This does not preclude, however, his asking for help when he needs it, nor does it mean that he, in turn, gives help grudgingly--a high degree of cooperation and comraderie is often found in male cooperative groups situated in sports, the military, and business. But it does mean that he is allowed to exercise control over his own activities and to do his job without interference.

Tannen (1990) offers insight as to how the difference in meaning men and women accord information can affect the nature of group interactions as the group works together in solving a problem. Whereas in ordinary conversation, Tannen explains, women are accustomed to expressing their fleeting thoughts and opinions as they come to them, men do not assume that their passing thoughts are worthy of utterance. That is, men are not in the habit of uttering their fleeting ruminations and so dismiss them as soon as they occur to them. Unless a man feels his thoughts are sound, relevant, or important, speaking them would give them more weight and significance than is warranted. All their lives, women

have had practice in verbalizing their thoughts and feelings in private conversations without unpleasant repercussions because the purpose of such talk in feminine culture is to gain intimacy and establish connections with others, not to compete for status in a hierarchical structure. In masculine culture, on the other hand, presenting thoughts that are inaccurate or not well thought out can lead to ridicule or be used against one because talk is so frequently used in contest to gain status or can put one in the uncomfortable position of misleading the group, which again, leads to a diminution of status, if not letting down the team. We recall Mr. B's response to Ms. D's confronting his working independently, "if I'm wrong then I don't want you to be . . . way off track then."

The cooperative model of teamwork seems to be in Mr. B's mind when he writes:

I would be double checking a problem and making sure I understood it. Meanwhile the other people were working ahead making sure we had all the problems finished on time . . . I was taking my time trying to get quality work (from Mr. B's post-exam reflection paper).

Mr. B understands his job to be that of working slowly and carefully making sure the results were correct while the others forge ahead to ensure the group gets all the problems answered. That this is Mr. B's idea of how the group should be working together is substantiated, as was pointed out previously, in floor 43 of the group exam when he legitimizes his copying the work of the women because he has carried out his part of the team's effort: "Can I see what you guys did over here? Can I see what you did over here, 'cause I trusted that

...

Furthermore, he feels justified in doing so because he had been invited to work alone by Ms. D in floor 21, "[Mr. B], do you want to keep working on it?" Mr. B does not understand that his working independently of the group contributes significantly to the group's interactional problems. To Mr. B, the problem is one of coordinating and integrating the various tasks that he assumes have been allocated amongst the group members by agreement. He persists, all alone, in the face of difficulty and then faithfully reports to the group as soon as he is certain of his results. Recall Ms. C's expression of annoyance with him in floor 33 of the exam when she finds out that he has persisted so long on a single problem, lagging far behind where the women are: "Are you still on that one . . . way down there?" Mr. B interprets this concern as a challenge, a move on her part to impugn his competence or to imply that he is not holding up his end of their group effort. "I'll get it . . . I'll get it," he retorts.

In summary, Mr. B's discourse style is preeminently masculine and is characterized by report-talk, the term Tannen (1990) uses to describe the way men use talk to conform to the norms of the masculine discourse culture. "Reporting" also describes the way Mr. B actually interacted with the group, that is, his working independently and then reporting his results, which I called his "reportorial style." His mode of small-group interaction is cooperative rather than collaborative. The group experiences great difficulty in achieving intersubjectivity because he cannot adjust his style to the demands of collaborative group work,

which are far more compatible with the norms of the feminine discourse culture. There is nothing about the norms of the feminine discourse culture that works against women establishing intersubjectivity in small groups. Indeed, the norms of establishing closeness with a small number of intimates in feminine culture should enable women to more readily enter into collaborative interactions in small learning groups and to habitually employ deeply ingrained linguistic strategies that promote intersubjectivity. In contrast to the norms of feminine discourse culture, the norms of masculine discourse culture are not compatible with the goals of establishing intersubjectivity and sustaining a lack of abiding authority in small groups. With their emphasis on structure, hierarchy, and independence, masculine cultural norms would seem to predispose men toward working cooperatively rather than collaboratively in small groups. This does not mean that most men cannot work as well as most women in collaborative groups, but it does mean that they will have to modify their discourse style when working in mixed-gender groups. We shall see how the men in group 2 make this accommodation in the next section.

Summary of Gender Issues From the Group 2 Exam

The floor analysis of the group 2 exam raises the following issues that seem to me to be implicated with gender: authority, argumentation, and intersubjectivity. I will summarize the details from the analysis of the group exam related to each of these issues and then examine them in the context of the group's

interactions throughout the semester while explicating their connections to gender communicative cultures.

Authority

Control of the group's interactional agenda passes back and forth quite freely between the various members of the group, though its nature seems to depend on the leader's particular role in the group at the moment, e.g. Ms. K assumes leadership when she announces that she knows how to do a problem or the women delegate authority to the men when the problem involves extensive calculator work. Note that although the women absent themselves from calculator work, Ms. M is quite competent in the use of the calculator, especially with the particular operations being delegated to the men. Mr. J attempts, off and on again, to play the role of group moderator during the exam (see floors 3, 13, 28, 33), but finally gives it up with humorous resignation when no one responds to his control. Ms. K has difficulty assuming leadership, even when she announces her intention to lead or even when she is repeatedly urged by Ms. M to lead. Although Mr. J on one occasion successfully marshals the consensus of the group in conjunction with his own authority (he is considered the mathematical authority in the group) to overcome Ms. K's authority, the men do not habitually exercise overt control over the group. Their control is more covert and intersubjective.

Intersubjectivity

Three aspects of intersubjectivity surface during the exam. The first aspect has to do with egocentric speech and indirect collaboration. Ms. K has difficulty making her thoughts public on a moment-to-moment basis. She is not reticent about speaking up in the group, but she cannot engage others in negotiating meanings while thinking aloud, repeatedly lapsing into unintelligible egocentric speech when she attempts to do so. By way of contrast, while the men fall into egocentric speech as much, if not more, than the women, they are able to think aloud publicly by elevating their voices into indirect collaborative speech that is intelligible to others in the group.

The second aspect has to do with the men's achieving a high degree of intersubjectivity between themselves, on occasion, in a subgroup using indirect collaboration in which the women do not participate, though at times their nonparticipation seems to be a matter of their own choosing. Although the women occasionally form highly collaborative subgroups as well, they do not use indirect collaboration and, moreover, the men seem to be able to follow their conversation quite readily.

The third aspect of intersubjectivity has to do with Mr. L's working independently of the group. I have already attributed Mr. B's working independently to his close adherence to the norms of the masculine culture. I will argue that Mr. L's habitual interactional behavior (as well as Mr. J's) in the group is a

modification of the masculine discourse style that better accommodates the demands of group collaboration. Mr. L is especially subject to the influence of the masculine discourse style, however, and as a result there are times when he works independently of the group, though not nearly as much as did Mr. B.

Argumentation

Men will halt the flow of argumentation if they do not understand it or are not convinced of its soundness, e.g. Mr. J in floor 3, Mr. L in floor 11, Mr. L in floor 13, or Mr. J in floor 19. In contrast, the women are more concerned with getting the answers than with taking care that they understand all the steps leading to it, e.g. as in floor 9, which was true of the women in group 1 also. Moreover, the women are less inclined to engage in sustained challenges of others' propositions with which they do not agree and are less likely to defend their own propositions when challenged by others, as in floor 26. As did the women in group 1, they will often avoid mathematical argumentation in order to preserve group harmony and are more apt to accept a proposition on the basis of group consensus rather than mathematical argumentation, as in floor 18, the explanation for which I have proffered during the group 1 analysis of gender effects. I would like to take note of an exception to the above, however, that I highlighted in the floor analysis of the group exam. Ms. M stops the flow of argumentation in floor 11, an equivocal floor, with her declaration, "I lost you [etc]," which causes a transition to floor 12, a univocal floor occasioned by Ms. M's further declaration:

"See, I don't know what happened. That's why I said I'm lost." This is an uncharacteristic behavior for Ms. M, whose primary role has been that of group encourager and consensus builder, not that of questioner or challenger of propositions. But this anomalous behavior provides a glimpse of a different, more mathematically capable Ms. M, which leads us into the semester's interactions.

Group 2 Gender Issues in Context

Argumentation in Context

Gender issues are often reflexively related, as Ms. M's story will illustrate. The issues involved in her story could have justified its subsumption under the authority or intersubjectivity sections as well as this section. I have placed her story under argumentation because it seems to me that it is more fundamental to an understanding of how the norms of the feminine discourse culture shaped the events of the narrative.

Ms. M was the least committed of all the group members to her own understanding of mathematics. Again and again in the margins of the transcripts I would note that she had little understanding or interest in understanding the problem at hand, and only occasionally would she push for explanations from others. She was the person in the group most likely to give up or get discouraged. For Ms. M, "getting" a problem usually meant that the group had come to an agreement, not that she personally understood the solution. That is, she

would look for the group's acceptance of a proposition rather than engage in genuine mathematical argumentation. I often noted that she was not convinced by her own understanding, but rather by what the group had decided. She often switched her support from one person to another without offering any reason or explanation. As a result, her utterances were most frequently ignored in the group (especially by the men), at times to the detriment of the group's development of taken-as-shared meanings. Even when she challenged someone, she would immediately accept that person's answer without pushing for an explanation or mathematical justification. I also noted that when she began an assertion, she often failed to complete it, letting it hang in midsentence, and that she habitually repeated other's sentences or phrases almost verbatim.

My initial impression of Ms. M was that her main interest in group participation was for its social aspects, an impression that was heightened by her score on the first exam, which was one of the lowest in the class. And so this impression remained until I transcribed the April 29th class period, a day when Ms. K was absent. I began the period by reviewing a problem the groups had worked on the previous period, namely, how to describe the weights of the fastest running females with respect to the entire class by using a box and whisker plot. The task for the day was to describe the heights and leg presses of the fastest running females with respect to the entire class. I begin with my transcription notes to describe what happens.

T [I often refer to myself as "T" in my notes] just went over the

procedure in detail. Obviously the group wasn't paying attention. [Mr. J] suggests the group write down, "I don't know," and then walk out, "because we're not going to get it. So why even try." Mr. L says he messed up his data and was trying to straighten it out while T was talking. Again, [Mr. J] is trying to get the whole group to say, "I don't know," and walk out. But [Ms. M] says!! very softly, "O.K. Let's start with a [the first step in the procedure]." Here [Mr. J] is not the social authority. [Mr. L] asks T for help. (missed opportunity. Maybe [Ms. M] could have gotten them going. She started the procedure in line 311. We'll never know because [Mr. L] asks T for help. The group does not pick up on [Ms. M's] lead) (notes from transcript of 4/29/94).

What initially surprised me is that instead of picking up on Mr. J's ploy to pack up and leave (it is too early in the period for this maneuver to be taken seriously) as an excuse for off-task banter, Ms. M quietly begins work on the problem. It is fairly late in the semester and I had never heard her take the lead in directing the group's attention to the task at hand, which is doubly surprising here since she is acting contrary to Mr. J, the mathematical authority in the group and quite frequently a social authority as well. I note that the group may have missed an opportunity for learning because the men do not follow her lead. I will now summarize my notes, leaving many phrases in the form in which I wrote them as I listened to and transcribed the tape in order to convey a sense of my own reactions.

After I leave the group, admonishing all the groups in the class to speak up, Ms. M does speak up, engaging the men in multivocal exchanges--unusual. She seems to be participating differently from when Ms. K is here. Ms. M seems to depend on Ms. K when Ms. K is there. But she seems to participate much more meaningfully now that she isn't there. Ms. M has hardly interacted socially with the men at all. I'm a bit surprised at the nature of her participation with the two men--genuine joint construction. There is a disagreement between Ms. M and Mr. L. Ms. M has caught Mr. L's error, "I think there's a mistake here (softly),"

but she is ignored. Mr. J finally corrects Mr. L. When Mr. L asks what they can conclude, Ms. M draws the conclusion. In the next sequence of interchanges Ms. M poses a question and then answers it herself. Again, the men do not answer Ms. M. When Mr. J is lost, Ms. M answers his question.

I notice a change in her voice; it is lower in pitch and slower. I have to speed up the tape in order to understand her (which speeds up the rate of delivery and raises the pitch) This is quite extraordinary because Ms. M's speech is normally so rapid and high-pitched that I usually am forced to slow down the tape in order to understand it.

Ms. M is again helping Mr. J. Has Ms. M ever done any helping on this scale before? I think she pretty much lets Ms. K do the helping. Mr. J is asking directly for help and Ms. M responds. Isn't this usually Mr. L's role? Ms. M is guiding Mr. J through the calculator steps. She again draws the required conclusion, which the men accept and write in their learning logs.

Is this the first time Ms. M has laughed today? (edited notes from transcript of 4/29/94).

My notes, however, do not adequately reflect how taken aback I was upon listening to Ms. M on this occasion. It seemed to me that I was listening to a different person--her initiating the task, her drawing of conclusions, her helping, her argumentation, her avoidance of off-task talk, and even the very sound of her voice. This person, however, was soon to disappear.

Ms. K has returned the next period the class worked in groups, May 3, though Mr. L is now absent. After a good deal of socializing at the beginning of the period, Mr. J directs the group's attention to the task. A conflict quickly develops between the women as to how to solve a system of linear equations, the task at hand. This is one of the few occasions when Ms. M forcefully opposed Ms. K. Mr. J goes along with Ms. M's proposition. All of these exchanges are not spoken with normal intonation, but with exaggerated accents. I note on the

transcription that the speakers play roles almost as if they are working puppets or using masks behind which conflicts may be played out. Then come the following exchanges:

- 1 Mr. J Okay. Now what do we do here, folks [spoken in an accent] Wait! Whoa!! You're going ahead of us there, [Ms. M] . . . aah [still spoken in an accent]
- [Ms. M laughs]
- 2 Ms. K | _ Excuse me! We have to go together. We're a group now?
- 3 Ms. M Okay
- 4 Mr. J Ah, we're doing this together? This is a team project? [he bangs the desk] And you are part of the team . . . whether we want it or not.
- 5 Ms. M Oh. Whether you want me or not.
- 6 Ms. K [softly] We'll share.

In line 2, Ms. K speaks straightforwardly without any "play" accent (as she has been using); except for the rising intonation at the end of "now," she is quite direct and forceful. My note pertaining to Ms. M's response at line 3 is: "I sense she's hurt--seems real" (note from transcription of 5/3/94). I confirmed my impression by watching this scene on videotape. My note reads, "M looks chagrined--rocks back and forth in her chair" (note from transcription of 5/3/94). In line 4, Mr. J does what the men often did when defusing potentially serious social discord: He uses mock aggression to play off Ms. K's real aggression, exaggerating it to the point where it cannot be taken too seriously.

The exchanges occurring immediately after the above passage are also revealing:

- 7 Mr. J [matter of factly] Hmm-hmm. So now what did you do girl? [to Ms. K]

- 8 Ms. K [laughs softly] I see you simplified that?
[repeats question--normal voice] Do you simplify this?
- 9 Ms. M |_ You have to
distribute . . . times . . . times
- 10 Mr. J |_ Don't use such big words [softly, mock chastisement]
- 11 Ms. M [laughs good naturedly] Sorry . . . multiply ones--x multiplied by one
did you get the two thirds []? [very rapid, slurred over, does not
make sense]

Mr. J's use of sexist language in line 7 is his way of controlling what he senses is a gender-related struggle of will between the two women and a way of rebuking Ms. K after he has ostensibly taken sides with her against Ms. M. This is not the first time he has used sexist language as a way of controlling or admonishing Ms. K. But equally sexist, and perhaps even more flagrant, is his interruption of Ms. M's explanation at line 10: "Don't use such big words," a form of condescension toward her, since the use of the term "distribute" is not that uncommon or technical in this class. It is as if he were patting her on the head for using technical words no one expects her to be able to use. Use of technical language is one way a person displays mathematical competence and so Ms. M's identity as a competent mathematics student is denied in even a minimal way. Even if Mr. J intends his jostling remark as a softener, a way of accepting Ms. M back into the group after Ms. K's rebuke, it also serves to allow her back only by dumbing down, by putting her in a non-expert role as one who merely provides socioemotional support. After she apologizes for demonstrating competence, she lapses into slurred and rapid speech that has been characteristic of her mathematical discourse style. She also lapses back into her role as group encourager and

social facilitator, her mathematical contributions from this point on seldom rising above error-correction moves. She will never again participate as an equal in the group.

I find it difficult to account for Ms. M's abrupt departure from her habitual pattern of behavior in the group the previous period, except that it is clearly linked to Ms. K's absence. Ms. K acted as an interpreter or buffer for Ms. M. She responded to Ms. M when the men ignored her and the two women formed a close psychological bond based on an agreement as to what role Ms. M was to play in the group. The means by which Ms. M's independence from Ms. K was possible (or through which it was enacted) was, of course, mathematical argumentation. When Ms. M continued to act independently the following period when Ms. K returned, Ms. K's sense of intersubjectivity with the group was disturbed. In the feminine discourse culture, women tend to accomplish what they want based on the strength of her affiliations with others and by having others cooperate with them, all of which is outside the pale of mathematical argumentation, which stands or falls on its own merit, its persuasiveness deriving from its structure, not from intimacy. Feminine discourse culture is based, in part, on women's connecting with each other and their preserving closeness with a small number of intimates. This is why Ms. M and Ms. K were so enthusiastic about their group; they had found intimacy, as is manifestly clear from their learning logs and group-experience reflection papers (see Appendices F and G). They even noted the day (3/7, the 20th class period) when the group "bonded." Ms. K wrote in her group-

experience reflection paper:

When we had comfort, which began very early in our group it stays for awhile and only gets better. We all felt like brothers and sisters and we always felt very considerate of each other . . . After this class was finished I felt very sad because I had made some good friends . . . We told [Ms. M] to call every one so that we can have a math reunion . . . The group was very exciting to be in (from Ms. K's group-experience reflection paper).

According to the norms of feminine discourse culture, Ms. K's sharp admonition to Ms. M can be interpreted as her attempt to restore and preserve the closeness of their relationship, which Ms. K characterizes as sisterly (recall that these are not minority students and hence Ms. K's use of the words "brothers and sisters" is not culturally induced). Ms. K felt distanced by Ms. M's display of intellectual autonomy and particularly her use of mathematical argumentation (both of which had carried over from the previous period) because in feminine discourse culture talk is used as a way of negotiating connection and closeness and not as a way of asserting autonomy and intellectual competence.

Since argumentation has been at the center of the conflict between Ms. M and Ms. K, I will continue discussing its role in the group over the semester as it relates to the group exam. The patterns of argumentation that surfaced during the group exam were typical of those that occurred throughout the semester. My transcription notes are generally consistent with the findings of the studies summarized by Webb (1991). That is, the men gave more elaborated, content-related explanations than did the women. They also tended to give more justifications, evidence, or reasons in support of their assertions and push others for

explanations and elaborations. Moreover, they were not interested in accepting answers without being convinced of their correctness. Over and over in the margins of the transcriptions I note, in contrast to the men, that one or the other of the women just wants the answer rather than understanding the underlying mathematical processes, relies on group consensus instead of mathematical justification, places social harmony and group consensus above mathematical argumentation, or does not press for explanations. It is not the purpose of this study, however, to attempt to provide evidence that men act more mathematically than do women. Rather, it is the purpose of this study to attempt to determine whether particular behaviors of a small number of individuals can be accounted for in terms of their respective gender discourse cultures. In particular, given the evidence that women seem to position themselves differently from the way men do with regard to mathematical argumentation, how can their membership in the feminine discourse culture account for this difference?

Although it is characteristic of the feminine communicative culture that women will tend to use talk to reach consensus and avoid conflict, it is the way that consensus comes about in collaborative mathematics groups that may prove problematic for women's achieving good mathematical discourse. One of the conditions for good mathematical discourse in collaborative groups is that group participants should attempt to achieve consensus through mathematical argumentation and to resolve conflicts by appeals to previously agreed upon mathematical facts, procedures, or warrants. This discourse condition may conflict with the

norms of feminine communicative culture and limit women's opportunities to learn if the women should attempt to achieve consensus by avoiding mathematical argumentation in order to preserve social harmony. Although there is no necessity that this should happen, there is a danger of their conflating mathematical argumentation with social disruption in the group.

The research on sex-segregated games (see Maltz & Borker, 1982) indicates that many girls' social activities do not have winners or losers, whereas in mathematical argumentation usually someone is right (the perceived winner) and someone is wrong (the perceived loser). Women may feel uncomfortable with engaging in and promoting mathematical argumentation should they perceive that being right or wrong could lead to publicly established winners or losers. Moreover, since girls' talk in their games tends to center on accommodating others' feelings and needs through skillfully employed conversational strategies that mediate potential conflict, women may not be comfortable with using language to press for clarification in mathematical disputes or to uncover contradictions that would bring people's viewpoints into direct conflict. The research on boys' games, in contrast, indicates that boys use language to assert one's dominance, to confront each other directly, and to appeal to rules that are externally imposed. Although this does not necessarily mean that men, therefore, will employ better mathematical arguments than women, it does suggest that they will not be as concerned about hurting other group members' feelings by exposing their mathematical inconsistencies, nor will they be as uncomfortable with confrontation and

argumentation per se in small groups.

Again, Tannen (1990) offers insight as to why mathematical argumentation may not comport with the norms of feminine communicative culture. Some women, as life-long members of the feminine communicative, do not learn to resist others' demands on the basis of principles, and they do not expect others to resist their assertions on principles either. Rather, they get what they want by using language to create and maintain close relationships and to resist others' demands by minimizing the differences between them in such a way that open confrontation is avoided. This does not mean, however, that women have difficulty in constructing or understanding mathematical arguments, but it does suggest that they might be more selective in how they employ mathematical argumentation in small groups and that the form of their argumentation might be less transparent than that of men.

As I have indicated previously when discussing the women's mathematical behavior in group 1, the way in which one uses (or does not use) mathematical argumentation is closely related to one's belief structure about the nature of mathematics. In the absence of an understanding of or appreciation for the role of argumentation, mathematics becomes a meaningless, rule-driven activity in which one must accept propositions on the basis of authority or group consensus. The women of group 2 expressed beliefs about the nature of mathematics quite similar to those of the group 1 women. These expressions of their mathematical beliefs and feelings of helplessness are revealed in occasional flashes, usually only

in brief phrases or even single words, yet they seem to exert a powerful conditioning influence on a host of discourse moves and interactions. The following examples of the women's expressions of such beliefs were excerpted from the transcripts of two days, May 4 and May 5:

May 4

Ms. K: I know but he's got the--that. Now how would he get that? Just because or what?

Ms. M: Because.

Mr. J: I just had y equals $x - 4$ over 4.

Ms. M: Whatever.

Mr. L: We should use the $4y$ equals $x - 4$

Ms. M: It's pathetic.

[While the men are talking with the teacher, Ms. K and Ms. M have been interacting intensely for several minutes, speaking very rapidly, overlapping, latching, sometimes uttering the same words simultaneously]

Ms. K: Okay. so it's not-the top one is AAAAH!

Ms. M: We're helpless . . . we're []

[After the group has been involved in an extended argument, the men have agreed on an answer, which differs from the women's.]

Mr. L: So minus $30y$ equals 120. you divide by -30 . So y equals -4 .

Mr. J: y does equal -4 .

Ms. K: Sure [in a if-you-say-so tone]

Ms. M: As long as you guys [the men] know what we're doing.

Mr. J: That's the right answers.

Ms. K: [to Ms. M] So did you read my fifth problem? [Laughing. Ms. K is referring to her solution of problem 5]

Ms. M: No, I didn't. I just figure if they know what they're [referring to the men] doing then we're all set.

May 3

Mr. J: Why . . . do you do six times three?

Ms. K: I don't know why. I just do it.

 Ms. M: We're all . . . isn't it pathetic?

In the excerpts above, we hear not only expressions of helplessness and adherence to meaningless rules on the part of the women, but also their accession to authority (male authority at that) and group consensus. The accumulated evidence regarding the dispositions toward the nature of mathematics and mathematical argumentation of the women in both groups, coupled with the fact that none of the men in either group at any time throughout the semester expressed or exhibited such attitudes, lends credence to the observation that some women may experience a conflict between the conditions for good mathematical discourse in groups and the norms of the feminine discourse culture.

Intersubjectivity in Context

When I discussed the dilemma in which the norms of the masculine discourse culture placed Mr. B when he entered his collaborative group, I pointed out several courses of action that were open to him. He could have vied for dominance, opted not to participate at all or, do what he did--participate cooperatively instead of collaboratively. But there was another option upon which he was not able to act consistently: He could have modified his linguistic strategies in some way so as to accommodate the demands of collaborative discourse. I also pointed out that the norms of the feminine discourse culture do not place women in such a position.

I will now argue that indirect collaboration is a modification (not the only one, however) of the masculine discourse style that can enable men who have difficulty in sharing their moment-to-moment thoughts in a group to accommodate the intersubjective demands of collaborative mathematical discourse. Moreover, since the norms of the feminine discourse culture and the demands of intersubjectivity are compatible, indirect collaboration is a characteristically male accommodation to the feminine discourse style as well. The first step in my argument is to establish that the evidence of this study strongly suggests that indirect collaboration was a linguistic strategy habitually employed by the men in group 2, but not by the women.

The group 2 exam contained ten individual instances of the men using indirect collaboration, six for Mr. L and four for Mr. J, and single instance of a woman, Ms. M, using it. In counting the instances of male indirect collaboration, I have not included those instances occurring in a connected series of exchanges all conducted in indirect collaboration between the men conversing as a subgroup. That is, I am counting only isolated utterances made by a single man and not those made in conversational exchanges conducted entirely in indirect collaboration. Ms. M's indirect collaborative utterance consisted of three words, "a minus b."

During the semester the group 2 men used indirect collaboration constantly in almost every class and usually several times during a class. I did not count the men's frequency for two reasons. First, counting separate instances was too

problematic for the reason I mentioned above and second, counting the men's frequency was unnecessary since it was a simple matter to contrast the women's use of it over the entire semester's transcripts. On April 20, Ms. K uttered the following in indirect collaboration: "Okay. Then that's four over three . . . then you sub . . ." These were the only words I heard a woman speak in indirect collaboration in the thousands of utterances the women made during the semester.

Though functionally different from indirect collaborative speech, egocentric speech is another form of thinking aloud. Men's use of egocentric speech in group 2 was as frequent, if not more frequent, than their use of indirect collaboration. I was able to find only one instance of a group 2 woman (Ms. K) using egocentric speech during the semester exclusive of the group exam. Ms. K's use of egocentric speech during the group exam, therefore, was a departure not only from her own discourse style, but from that of Ms. M as well, and, as we have seen, caused problems in group communication.

There was one instance of indirect collaboration in group 1 during the entire semester. This sole instance was uttered by Ms. A during the group exam. There were two instances of egocentric speech during the group exam, one by Mr. B and one by Ms. C. During the semester (exclusive of the group exam), there were a total fifteen egocentric utterances in this group: nine were made by Ms. A, two by Ms. C, and four by Mr. B.

In summary, the evidence is that a) only the men of group 2 habitually used indirect collaboration as a linguistic strategy, b) none of the women in either

group habitually used indirect collaborative speech (only two instances occurred throughout the entire semester), and c) Mr. B never used indirect collaborative speech throughout the entire semester. The occurrences of egocentric speech followed a somewhat similar pattern. The men in group 2 habitually used egocentric speech throughout the semester and the women in either group used it only occasionally (almost half of the instances occurred during the group exam). Mr. B used egocentric speech on five occasions during the entire semester and each of these instances occurred when he was jointly engaged with the women, that is, when he was not working independently.

Interpreting the evidence through the theory of gender discourse cultures, we have the following. If Mr. L and Mr. J had been strictly adhering to the norms of the masculine communicative culture, their group discourse style would have resembled that of Mr. B, who did adhere to masculine discourse norms. That is, they would have habitually withdrawn from the women and worked independently. On occasion, they did follow the norms of masculine culture and withdraw from the group (especially Mr. L), as they did at the end of the group exam. As we shall see later, however, their departure constituted a relatively small portion of the entire exam time compared to Mr. B's departure. Therefore, the group 2 men have modified their masculine discourse styles in some way or other. I will now argue that while there may be other ways in which they modified their masculine style their use of indirect collaboration can be interpreted as one such modification.

A man uses indirect collaboration as a compromise between a) preserving his need to maintain control of his own actions and those of others, to exercise authority, and to remain free from the intrusive moment-to-moment ideas and demands of others, on the one hand, and b) entering into that singular psychological space in which each individual's thoughts, intentions, and meanings should be accessible and available to others and in which no one exercises abiding authority. The development of shared meanings in joint mathematical discourse requires that one think privately and publicly at the same time. Men who are accustomed to developing their chains of ideas privately before publicly reporting the results of their thinking are required to move into a half-private, half-public mode of discourse on a moment-to-moment basis; they cannot wait until their reports are complete to deliver them, otherwise meanings could not be developed in process with others. Nor can they go completely public with their thoughts during the act of thinking them without violating their habitual tendency to think privately before reporting to the group. So they must somehow think aloud while making themselves intelligible to others at the same time. They must keep their voices low enough so as not to appear to dominate others as they report continuously their on-going thoughts, thereby allowing others to interrupt, contribute, or disagree. At the same time, reporting one's developing thoughts not only gives one direction over one's own thinking, it also allows for a measure of control over the group's interactions, or at least offers the possibility of influencing the interactions of the group. Nevertheless, one must not be so involved with one's own

thinking that he cannot attend to what others are saying, which may be unrelated in an immediate sense to what he is currently thinking.

Accordingly, masculine discourse norms are modified in the following ways in the accomplishment of indirect collaboration:

1. Since there is usually only one person at a time speaking in an indirect collaborative voice, achieving dominance in the group is reduced to asserting one's singular presence in the group.

2. The exercise of control of the group is reduced to putting one's personal agenda on the floor without creating a singly-developed floor (one speaker at a time).

3. Striving for independence from the demands of the others is modified to setting the conditions under which others make demands upon one's thoughts thereby allowing one to retain a measure of independence.

Moreover, the after-the-thought reporting characteristic of the pure masculine discourse style is modified to the during-the-thought reporting characteristic of indirect collaboration.

The accomplishment of all of the above is no mean feat given that it is so easy to fall into egocentric speech lying just under the surface of indirect collaborative speech, as we have seen Ms. K do in the group exam. Since women acculturated to the feminine discourse culture have learned how to make sense of the world through their relations with others, they have also learned how to habitually think outside themselves in concert with a few intimates. That is, when engaged

in collaborative group discourse, a women does not normally feel the need to direct her thinking with egocentric speech. In contrast to many men, she is accustomed to thinking in multiple voices and to having others make demands on her consciousness. For men, who have been acculturated to thinking apart from others, it is not that great a step to elevate their already-present, self-directing egocentric voices into their indirect collaborative voices when working in collaborative mathematics groups. It is for these reasons that Ms. K, in contrast to the men, had such difficulty in thinking aloud in a voice sufficiently elevated for others to follow on those three occasions during the group exam I have documented. She was never able to find her footing on that middling ground of indirect collaboration situated between normal speech and egocentric speech, which was marked, we have observed, by her shifting use of outer-directed and inner-directed pronouns.

Similarly, indirect collaborative speech characterizes an intermediate stage between Mr. B's masculine cooperative style and a true collaborative style of working in groups. It must be emphasized again, however, that there were times during the semester when Mr. B did achieve good collaborative discourse with the women. Nevertheless, his habitual use of the masculine style caused serious problems all through the semester and when faced with personally challenging problems during the exam he always reverted to the cooperative mode--as did Mr. L in the last stage of the exam.

One of the reasons why indirect collaborative discourse is sometimes less

than effective in promoting good group discourse is that on several occasions the men worked exclusively with each other, developing between them a very strong state of intersubjectivity. This tight circle of male intersubjectivity seemed nigh impenetrable by the women, as illustrated below. At the beginning of the class on April 15, just the groups started working on a problem, the men immediately began to work together quietly and intensely. After a full minute, I noticed that they seemed closed off from the women (a long time for the women in this group to be disengaged) and urged the groups to work together:

- 1 T Don't be shy!
- 2 Ms. M [teasing] Yes, men. Don't be shy.
- 3 Mr. L [continuing a little louder] How does that happen? Supposed to be
y's first . . . isn't it?
- 4 Mr. J [back to previous voice level] Supposed to be.
[Ms. K laughs]
- 5 Mr. J Jeez
- 6 Ms. K |_ What?
- 7 Mr. L |_ It's a negative one over . . .
- 8 Mr. J Okay. So it's . . . it's . . . it's one plus two over
- 9 Ms. K |_ How do you know
which ones are which?
- [male voices continue in indirect collaboration]
- 10 Ms. K Does it matter? . . . I don't think it matters, does it?
- 11 Mr. J [very soft, noncommittal] Uh-huh
- 12 Ms. K You guys doing it the right way??
- [brief silence]
- 13 Mr. J Probably not.

It is difficult to convey how soft and involved the men's voices sound. Ms. K's voice, in clear contrast, is spoken at a normal level, as if she were trying to get the men to likewise speak at normal conversational level. The men's voices, though soft, are audible. So Ms. K is attempting to break up the intensity of their

involvement rather than trying to get them to speak more intelligibly. I noted on the transcript, "Men are collaborating indirectly--very quietly. Closed off from the women." In the passage above, there is one attempt by the teacher and four attempts by the women to open the men's circle of intersubjectivity. Ms. K laughs after line 4 because despite the teacher's admonition and Ms. M's good-natured teasing in line 2 the men lapse back into their previous mode of interaction. Ms. K attempts in line 6 to engage Mr. J by inquiring about the reason for his exclamation in line 5. Ms. K attempts again in line 9 to break through, this time with a specific question. After she receives no response, she asks again in line 11, answering her own question with a rising intonation at the end of her sentence in yet another attempt to evoke a response. After receiving a noncommittal response in line 11, she successfully provokes a response with a direct challenge in line 12. The group then successfully engages in a long equivocal floor constituting good group discourse.

Authority in Context

I mentioned above that indirect collaboration is a modification of the masculine discourse by which a man may put his personal agenda on the floor without creating a singly-developed floor (one speaker at a time). This is the way Mr. L, in contrast to Mr. J, exercised social authority in the group. As I noted previously, Mr. J attempted several times, unsuccessfully, during the exam to exercise overt control of the group's interaction by creating singly-developed floors with

himself as chairman, the kind of floor that Edelsky (1993) found that women do not find as comfortable as collaboratively developed floors. Although he attempted, on occasion, to do the same thing during the semester, usually with the same degree of unsuccess, Mr. J was very successful at defusing some rather serious social confrontations by using mock aggression, verbal masks, and character play acting.

I found no instances where the men openly competed for leadership. Nor did I ever sense any underlying tensions between them. Such was not the case, however, between the women. I have already documented Ms. K's treatment of Ms. M, but there were several other confrontations between them as well throughout the semester, none of which were ever mentioned in any of the group's reflection papers or daily learning logs (see Appendix G). My impression of the group, based on my in-class observations and my reading of their learning logs, was formed early in the course and persisted throughout the semester: This was an egalitarian group in which women were very comfortable. In particular, I did not see any manifestations of overt male social authority and in addition the women were very talkative. The group engaged in off-task social conversations quite frequently and Ms. K was active in trying to direct the group to its task. Ms. K was also instrumental in keeping the group engaged in working on the same task at the same time. On one occasion, she reprimanded Mr. L for working independently of the group, which he accepted good naturedly (though we must remember that Ms. K, along with Ms. M, sanctioned Mr. L's working

independently toward the end of the group exam). Ms. K was also responsible, in large part, for Mr. J's lack of success in controlling the group's agenda by playing chairman of the floor. Ms. K considered herself the social authority in the group, as evidenced from a personal interview I had with her (tape-recorded on May 6, 1996), as well as from her reflections:

And to say the least I was the one who opened up every on [everyone] and tried to get them to talk. I am a person when nervous I tend to talk a lot and you can ask any one in the group and they well [will] say that (from Ms. K's group-experience reflection paper).

But in spite of all the information I had available to me on an on-going basis concerning group interactions, it was only much later upon reading the transcripts and putting together all the pieces of data I had collected that I realized that the real authorities in the group were Mr. L and Mr. J, the social and mathematical authorities, respectively. On May 3 when Mr. L was absent, the group talked about Mr. L after coming to an impasse with the problem at hand:

- 1 Ms. K Okay, what do we do?
- 2 Mr. J [egocentric speech] Okay [egocentric speech]
- 3 Ms. K Where's [Mr. L] when we need him?
- 4 Mr. J He wouldn't be able . . . this is the kind of stuff he doesn't do well
- 5 Ms. M |_ He doesn't know this
- 6 Ms. K This stuff isn't where he []
- 7 Mr. J Give him-give him a calculator and he'll do well . . . that and the
question for the teacher-he'll do well, too,
- 8 Ms. K mm-hmm [affirmative]

After these exchanges the group fell into 3 minutes of off-task talk (this is a relatively long stretch of social talk in a group), during the last .5 minute of which Ms. K attempted three times to bring the group to task, even by repeatedly

banging Mr. J's arm with her notebook. A few minutes later, the group again talks about Mr. L:

- 9 Mr. J Maybe we should just wait for [Mr. L].
 10 Ms. M I know, but Mr. L doesn't know how to do these either. [] he was like totally lost.
 11 Ms. K I know. Least of all

There are several observations to be made about these passages. Each member of the group states that Mr. L is not capable of doing these kinds of problems, though he is acknowledged to handle the calculator well. It is ironic that during the group exam two class periods later it was Mr. L who led the group through the very problems the other group members repeatedly claimed he could not deal with. Mr. L is also acknowledged to be the person who makes the decision to call the teacher over to the group for help. During the remainder of the period, most of which was spent socializing, the group never did resolve its difficulty with the problems at hand, nor did anyone call the teacher to the group for help. After reading their learning logs for that day, I wrote in my teaching log: "G2 had a merry ole time but did not complete 2 problems w/o Mr. L" (teaching log entry, 5/3/94). Mr. L later wrote:

There was one day on May 3rd when I wasn't able to attend class that we discovered I am the chief motivator for the group. In my absence, very little got done. The group goofed off and were not focused on the problems needing to be solved without me there (from Mr. L's group-experience reflection paper).

As wide of the mark as the group was concerning Mr. L's capability in dealing with the problems at hand, it was right on target regarding Mr. L's

capability with the calculator as well as his vested authority in calling me to the group for help. Mr. L was innovative in working with the calculator. On several occasions during the semester, including the group exam, when the group got stuck with an algebraic or graphing problem he found an alternate graphic solution using the calculator. One class period he surprised me by solving a problem involving the median (I had not previously mentioned the term) by looking up the solution to a similar problem in the calculator manual involving menus I had not presented (he had never used a graphing calculator before this class). It is also true that Mr. L was, without exception, the person who called me over to the group on the several occasions the group needed help throughout the entire semester. Moreover, he was, without exception, the person who spoke for the group when I called on the groups to present their finding for whole class discussion.

There were many times during the semester when Ms. K made the moves to bring the group back to the problem at hand from its off-task talk (which seldom ever involved Mr. L). But, as we observe above, her efforts were often ignored. Mr. L, on the other hand, the person who really held the group together, seldom overtly directed the group back to its task. Rather, he used indirect collaboration to assert his presence and his agenda, the effect of which seemed to signal, "I'm going to keep working and you are welcome to join me if you wish." Like Ms. K, Mr. L was not always immediately successful in bringing the group back to task, but by using indirect collaboration he provided a sense

of working continuity for the group.

Mr. J was the acknowledged mathematics authority in the group. My impression of Mr. J was that he was the most mathematically sophisticated member of the class, so much so that at the beginning of the semester I was puzzled as to why he was placed in the course to begin with. As the semester went along, however, it became evident that his dedication to his own understanding was erratic and he was the most likely of all the men in the class to engage in off-task conversation. It was not because of Mr. J's knowledge of arithmetic or algebraic procedures, however, that he was regarded as the mathematics authority in the group but rather because of his understanding of the nature of mathematics, particularly the role of argumentation in establishing conjectures, and his ability to articulate satisfactory explanations. Although Mr. L was not regarded by the group as the mathematical authority, I regarded his mathematical activities as having a considerable positive influence on the group's collective thinking for the same reasons I have just ascribed to Mr. J's activities. I have argued previously that one's gender discourse culture may be implicated in one's mathematical belief system.

I will now summarize the salient issues of authority and gender in this group. First, despite the overt signs of Ms. K's active leadership in facilitating the group's conversation and her frequent calls for the group to resume on-task talk after the group had been socializing, it was Mr. L who was central in holding the group together through his use of indirect collaboration, a characteristic of his

modified male discourse style. Moreover, Ms. K's attempts to bring the group back to task throughout the semester often went unheeded unless one of the men lent his support to her efforts. Second, it was the men who most frequently initiated work on a problem. Third, in almost all the occasions throughout the semester in which the group was uncertain as to how to proceed with a problem, i.e. situations in which there was an unresolved conflict between opposing viewpoints or a lack of persuasive explanations, the men almost invariably determined the group's course of action. These uncertain states were resolved either by the men's mathematical authority and/or social authority, even when, as we saw in the group exam, a woman had a legitimate claim to authority over a particular problem. I have argued previously that the feminine cultural norms of group harmony and avoidance of conflict and the masculine norms of control and engagement of conflict can be held partially accountable for such outcomes.

Findings From Floor Codes

The women almost never worked independently of their group. Out of the combined total of 147.1 min. that both groups worked on the exam (G1: 87.5 min.; G2: 59.6 min.), the women worked independently 3.7 min., or 2.6% of the total time, whereas the men worked independently 52.4 min., or 35.6% of the total time. As I have mentioned, Mr. B's disengagement from the women in group 1 was so pervasive that the group functioned as two separate subgroups, one in which he was engaged, which I call "G1 wholly engaged," and the other

when the women were forced to work as a subgroup without him, which I call "G1 women's subgroup." Of the total time G1 exam time (87.5 min.), Mr. B was engaged with the group for 39.8 min. (45%) and 47.7 min. (55%) when he was not. Even when the women functioned as a subgroup, however, Mr. B's independent actions still had an effect on the women's discourse, which is why there is masculine discourse data appearing in the women's subgroup data in the appendices. Although it is difficult to determine the full extent of this cross-over effect, the analysis of floors 37 and 44 of the women's subgroup revealed, as we have seen, that Mr. B's actions had a direct bearing on the women's failure to achieve good discourse. In fact, this cross-over effect accounts for 50% of the gender-implicated failure of the women's subgroup to achieve good discourse even though Mr. B was not participating with the women.

Overall Gender-Effect Findings

Sixty percent of the discourse of the combined groups (88.7/147.1) was not good mathematical discourse. Of this failed discourse, 49% (43.1/88.7) was gender implicated, feminine discourse accounting for 22%, masculine discourse accounting for 22%, and both feminine and masculine discourse (i.e. both occurring in the same floor) accounting for 5%. This equal division of gender effects holds in each of the individual groups, even though the groups differed considerably as to the amount of gender-implicated failed discourse that occurred in them. Although both discourse styles are equally accountable for the gender-implicated

failed discourse, analysis reveals that the reasons for why each discourse style was implicated in the failed discourse are quite different.

The most striking finding is that all of the masculine discourse that contributed to the groups' failure to achieve good mathematical discourse was due to the men's difficulty with intersubjectivity. In fact, lack of intersubjectivity accounted for 56% of all the gender-implicated failed discourse, 90% of which is attributable to the men. The feminine discourse that contributed to the groups' failure to achieve good mathematical discourse (50% in all) breaks down as follows: group harmony 20%, consensus 14%, math beliefs 7%, helplessness 4%, and intersubjectivity 6% (there is a 1% discrepancy due to rounding errors). The difference between the contributing effects of the two discourse styles is even more pronounced when we realize that Ms. K was solely responsible for the feminine intersubjectivity effect (6%) and that this was an anomaly; that is, the group exam was the only occasion throughout the entire semester in which she had difficulty with intersubjectivity. This suggests that there is very little overlap between the kinds of problems women and men have in achieving good mathematical discourse.

Findings of Gender Effects in Floor Types

There are also clear differences in the types of floors in which feminine or masculine discourse caused the failure of good mathematical discourse. 50% of the failed discourse that occurred in multivocal floors (those floors in which two

or more participants argue for differing positions) was due to feminine discourse, whereas none was attributable to masculine discourse. On the other hand, 73% of the time involved in off task floors was attributable to masculine discourse and none to feminine discourse. 38% of the time involved in constituting no floors was attributable to masculine discourse and only 1% to feminine discourse. Over 3 times as much masculine discourse was involved in the failed discourse occurring in group management floors than feminine discourse (20% and 6%, respectively). On the other hand, over 3 times as much feminine discourse was involved in the failed discourse occurring in univocal floors (one group member has a solution and explains it to one or more people who do not have the solution) than masculine discourse (41% and 13%, respectively). Of the combined failed discourse occurring in the leading voice floors (no one has a solution, but someone leads the others in the inquiry) in group 2 and the wholly-engaged subgroup of group 1 (i.e. omitting the women's subgroup), 38% was due to the failure of feminine discourse and 14% was due to the failure of masculine discourse, which means that nearly three times as much feminine discourse was implicated in the failed discourse than was masculine discourse.

These findings underscore the contention that the problems masculine discourse causes in a group have not so much do with mathematical argumentation but rather with men's difficulty in achieving intersubjectivity with other group members, either by being disengaged or by precipitating those kinds of floors that lack cohesion, such as off task, group management, or no floors. The problems

feminine discourse causes in a group do not arise so much at the interactional level, but rather from women's avoidance of mathematical argumentation for the sake of preserving group harmony and arriving at group consensus, thus causing difficulty in those floors closely associated with mathematical argumentation, that is, multivocal, univocal, and leading voice floors. Again, the effects are pronounced, women being about three times as likely as men (and even more, in some cases) to cause problems in those key floors in which taken-as-shared mathematical meanings are constituted. On the other hand, the group may never get around to constituting these floors in the first place because of the problems men cause with intersubjectivity, the effect of which is equal to the effect that women cause in the failure of the group to achieve good discourse.

One other floor type seems distinguished by gender effect. Reluctant responder floors occurred only in the women's subgroup but accounted for 12% of the all the failed discourse that occurred in all three groups combined. Moreover, the women failed to achieve good discourse in any of them and 21% of this failed discourse was attributable to feminine discourse. In a reluctant responder floor, the reluctant responder is almost working independently but the probes of the questioners do not allow the reluctant responder to disengage completely. Ms. A and Ms. D did not allow Ms. C to work independently, whereas they did allow Mr. B to do so. It would seem that women feel that it is acceptable to prevail upon the tendency of another woman to work alone but feel uncomfortable doing so with a man. The women in group 1 certainly attempted to engage Mr.

B, but only intermittently and not on a moment-to-moment basis as did Ms. A and Ms. D with Ms. C in the reluctant responder floors in the women's subgroup. Moreover, the women did not insist that Mr. B work with them. This means that even when there is a tendency for a woman to disengage from other women, intersubjectivity does not completely break down. According to the norms of the feminine culture, women will tend to use talk in small groups to negotiate for closeness (Ms. A's and Ms. D's probings) and to avoid appearing better than others (disengagement on Ms. C's part would be construed as appearing to be better than Ms. A and Ms. D). So reluctant responder floors occur at the periphery of the circle of closeness established by the norms of feminine culture. When the women try to negotiate for closeness with Mr. B, however, they are not successful because Mr. B strongly adheres to the independence norm of the masculine culture and because he is not under the sway of the norms of the feminine culture, he does not feel their force. That is, there is a breakdown in communication due to differing cultural expectations of women and men.

Findings Regarding Failed Discourse Conditions

Analysis of the gender-implicated violations of the conditions for good group discourse likewise points out marked differences between men and women. If we include overlapping conditions (i.e. those times when more than one violation occurs during a floor) in the data summaries, we find that 52% of the total women's gender-implicated failed discourse involved violations of condition 6,

authority, 15% involved violations of condition 4, argumentation, 10% involved violations of condition 5, intersubjectivity, 10% involved violations of condition 1, dedication, 8% involved violations of condition 3, listening and making sense, and 5% involved violations of condition 2, helping. In contrast, 96% of the total men's gender-implicated failed discourse involved violations of condition 5, intersubjectivity, and 4% involved violations of condition 2, helping. This supports the contentions made previously that women's adherence to the norms of the feminine discourse culture gives rise to their avoidance of mathematical argumentation for the sake of group harmony and consensus, thereby rendering them more susceptible to the sway of authority, the effect of which resulted in over half the women's violations of their gender-implicated failed discourse. Men's adherence to the norms of masculine culture, on the other hand, resulted in the violation of the intersubjectivity condition and not much else, which means that the difficulty that masculine discourse causes for the achievement of good group discourse (equal in extent to that of feminine discourse), while powerful and pervasive, is far more circumscribed in its origin than is that of feminine discourse.

There is one further observation to be made about the violation of condition 5, argumentation. Since argumentation is central in the construction of good mathematical discourse, it may seem surprising that comparatively few gender-implicated violations were attributed to it. Indeed, condition 5 was violated many more times than appears in the data, but these violations resulted from more fundamental causes, e.g. consensus, authority, intersubjectivity, that prevented

mathematical argumentation from taking place in the first place rather than a failure on the part of the group participants to employ sound mathematical reasoning per se.

In summary, the floor findings suggest that while the gender discourse styles of men and women are equally implicated in their groups' failure to achieve good discourse, the underlying reasons for such failure are quite different. Moreover, these differences were manifested in the types of floors the group constituted, as well as the conditions of good discourse that were violated.

CHAPTER VI

CONCLUSION

Findings Regarding the Research Question

My research question was: Is gender discourse implicated in a group's failure to achieve good mathematical discourse and, if so, in what ways and to what effect? This study suggests that women's and men's membership in different communicative cultures gives rise to gender discourse that is strongly implicated in a group's failure to achieve good mathematical discourse when engaged in performing mathematical tasks. Women and men were found to be equally responsible for the failure of their groups to achieve good discourse, but in quite different ways:

- 1. Men's strict adherence to the norms of the masculine discourse culture can give rise to difficulties in achieving intersubjectivity in the group.**
- 2. Adherence to the norms of the feminine discourse culture can give rise to women's avoidance of mathematical argumentation for the sake of group harmony and consensus.**
- 3. Women are more likely to defer to the authority of the group or to the authority of another group member should they avoid mathematical argumentation in the belief that argumentation disrupts group harmony and consensus.**

4. Women's avoidance of mathematical argumentation may exacerbate their feelings of helplessness, particularly if these women hold the belief, attributable, in part, to their membership in the feminine communicative culture, that mathematics is a meaningless language game in which outcomes are determined on the basis of authority.

Of the two and a half hours of discourse the groups produced during the group exam, more than half of the total discourse was not good mathematical discourse and gender discourse was found to be implicated in half of this failed discourse. Almost all of the masculine discourse implicated in the groups' failure to achieve good mathematical discourse was due to the men's failure to achieve intersubjectivity with other group members, whereas very little of the feminine discourse implicated in the failed discourse was due to the women's failure to achieve intersubjectivity.

Women's and men's membership in different communicative cultures differentially gave rise to failed discourse in the types of floors the groups constituted. Men's difficulty in achieving intersubjectivity resulted in their disengagement from other group members and precipitated interactions that were not focused on the mathematical task at hand so that taken-as-shared mathematical meanings could not be developed. Women's avoidance of mathematical argumentation for the sake of preserving group harmony and achieving group consensus resulted in their failure to develop taken-as-shared meanings during those group interactions that occurred when two or more people argued for differing

propositions, or when one person was explaining a solution that others were trying to understand, or when one person was leading the inquiry to a problem to which no one as yet had a solution.

The gender-implicated violations of the conditions of good mathematical discourse likewise manifested sharp differences between men and women during the group exam. More than half of the total women's gender-implicated failed discourse involved violations of the authority condition, which means accepting propositions on the basis of someone else's authority or because of group consensus, and the other half was more or less evenly distributed across the remaining conditions for good mathematical discourse. Almost all of the men's gender-implicated failed discourse, on the other hand, was attributable to their violation of the intersubjectivity condition, not because of their failure to employ argumentation when talking about the mathematics under consideration but because of their failure to develop taken-as-shared meanings on a moment-to-moment basis with other group members, particularly the women. The men seldom violated any other condition for good discourse and never violated the authority condition that played such a predominant role in the women's violations.

Secondary Findings

There are two findings that emerged from this study that might be of interest to teachers and researchers interested in analyzing and promoting good mathematical discourse in small groups. These findings concern direct address and

indirect collaboration.

Direct Address

As I have previously documented, group participants' use of direct address was an indication that moment-to-moment collaboration had broken down. Group 1, which experienced far more interactional problems than group 2 during the group exam, produced direct addresses at the rate of 22 per hour, whereas group 2 produced 3 per hour. As might be expected, Mr. B received half (16) of the 32 direct addresses that occurred in group 1, which is a reflection of the many attempts the women made to bring Mr. B back into collaboration with them. Mr. B never once used a direct address to any of the women, an indication that he did not sense the interactional problems in the group, which, of course, were largely due to his working independently of the women. Ms. C, on the other hand, directed all nine of her direct addresses to Mr. B, while receiving eleven from Ms. A and none from Ms. D. This reflects Ms. A's attempts, as noted previously, to act as group mediator and ameliorate the strained relations between Ms. C and Ms. D. Ms. D made three direct addresses to Ms. A in an attempt to initiate collaboration between the two of them because Ms. C was reluctant to work with her and Mr. B was working independently. She also made one direct address to Mr. L, the class monitor in group 2, which in this case marked her discourteous behavior to her group. This pattern of direct addresses captures in a striking way, it seems to me, the interactional difficulties that occurred in the group.

My explanation for this finding is that when group participants are intersubjectively involved with each other in the moment-to-moment development of taken-as-shared meanings, they join together in a singular psychological space in which there is no need to address each other by name because their attention is so focused on the common enterprise that it is not necessary to call any particular person's attention to it.

Indirect Collaboration

I have argued that indirect collaboration may be a way that men adjust their discourse to accommodate group work and have suggested ways in which the norms of the masculine culture are modified in the accomplishment of indirect collaboration. The evidence of this study suggests that indirect collaboration is a characteristic of the masculine discourse style. On the solitary occasion throughout the entire semester when a woman did attempt to use indirect collaboration her efforts were so noticeably unsuccessful that the other group participants commented on it and attempted to keep her from lapsing into unintelligible egocentric speech. This finding, if substantiated by further research in other classrooms, could inform intervention strategies for mixed-sex groups in which the men are having difficulty in achieving intersubjectivity.

Implications for Teaching

Some Complexities

Good discourse might be more effectively promoted in mixed-sex groups if teachers were aware of some of the complexities that can occur in group interactions, particularly those associated with the kinds of gender effects brought to light by this study. In addition to what happens in the groups themselves, however, there are also complexities involving a teacher's impressions of the groups as he/she circulates about the classroom interacting with the groups for brief periods of time.

Before turning, then, to recommendations for teaching mathematics in mixed-sex groups, I would like to begin with what I learned as a teacher/researcher. That is, my perceptions of what was happening in the groups when I was engaged in teaching were, in some respects, quite off the mark. This was in spite of my constant observation of the groups as closely as I was able under the exigencies of teaching and in spite of my reading and responding to the students' learning logs on a daily basis. My experience is not unlike that of the researchers engaged in the Cobb-et-al. study. Cobb (1995) reports that the American researchers were genuinely surprised by some of their findings, even though they had visited the research classroom almost daily during their study. As a result, they had to revise some of their initial impressions about the productivity of particular groups' interactions. Cobb writes:

[I]t appears that neither harmonious, on-task activity nor the mere occurrence of explanations are good indicators of interactions that are productive for mathematical learning. Instead, criteria indicate that teachers should monitor the extent to which children engage in genuine argumentation when they solve tasks and discuss their solutions. Further, teachers should intervene as necessary to guide the development of small-group norms that make genuine argumentation possible (p. 125).

I believed that the harmonious talk I heard in group 2 and the enthusiastic responses to group work the participants (especially the women) wrote in their learning logs (see Appendix G) were evidence that good mathematical discourse was occurring. This belief was not entirely mistaken, but I did not realize until I had spent months analyzing the data that much of my impression of the group had been based on the women's rapport talk and that all too often the women had allowed group harmony and consensus to take precedence over their own mathematical understandings.

On the other hand, as I have previously noted, I had thought that the explanations I heard Mr. B give in group 1 were an indication that the group was achieving good mathematical discourse, but I did not realize that Mr. B's explanations had not been developed on a moment-to-moment basis with the women but were being reported after the fact, a consequence of his masculine reportorial discourse style. That is, I mistook group cooperation for good group collaboration, as did, I have argued, Mr. B himself. This misperception on both our parts may be due to the fact that we are both life-long members of the male communicative culture, which means that not only is the gender discourse of students implicated in the failure of good group discourse but also that the gender-induced

expectations of the teacher may be implicated in his failure to recognize a situation that required intervention. On the other hand, women teachers, as life-long members of the female communicative culture in which harmonious group relations are so highly valued, may be as likely as I, if not more so, in mistaking the kind of rapport talk found in group 2 for good mathematical discourse.

Cobb urges that teachers should guide the development of small group norms that make genuine mathematical argumentation possible, a task, that is not as straightforward as it sounds. For one thing, when promoting such norms the teacher must be acutely aware that the discourse problems of women and men are quite different. In particular, the evidence of this study suggests that a teacher's uncritical assertion of group norms to promote mathematical argumentation might conflict with women's deeply ingrained norms of the feminine discourse culture and could result in confusion and frustration on the part of both students and teacher. Moreover, the evidence of this study suggests, as I have pointed out, that difficulty with argumentation *per se* may not be the root cause of the group participants of either sex to fail to achieve good discourse.

Another mistaken impression I had of group 2 interactions during the last portion of the group exam pertained to what seemed to me to be irresponsible behavior of the part of the group to support Mr. L in his solitary effort to solve the last problem. As I have previously mentioned, each of the group members pointed out in the post-exam reflection papers that Mr. L seemed to know what he was doing and consequently left him to his own devices. Moreover, the group

seemed to hold Mr. L responsible for the failure of the group to completely solve the problem. It was not until nearly the end of my analysis of the data that I realized that the group's imputations of blame may not have been as unjustified as I had thought and that I had failed to recognize that Mr. L's gender-implicated violation of intersubjectivity was, in all likelihood, the cause of the breakdown of good discourse in this usually highly collaborative group.

While it may be due to the particular population to which my students belong, I did not find evidence that the men competed with each other, nor did they ever develop strained relations with each other. This was not always true of the women, however. In the Introduction, I hinted that women may employ conversational strategies that inhibit each others' mathematical growth, at least in the presence of men. While the norms of the feminine culture promote group harmony and egalitarian relationships between women in small groups and should therefore promote learning, they also can foster the suppression of women's emerging mathematical capabilities by other women, as the story of Ms. M and Ms. K illustrates. Again, this occurred in the presence of men, but while masculine discourse was as implicated in failed discourse as was feminine discourse, there were times when the participation of men seemed to bring out Ms. M's and Ms. D's mathematical competence, which was something they did not display in the presence of the other women in their groups and which made them appear to be quite different people. This may be due to men's experience in the masculine communicative culture in handling argumentation and confrontation that in

turn provides the space and safety for those women who tend to conflate argumentation with social disruption to explore and grow.

My mistaken impressions of good group discourse, as well as those of the researchers in the Cobb-et-al. study, coupled with the subtle and often puzzling aspects of gender effects, underscore the complexity of group interactions and how difficult it is, without an awareness of their underlying mechanisms, for a teacher to evaluate a group's effectiveness in promoting mathematical understandings while, at the same time, dealing with the multifaceted demands of the classroom. Nevertheless, I believe that studies such as this one can promote better mathematical discourse in mixed-sex groups and I would like at this time to make some recommendations.

Recommendations for Teaching

The results of this study suggest that when a teacher observes a breakdown in communication in a mixed-sex group, he/she should keep in mind that both the men and the women are quite likely to be equally responsible for the breakdown, but in different ways. Men, for example, might have to be encouraged to act more interdependently with the group, particularly with the women, and women might have to be persuaded to place a higher value on mathematical argumentation than on group consensus and harmony. This is much easier said than done, though even the recognition of these matters is a step in the right direction. Men may very well believe that they are interacting in the group in a way the teacher

expects, when, in fact, they have been acting in a cooperative mode rather than a collaborative one. The women, on the other hand, may feel their identities as women, as life-long members of the feminine communicative culture, threatened should they engage in any form of argumentation they feel would destroy their relations with the group or elevate them above the others, particularly the men in the group. That is, simply admonishing the men to act more collaboratively and the women to act more argumentatively may not, in itself, prove effective.

This situation is not unlike what occurs when we teachers "tell" our students how to solve problems and we can expect about the same results. Taking an alternate approach, some teachers model the problem-solving process in whole-class discussions by thinking aloud so that the students have the opportunity to internalize the teacher's voice, and thereby incorporate the teacher's experience into their own problem-solving processes. I would recommend a similar modeling approach that would provide students with the opportunity to internalize those interactions that promote good discourse in groups. It follows from the sociolinguistic assumptions of this study that small group discussions are strongly influenced by cultural communicative norms, and hence any attempts to address interactional problems that prevent a group from achieving good discourse should likewise involve sociolinguistic considerations based on knowledge of how the masculine and feminine communicative cultures operate. This means that the teacher, when attempting to address gender effects or the breakdown of good discourse in groups, must pose and then resolve group interactional problems in a

realistic fashion when modeling group interactions. He or she might create the voices of imaginary group participants engaged in conversational exchanges, along with their on-going thoughts or attitudes that could be suggested in off-stage whispers, all the while providing a running commentary on what is happening. The findings of this study suggest that the teacher's use of off-stage whispers might also provide a model for how men who are having difficulty achieving intersubjectivity could modify their discourse style by using the indirect collaborative voice as a means of entering into the group's moment to moment development of taken-as-shared meanings.

A modeling approach to group interactions suggests that teachers, then, might enact the various culturally-induced attitudes and perspectives of students in believable and convincing ways so that the students could recognize and identify with the characters in these dramatic creations. The teacher must articulate the thoughts and feelings of the group participants and then dramatize what happens when they come in conflict not only with each other, but also with what constitutes effective group discourse. In short, the teacher must play the parts of the participants in the group and in so doing the classroom becomes, in some sense, theatre.

This suggestion is not that far removed from what already occurs in teacher training when we realize that some college teacher education programs already use (if not require) videotaping to enhance preservice teacher performance and that some states require this for permanent certification of in-service

teachers. Nonetheless, the difference between a teacher acting out group interactions as suggested above and leading a discussion about mathematical content is quite significant. If we believe, however, that learning is socially constructed, that social influences such as gender manifest themselves in communication, and that small groups are effective in promoting learning through communication and collaboration, then a narrow focus on mathematical content alone and the communication of that content in the training of mathematics teachers would seem to be less than adequate for our educational aims. In her discussion of equity in mathematics education, Noddings (1996) writes,

[I]f mathematical communication is stressed before diverse groups have learned how to communicate on ordinary matters, if no attempt is made to help students understand and appreciate diverse modes of communication, the result may be continued exclusion (p. 611).

The question, then, is how mathematics teachers themselves can learn to help students communicate in groups when these students (and teachers as well) speak to each other through differing gendered modes of communication. In view of my suggestion above that teachers might become enactors, as well as facilitators, of these modes of communication, I turn to some suggestions for secondary mathematics teacher training. Although my suggestions are based on findings involving entry-level college developmental students, it would seem unlikely that these students would differ significantly in their discourse styles from precollege students, especially when we realize that they were quite recently secondary students themselves. My recommendations, then, are to be taken as suggestive of how gender

discourse issues could be incorporated in the training of secondary mathematics teachers and are intended to hint at what that might look like.

First and foremost, mathematics educators should recognize that students are not going to abandon their life-long gendered ways of talking when they participate in group discussions and that teachers should be made aware of what these ways are, what their effects are, and how these effects are likely to influence the development of taken-as-shared meanings in group discourse. This study, for example, pinpoints the different areas in which gender-implicated problems in group discourse are most likely to occur, describes the types of interactions in which masculine and feminine discourse problems will most likely manifest themselves, and identifies those aspects of good mathematical discourse that each discourse style will most likely violate. It also suggests that teachers should be alert to certain discourse markers, such as the group's frequent use of direct address, that signal that the group is experiencing interactional problems. Admittedly, such findings are tentative and much more work needs to be done. Nevertheless, work can begin incorporating these or other discourse perspectives that address gender and culture in course work dealing with classroom communication.

Exposing students to these topics through reading and discussions alone is not sufficient. Preservice teachers should experience performing them, much in the same way as students are required to perform in speech classes. Moreover, I suggest that audio or video tapes of students at various grade levels working in groups be developed and transcribed. Preservice teachers should listen to the

tapes, analyze the transcriptions, and be afforded the opportunity to openly and frankly discuss what they observe from various perspectives on culture, gender, and discourse. Each student could then reenact a segment(s) of this discourse, effectively encapsulating for the preservice class the roles and viewpoints of the participants, after which he or she would then redirect the class's attention as to what the participants could and/or should have said or done, again illustrating these modifications in enacted conversational exchanges along with an accompanying commentary.

This recommendation requires, of course, sensitive and knowledgeable in-class faculty supervision, which ideally, it seems to me, should involve mathematics educators working in conjunction with faculty from other educational specialties, or even faculty from communication arts and sciences, psychology, sociology, social linguistics, or counseling. I would also suggest that classroom supervision involve both men and women. I know that I, even though I have spent time thinking about these matters, would feel more comfortable having a woman's perspective in such a context. If the issue should come up, for example, that some women students will not display mathematical competence in the presence of men students because they feel it would make them appear less sexually attractive, less feminine, I can address this issue from my own attitudes and experiences as a man, but I would most certainly welcome a woman's reflections and experience.

It can be objected, however, that it is inappropriate that such matters should be allowed to come to the fore in preservice mathematics education. I

would agree if it were the case that gender discourse plays little or no role in mathematics discussion groups. But based on the evidence of this study, as well as that of other studies (e.g. those reviewed by Webb, 1991), I do not believe that such is the case. I would argue, then, that gender issues, and gender discourse in particular, must be acknowledged, understood, and discussed. When this happens, it is to be expected that some rather difficult issues should arise; nevertheless, they should be welcomed, for in this way teachers will have had experience in dealing with them in their training.

Preparing teachers to address problems arising from gender discourse in group work by modeling group processes can also be used as a springboard for modeling how groups should constitute good group discourse quite apart from issues of gender discourse. Again, the focus should be upon enactment of group processes, which should not be left to chance, but should be part and parcel of the teacher's craft developed in preservice training.

Implications for Future Research

Issues Concerning Methodological Limitations

As I have previously pointed out, there are two criticisms that can be brought to bear on the design of this study that would circumscribe the generalizability of the above findings: (1) the use of the group exam, and (2) the nature of the mathematical tasks the students engaged. The implication of the former

criticism is that the extensive failed discourse found in the floor analysis can be attributed to the group participants having to talk about mathematics under the pressure of an exam; the implication of the latter criticism is that the nature of the content of the course is not conducive to good mathematical discussion to begin with, and therefore failed discourse is to be expected. Moreover, the implication of both these criticisms is that if there is less failed discourse, there would be fewer pervasive gender effects.

In Chapter IV, I pointed out that I wanted to encapsulate for the reader the interactions the group had constituted over the entire semester in one body of data produced when the participants were making an concerted effort to work together. Admittedly, there is a trade off between presenting the results of an analysis of a large body of recorded data accumulated over an entire semester and being able to supply a detailed description of the participants' discourse as is exemplified by floor analysis. While there may have been more failed discourse at the end of the exam due to the constraint of time, I was careful to demonstrate that the failed discourse I attributed to gender discourse was typical of the discourse the group had constituted during the semester in non-test situations. The evidence suggests, therefore, that the exam situation did not give rise to atypical gender effects, though it may have caused more failed discourse than would have occurred in a comparable period of time in other circumstances.

In Chapter IV, I also discussed the nature of the content in the course, which involved both procedural and conceptual knowledge, relating that the

microculture of the classroom was such that students questioned and challenged each other in their attempt to negotiate taken-as-shared meanings about certain mathematical ideas, some of which were new to them (e.g. the statistical material), in ways that constituted the possibilities for authentic, if not good, mathematical discourse. Nevertheless, the question of how much more of the groups' discourse would have been considered good discourse if the participants had been discussing "richer" problem contexts remains open, though it seems to me somewhat dubious to consider the talk of students jointly engaged in trying to understand those mathematical problems they have hitherto not understood as constituting a lower or less desirable form of discourse. The further implication that a richer type of mathematics would mitigate or even eliminate the socially enculturated undesirable effects of gender remains unaddressed by this study, though it raises questions that should be of vital concern to mathematics educators. Although the results of this study are circumscribed by the above considerations, I submit that they provide a baseline of theoretically grounded findings that has value for research that seeks to address the above issues for the following reasons.

If richer problems produce fewer and/or less pervasive gender effects, then we might suspect that gender-implicated failed discourse has its source in content and curriculum. Studies such as this one would provide specifics for comparison, albeit in a negative sense, as to what ways the nature of the mathematical task affects not just failed discourse but gender-implicated failed discourse as well, thereby lending research-based support for furthering curricular reform. If, on

the other hand, the same gender effects occur more or less independently of the type of mathematical task, then we must acknowledge a problem of a different kind, one that will persist in spite of course content and that might better be approached from a sociological perspective rather than from a strictly curricular one, though content and the structuring of that content for effective use in groups would still be of concern. In this event, the results of studies such as this one would provide a sociolinguistic base upon which to build further studies.

In addition to the methodological limitations addressed above, as well as the limited number of groups studied and their gender mix, the findings of this study depend heavily upon its theoretical framework, which involves (a) the cultural difference approach to gender discourse that informs my models of feminine and masculine communicative cultures, (b) the ethnomethodological approach to conversational and interactional analysis, and (c) the assumptions underlying the model of good group mathematical discourse. Although this string of theoretical contingencies circumscribes these findings, the questions the study raises for further exploration, its methodology, and its call for further theoretical development in gender theory may be of value to future research.

Extensions and Further Questions

1. The relationship between the nature of the mathematical task and the quality of group discourse should be explored, particularly with regard to the occurrence and pervasiveness of gender effects.

2. The discourse of single-sex and mixed-sex groups should be compared and the advantages/disadvantages of single-sex versus mixed-sex group discourse should be determined with regard to the achievement of good group discourse.

3. Intervention strategies based on sociolinguistic perspectives should be devised and evaluated that are designed to mitigate negative gender effects in small group interactions and discourse.

4. Studies similar to this one could be conducted using different theoretical perspectives on gender and /or models of good group discourse.

5. Comparative studies could be made of group work in mathematics classrooms with group work in nonmathematics classrooms in which there is joint inquiry or argumentation, e.g. English or political science classes, in order to identify group discourse characteristics and interactions that could account for the differentiated participation of women in these classrooms.

Methodology

Chunking lines of transcribed speech by floors is a technique whereby hundreds of lines of transcribed speech can be classified into a relatively few types of interactions (nine in this study). The codes for these floors indicate the type of interaction (e.g. equivocal, multivocal, univocal) and who was involved in the interactions, as well as what their relationships were to each other. The timing of these floors allows the researcher to measure the effects of certain interactions that occurred in the floors. Floors provide, then, a bridge between qualitative and

quantitative analysis.

Floor constructs do not depend on a particular theory of gender or particular model of good discourse. In fact, a researcher could use them to analyze good mathematical discourse in groups quite apart from gender. What is required for their use is a list of model conditions and one or more variables of interest to be investigated. In addition, the researcher can devise his/her own types of floors or modify their codes in any number of ways in order to detect the variables of interest. The amount of information generated between and within groups permits detection of interesting effects by multivariate analysis, the beginnings of which can be discerned in this study.

Theory

I have suggested that women's beliefs about the nature of mathematics, their feelings of helplessness, and their lack of persistence when faced with mathematically challenging problems while collaborating in small, mixed-sex learning groups can be explained, in part, by women's enculturation in the feminine communicative culture . I also stated that I find this explanation, based as it is on the theoretical framework I have developed for this study, to be incomplete. Many of the reactions of the women in this study seemed to me to be of a more personal, psychological, or even epistemological nature than my particular culturally-oriented perspective could account for, yet, at the same time, the evidence strongly suggested that they were gender related. There are several psychological

constructs that could supplement the cultural difference approach I have employed in accounting for the mathematical behavior of the women in this study, but the approach that seems to me to offer an interesting, alternative description of, though perhaps not explanation for, such behavior has been developed by Belenky, Clinchy, Goldberger, and Tarule (1986), which can be characterized as "women's ways of knowing." Damarin (1995) provides a brief description of these ways of knowing, which I have appropriated and adapted below.

Women move through various psychological and epistemological stages in their ways of knowing. These stages are not necessarily hierarchical; that is, a woman might belong to more than one stage at a time in her progression. The stages may be characterized as follows:

1. Silence, characterized by the belief that authorities are all-powerful; there is an absence of expectation with regards to understanding.
2. Received knowing, acceptance of authority by rote, "whatever you say, doc."
3. Subjective knowing, "knowing in my gut," assumption there are always right answers.
4. Procedural knowing, characterized by separated knowing, disconnected impersonal, propositional reasoning.
5. Connected knowing, the seeking of explanations for one's perceptions, and an interest in the thoughts of others.
6. Constructed knowing, characterized by an effort to integrate knowledge

and an appreciation for the complexity of knowledge.

It seemed to me that the women in this study could be aptly characterized as belonging to one or more of these lower stages. Though I find the above descriptions suggestive and fairly accurate, I find them too limited in themselves for the purposes of this study.

Damarin writes:

This model describes women's lives, in particular and as gleaned from the WWK data, in several ways. Silence is seen as an effect of generations of women's socialization to acquiesce to male authority. Subjective knowing identifies and valorizes what has traditionally been denigrated as 'women's intuition.' And, connected knowing identifies a kind of procedural knowing which is different from 'masculine rationality,' but qualifies as reasoning (p. 38).

Although the above model suggests a link between the social and psychological planes in terms of male dominance, I would suggest that the theoretical links between women's ways of knowing and communicative gender cultures be established and elaborated. Such a theoretical development would better account for the mathematical behaviors and beliefs of the women in this study and could provide a more informed basis for the development of intervention strategies for mathematics teachers and researchers.

Appendix A
Group 1 Floors

APPENDIX A

Group 1 Floors

Lapsed Time (Min.)	Floor Code	Fl. ¹ Len. (Min.)	GGD ² Effect	Cond ³	Gender	Problem #			
						C	A	D	B
1	LVE:C-{A,B}\D-ABS	1.0	Y	See Appendices B or C		1	1	X	1
2	LVE:C-A->B\D-ABS	0.8	N			1	1	X	1
3	GMF	0.7	N			2	2	1	2
4	RRF:A->C\B-IND, B-IND	1.0	N			2	2	1	2
5	NF	1.6	N			2	2	1	2
6	UVF:C-{A,D}\B-IND	3.7	Y			2	2	2	2
7	UVF:C-B\EVF:A,D	0.7	Y			2	2	2	2
8	NF	2.2	N			3	3	3	3
9	GMF	0.3	N			3	3	3	3
10	EVF	1.6	Y			3	3	3	3
11	GMF	0.6	N			3	3	3	3
12	LVE:C-{A,D}\B-IND	2.3	Y			4	4	4	3
13	UVF:B-G	3.2	N			3	3	3	3
14	MVF:B>C	2.0	N			3	3	3	3
15	MVF:C=D\B-IND	3.6	Y			4	4	4	4
16	EVF\B-IND	1.6	N			5	5	5	5
17	RRF:{D,A}->C->C	1.4	N			4	4	4	4
18	RRF:{D,A}->C\B-IND	2.3	N			5	4	4	5
19	EVF:{D,A}\C-IND,B-IND	1.1	N			5	5	5	5
20	RRF:D->C\B-IND	1.0	N			5	5	5	5
21	NF	2.9	N			5	5	5	5
22	RRF:A->C\B-IND	1.4	N			6	6	6	5
23	RRF:{A,D}->C\B-IND	2.1	N			6	6	6	5
24	EVF\B-IND	2.2	Y			6	6	6	5
25	MVF:B>C	2.0	N			5	5	5	5
26	EVF\B-IND	5.4	Y			5	5	5	5
27	RRF:{A,C}->B	1.8	N			5	5	5	5
28	RRF:{A,D}->C\B-IND	2.3	N			5	5	5	5
29	WF\B-IND	0.4	Y			7b	7b	7b	5
30	GMF\B-IND	0.5	N			7a	7a	7a	5
31	RRF:{A,D}->C-IND\B-IND	2.6	N			7a	7a	7a	5
32	NF\B-IND	0.1	N			7a	7a	7a	5

Appendix A--Continued

Lapsed Time (Min.)	Floor Code	Fl. ¹ Len. (Min.)	GGD ² Cond ³ Effect	Gender	Problem #			
					C	A	D	B
33	LVFD-A\GMF:C,B	0.6	N		7a	7a	7a	5
34	MVF:{A,D}=C\B-IND	0.6	N		7a	7a	7a	5
35	GMF	0.7	N		7a	7a	7a	5
36	RRF:{A,D}->C\B-IND	0.3	N		7a	7a	7a	5
37	LVF:C-{A,D}\B-IND	0.7	N		8a	8a	8a	5
38	GMF	0.3	N		8a	8a	8a	5
39	MVF:B>{C,A}	0.9	N		5	5	5	5
40	LVF:C-B	1.3	N		5	5	5	5
41	GMF	0.3	N		5	5	5	5
42	RRF:D->{A,B}\C-IND	0.5	N		5	5	5	5
43	EVF	0.9	Y		8a	8a	8a	?
44	EVF:{C,D,A}<-\B-IND	1.8	N		8b	8b	8b	?
45	UVF:C-{A,D}\B-IND	0.9	Y		8b	8b	8b	?
46	WF\B-IND	1.5	Y		8b	8b	8b	?
47	NFB-IND	0.9	N		8c	8c	8c	?
48	MVF:{C,A,D}=B	0.9	N		7a	7a	7a	?
49	LVF:C-G	2.4	N		8c	8c	8c	8c
50	LVF:C-D\B-IND	2.6	Y		9a	9a	9a	?
51	LVF:C-A\OTF:D-L\B-IND	1.0	N		9a	9a	OT	?
52	GMF	0.8	N		9a	9a	9a	9a
53	EVF:{C,A,D}<-B	5.6	N		9a	9a	9a	9a
54	EVF:{C,A}\D-NON\B-IND	2.2	N		9a	9a	9a	9a
55	WF	2.3	N		9b	9b	9b	?
56	RRF:{D,A}->B-IND	1.6	N		9b	9b	9b	?

Notes: 1 Floor length
2 Good group discourse?
3 Discourse condition violated

Appendix B
Group 1 Floors Wholly Engaged

APPENDIX B

Group 1 Floors Wholly Engaged

#	Length	Floor Code	GGD ¹	Cond ²	Gender Effect
1	1.0	LVF:C-{A,B}\D-ABS	Y		
2	0.8	LVF:C-A->B\D-ABS	N	5-B	Inter-B
3	0.7	GMF	N		
5	1.6	NF	N		
7	0.7	UVF:C-B\EVF:A,D	Y		
8	2.2	NF	N		
9	0.3	GMF	N		
10	1.6	EVF	Y		
11	0.6	GMF	N	5-B;6-C	Inter-B; Harm-C
13	3.2	UVF:B-G	N	6-D	Math Beliefs-D
14	2.0	MVF:B>C	N	4-C	Harm-C
17	1.4	RRF:{D,A}->C->C	N	2-C,B;5-G	
21	2.9	NF	N		
25	2.0	MVF:B>C	N	5-B;6-C	Inter-B; Harm-C
27	1.8	RRF:{A,C}->B	N	5-B;1-D	Help-D
33	0.6	LVFD-A\GMF:C,B	N	5-B	Inter-B
35	0.7	GMF	N	5-B;6-D,A	Inter-B; Harm-D,A
38	0.3	GMF	N	5-B	Inter-B
39	0.9	MVF:B>{C,A}	N	3-D	
40	1.3	LVF:C-B	N	3-D	
41	0.3	GMF	N		
42	0.5	RRF:D->{A,B}\C-IND	N	3-D;6-D;5-C	Con-D
43	0.9	EVF	Y		
48	0.9	MVF:{C,A,D}=B	N	6-C,A,D	Con-C,A,D
49	2.4	LVF:C-G	N	5-B;6-A,D,C	Con-C,A,D
52	0.8	GMF	N	5-B;1-D	Inter-B
53	5.6	EVF:{C,A,D}<-B	N	5-B	Inter-B
55	<u>2.3</u>	WF	N	1-D	
39.8 min.					

Notes: 1 Good group discourse?
 2 Discourse condition violated

Appendix C
Group 1 Floors Women's Subgroup

APPENDIX C

Group 1 Floors Women's Subgroup

#	Length	Floor Code	GGD ¹	Cond ²	Gender Effect
4	1.0	RRF:A->C\B-IND, B-IND	N	5-D	
6	3.7	UVF:C-{A,D}\B-IND	Y		
12	2.3	LVF:C-{A,D}\B-IND	Y		
15	3.6	MVF:C=D\B-IND	Y		
16	1.6	EVF\B-IND	N	4-G	Con-A,D,C
18	2.3	RRF:{D,A}->C\B-IND	N	2-C;5-C	
19	1.1	EVF:{D,A}\C-IND,B-IND	N	5-C	
20	1.0	RRF:D->C\B-IND	N	2-C;3-D	
22	1.4	RRF:A->C\B-IND	N	2-C;5-A,C,D	
23	2.1	RRF:{A,D}->C\B-IND	N	3-C	
24	2.2	EVF\B-IND	Y		
26	5.4	EVF\B-IND	Y		
28	2.3	RRF:{A,D}->C\B-IND	N	5-C	
29	0.4	WF\B-IND	Y		
30	0.5	GMF\B-IND	N	6-D	Con-D
31	2.6	RRF:{A,D}->C-IND\B-IND	N	2-C;5-C	
32	0.1	NF\B-IND	N	1-D	Help-D
34	0.6	MVF:{A,D}=C\B-IND	N	6-C	
36	0.3	RRF:{A,D}->C\B-IND	N	6-A,D	Harm-D
37	0.7	LVF:C-{A,D}\B-IND	N	5-A,C,D	Inter-B
44	1.8	EVF:{C,D,A}<-B-IND	N	5-A,C,D	Inter-B
45	0.9	UVF:C-{A,D}\B-IND	Y		
46	1.5	WF\B-IND	Y		
47	0.9	NF\B-IND	N		
50	2.6	LVF:C-D\B-IND	Y		
51	1.0	LVF:C-A\OTF:D-L\B-IND	N	1-D	
54	2.2	EVF:{C,A}\D-NON\B-IND	N	1-D	
56	1.6	RRF:{D,A}->B-IND	N	2-C;1-D	

47.7 min.

Notes:

- 1 Good group discourse?
- 2 Discourse condition violated

Appendix D
Group 2 Floors

APPENDIX D

Group 2 Floors

Lapsed Time (Min.)	Floor	Code	Fl. ¹ Len. (Min.)	GGD ²	Cond ³	Gender Effect	Problem #			
							K	M	J	L
0.0	1	EVF	1.5	Y			1	1	1	1
							2	2	2	2
1.5	2	MVF:M>{L,K}	1.4	Y			2	2	2	2
1.9	3	EVF	4.5	Y			3	3	3	3
6.4	4	UVF:L-J	.7	Y			3	3	3	3
7.1	5	EVF	2.6	Y			3	3	3	3
							4	4	4	4
9.7	6	LVF:J-G	.5	Y			4	4	4	4
10.2	7	MVF:M>{J,K}	.6	Y			4	4	4	4
10.8	8	LVF:J-G	1.0	Y			4	4	4	4
11.8	9	EVF	3.0	Y			5	5	5	5
14.8	10	LVVF:K-G	2.0	Y			5	5	5	5
16.8	11	EVF	2.7	Y			5	5	5	5
19.5	12	UVF:J-M	.6	Y			5	5	5	5
20.1	13	MVF:J>{L,M}	1.2	N	3-J;6-J;4-L		5	5	5	5
21.3	14	EVF	1.5	Y			5	5	5	5
							6	6	6	6
22.8	15	OTF:J,MK-IND,L-IND	.6	N			6	OT	OT	6 ⁴
23.4	16	LVF:K-G	2.3	N	6-G		6	6	6	6
25.7	17	GMF	.6	N			7a	7a	7a	7a
26.3	18	LVF:K-G	1.3	N	5-K	Inter-K	7a	7a	7a	7a
27.6	19	EVF	1.4	N	5-K	Inter-K	7a	7a	7a	7a
29.0	20	MVF:K=L	1.5	N	3-K		7a	7a	7a	7a
30.5	21	WF	.8	Y			7a	7a	7a	7a
31.3	22	GMF	1.5	N			7a	7a	7a	7a
32.8	23	WF	2.2	Y			7a	7a	7a	7a
35.0	24	MVF:L>G	.6	N	6-K,M;3-G					
						Con-K,M	7a	7a	7a	7a
35.6	25	LVF:L-J	1.1	N	3-K,M	Inter-J,L				
					2-J,L	Beliefs-K,M	7b	7b	7b	7b
36.7	26	MVF:J>K	2.7	N	6-K	Harm-K	8a	8a	8a	8a
39.4	27	EVF	1.6	N	5-G		8b	8b	8b	8b

Appendix D--Continued

Lapsed Time (Min.)	Floor Code	Fl. ¹ Len. (Min.)	GGD ²	Cond ³	Gender Effect	Problem #			
						K	M	J	L
41.0	28	UVF:L-G	2.3	N	3,5-J,M	8b	8b	8b	8b
43.3	29	UVF:K-G	1.3	N	5-G	8c	8bc	8c	8c
44.6	30	GMF	2.6	N		9a	9a	9a	9a
47.2	31	UVF:L-G	2.3	Y		9a	9a	9a	9a
49.5	32	OTF\L-IND	.8	N	5-L	Inter-L	OTOT	OT	9a
50.3	33	GMF	.3	N	5-L	Inter-L	9a	9a	9a
50.6	34	OTF	2.3	N	5-L	Inter-L	OTOT	OT	9a
52.9	35	UVF:L-G	1.6	Y		9a	9a	9a	9a
54.5	36	EVF	2.9	Y		9b	9b	9b	9b
57.4	37	OTF:M,K\UVF:L-J	.5	N	5-L,J	Inter-L,J	OT	OT	9b
57.9	38	OTF\L-IND	.7	N	5-L	Inter-L	OTOT	OT	9b
58.6	39	UVF:L-G	1.0	N	5-L	Inter-L	9b	9b	9b
59.6									

Notes:

- 1 Floor length
- 2 Good group discourse?
- 3 Discourse condition violated
- 4 Off task

Appendix E
Group Exam

APPENDIX E

Solve for y and simplify for questions 1 and 2:

1. [10] $y + 2 + 3x = 5 - 4x$

2. [10] $\frac{3}{2}(x - 2) - \frac{y}{2} = \frac{x}{3} + y$

3. [10] Solve for a : $c = \frac{ba - b}{a - 1}$

4. [10] Solve the following system of linear equations algebraically:

$$2x + y = 5$$

$$3x - 4y = 2$$

5. [10] Find the equation of the line passing through (1,2) and (-1,3).

6. [10] Suppose the slope of a line is $\frac{4}{9}$. If a bug crawls along the line from one point to another point so that its horizontal displacement is 2.34 in, what will be its corresponding vertical displacement? Round your answer to the nearest hundredth.

7. [10] For a and b below, graph the lines given equation:

a) $y - 1 = 2(x - 1)$

b) $y = 2$

8. For the box-and-whiskers plot below



[5] a) What percent of the data lies between Q_1 and the maximum?

[5] b) Will the mean be less than, equal to, or greater than the median?

Explain your answer in order to receive credit.

APPENDIX E--Continued

[5] c) If there are 60 data points distributed in the plot from the minimum to Q3, what is the total number of data points represented in the entire plot?

9. Various data for leg press, height, and weight of certain ninth grade female athletes has been transmitted to your calculator.

[5] a) In the chart below, identify the females in the upper quartile of the leg press, along with their respective heights and weights.

NOTE: Student Number: L1

Leg Press: L4

Height: L3

Weight: L2

<u>Student Number</u>	<u>Leg Press</u>	<u>Height</u>	<u>Weight</u>
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[10] b) Describe the heights and weights of the athletes identified in a) above with respect to the heights and weights of the entire class. Show all work, including plots.

Appendix F
Excerpts From Group 1 Learning Logs

APPENDIX F

Excerpts From Group 1 Learning Logs

2/2/94 (3rd class period)

Ms. A: My group is very comfortable for me.

Ms. C: Yes, we helped each other out well.

Ms. D: Yes, I like my group & it is working out pretty good.

Mr. B: I like my group so far. It seems helpful to everyone. TI82 is amazing.

2/4 (4th class)

Ms. A: Group is fine.

Ms. C: Group ok

Ms. D: Group working good.

Mr. B: The group is working well for me. We get along great.

2/15 (9th class)

Ms. A: absent

Ms. C: yes

Ms. D: Groups working out fine.

Mr. B: Groups are going good. We had a little trouble with some math problems but I think we solved that

2/18 (11th class)

Ms. A: Group is fine.

Ms. C: the TI82 is okay, it is a lot quicker & does a lot for you.

Ms. D: Groups good. We work together well.

Mr. B: the groups are working out great.

2/21 (12th class)

Ms. A: [no comment]

Ms. C: [absent-funeral]

Ms. D: Groups fine!

Mr. B: groups are still helpful. I work slowley to figure things out. Other people work ahead and don't understand what they are doing

2/23 (14th class)

Ms. A: Group is fine.

Ms. C: ok

Ms. D: Group's fine. I kinda understand parts but totally depend on my group for certain help.

Mr. B: My group was very helpful today.

2/25 (15th class)

Ms. A: [no comment]

Ms. C: the group seems to want answers w/o solving anything.

Ms. D: Group ok [I had a conference with her later this day]

Mr. B: Groups are still going well. I think we were all kinda confused.

Appendix F--Continued

Excerpts From Group 1 Learning Logs

3/1 (17th class)

Ms. A: group is fine

Ms. C: ok

Ms. D: Working better->starting to communicate better!

Mr. B: Groups are working very well today, no one got ahead of anyone else and questions were asked when something was not understood

3/8 (21st class)

Ms. A: group fine

Ms. C: ok

Ms. D: Groups ok

Mr. B: the groups went okay today. I understand what to do but still like to do things slow to make sure I did it right. Meanwhile others were jumping ahead and they were frstrated when I wasn't able to explain somthing to them right away or didn't know how to explain something really simple to them.

3/11 (23rd class)

Ms. A: Group is fine.

Ms. C: ok

Ms. C: Groups ok

Mr. B: groups are working fine

3/14 (24th class)

Ms. A: group almost done

Ms. C: My group skipped around. For the second half of the semester, I would like to change groups.

Ms. D: We skipped around on the page. Groups good.

Mr. B: groups worked great today. Things seem to be going well.

3/29 (26th class)

Ms. A: Group fine

Ms. C: I would still like a new group.

Ms. D: [no comment]

Mr. B: Groups are working fine today

4/11 (33rd class)

Ms. A: Group's fine

Ms. C: [Mr. B] explained it. I think I understand calculator graphing also.

Ms. D: Groups fine

Mr. B: We started off [I asked the groups to write their solutions on the board; Ms. C put the group 1's solution on the board] and I saw we made a mistake and changed our answer [he went to

Appendix F--Continued

Excerpts From Group 1 Learning Logs

the board and made a correction after Ms. C had sat down]
and I still like my answer. Groups worked really well today.

4/19 (36th class)

Ms. A: Group is fine

Ms. C: ok

Ms. D: Groups fine!!

Mr. B: Groups were okay but frustrating. They didn't care to try and understand different answers.

4/25 (39th class)

Ms. A: I think we all understood.

Ms. C: We all agreed & helped each other well.

Ms. D: Groups fine! Group worked well together today

Mr. B: The group worked fine today. No problems.

4/27 (41st class)

Ms. A: Group fine.

Ms. C: [no comment]

Ms. D: [absent]

Mr. B: Group went pretty good today. I thought it was frustrating to explain what to do on the last problem.

4/29 (42nd class) [I announced the group test]

Ms. A: Group fine.

Ms. C: I think a group test will be good, if we all work together, not having people let others do the work.

Ms. D: Groups ok

Mr. B: [absent]

Appendix G
Excerpts From Group 2 Learning Logs

APPENDIX G

Excerpts From Group 2 Learning Logs

2/2/94 (3rd class period)

Ms. K: My group is working out pretty well. We haven't had to do too much but that is O.K. Sometimes I have trouble with the Math. When it comes to Math I am not very bright.

Ms. M: Absent (attending a hand, & I seem to know the calc conference)

Mr. L: I feel comfortable in my group so far. [Mr. J] and I have been helping each other out quite a bit. He is better at doing things by calculator better. We work pretty well together. I feel as though I am really learning this for the first time! I am really enjoying this class. I am getting a better understanding of Math.

Mr. J: Groups are going fine. I haven't done a whole lot of interaction w/ them yet, but I think it will work out fine.

2/4 (4th class)

Ms. K: The group are working out, if I didn't have it I would not know what to do.

Ms. M: Our group works well. We feel open to talk the more days we're together.

Mr. L: Group activities are still going well. I don't feel quite so stupid now.

Mr. J: The group was good today. it helped [me] get out of a couple of problems.

2/15 (9th class)

Ms. K: The groups are helping. They show me what I do wrong and how to fix it.

Ms. M: Group is fine, I find it helpful even though we're quiet.

Mr. L: Groups are going well. We are all communicating well w/ one another.

Mr. J: Groups helped a lot today.

2/18 (11th class, began taping)

Ms. K: Group are working out good. It is some one to talk to.

Ms. M: Group is great. I really enjoy and find it very interesting using the calculator. It's challenging but yet interesting.

Mr. L: Groups going well.

Mr. J: The calculator is working real well for me. it takes some getting used to, but I'm catching on.

2/21 (12th class)

Ms. K: Groups are working out great. They helped me find the way to do things.

Ms. M: I really like my group. It works out well.

Appendix G--Continued

Excerpts From Group 2 Learning Logs

- Mr. L: Group discussion & assistance good.
- Mr. J: The group helped w/ each process & together we got the last one.
- 2/22 (13th class)
- Ms. K: Groups are working well. We talk a lot more than when we first started.
- Ms. M: absent
- Mr. L: I think we are all a little stumped on this one, because not much group discussion today.
- Mr. J: Once again, groups went fine. A little more quiet today.
- 2/23 (14th class)
- Ms. K: Groups are working out very well. It is nice to have people who know what they are doing.
- Ms. M: Group is great!
- Mr. L: Group still working well together.
- Mr. J: Groups are working great. We're have[ing] a good time and learning too.
- 3/1 (17th class)
- Ms. K: Group is great, please don't change them.
- Ms. M: Groups are working out well, they help me to understand Math a little better.
- Mr. K: Groups still going well. Good communication. Good group work.
- Mr. J: Groups are going fine, they help me out quite often.
- 3/7 (20th class)
- Ms. K: Got frustrated working on problem 2. Good group bonding!
- Ms. M: Good group bonding.
- Mr. L: Good group bonding. Great discussion & understanding between us.
- Mr. J: Today we got frustrated at a few review problems dealing w/ means & frequencies. Good group bonding.
- 3/9 (22nd class)
- Ms. K: Went well, we were tired though, performance wasn't best.
- Ms. M: Group was tired, so we did not perform as well.
- Mr. L: Group seemed a bit tired today. Not up to par in thinking ability.
- Mr. J: Group was a bit tired today, so performance was not up to par.
- 4/4 (29th class)
- Ms. K: Groups were good. I got stuck and they helped me out.

Appendix G--Continued

Excerpts From Group 2 Learning Logs

Ms. M: Group is great. Graphing is cool, I like it. I find it very interesting.

Mr. L: I think this is really neat. I need a better understanding of what the graph represents. Group working well together.

Mr. J: I was amazed at what the calculator can do & it was fun doing it. Group is swell.

4/11 (33rd class)

Ms. K: Today we worked on calculator graphing. However we still come to different conclusions. Groups are great. We are all very analytical.

Ms. M: I find this problem challenging. But I still haven't decided how I can come up with the right answer. I love being in such an analytical group!

Mr. L: Today, we tried some more graphing. We had disagreement w/ rest of class on above problem as to what answer is. It is quite confusing. Good group participation. I have personal conflict am dealing with from weekend. Not too talkative or thinkative today. Sorry!

Mr. J: We had trouble figuring out the (0,1) because we didn't know how to put it into the equation. The group is actually what helped us to catch onto the problems & to figure out to fix it.

4/25 (39th class)

Ms. K: My group is working out very well. Very good discussion. Talk about a lot.

Ms. M: Group is swell. Very good discussion.

Mr. L: Group still working well together. I really like our group. Good discussion today.

Mr. J: Our group had a very good discussion today.

4/29 (42nd class)

Ms. K: absent (track meet)

Ms. M: Group worked well in helping each other out when calculator was processing wrong data. Group stuck together and solved it.

Mr. L: Good group discussion & help. Work well together.

Mr. J: Group really helped me when I was lost today.

5/6 (46th class, group exam)

Ms. K: Are [our] group worked really well together.

Ms. M: Group worked great.

Mr. L: Great group interaction and help from one another. We all contributed in diff [different] ways on diff types of problem.

Mr. J: Group saved my butt.

Appendix H

Human Subjects Institutional Review Board Approval

Human Subjects Institutional Review Board

Kalamazoo, Michigan 49008-3899
616 387-8293

WESTERN MICHIGAN UNIVERSITY

To: Allen Emerson
Dr. Christine Browning

From: Richard A. Wright, Chair
Human Subjects Institutional Review Board

Subject: HSIRB Project # 93-08-04

Date: September 30, 1996

This letter will serve as confirmation that the title and advisor modifications of your research project "Collaborative Groups and Graphing Calculators: Knowledge Acquisition and Problem-Solving Processes of College-Level Developmental Mathematics Students," requested in your memo, have been approved by the Human Subjects Institutional Review Board. The new title will read, "Gender Discourse in Small Learning Groups of College-Level Developmental Mathematics Students."

Your project is approved for a period of one year from the above date. If you should revise any procedures relative to human subjects or materials, you must resubmit those changes for review in order to retain approval. Should any untoward incidents or unanticipated adverse reactions occur with the subjects in the process of this study, you must suspend the study and notify me immediately. The HSIRB will then determine whether or not the study may continue.

Please be reminded that all research involving human subjects must be accomplished in full accord with the policies and procedures of Western Michigan University, as well as all applicable local, state, and federal laws and regulations. Any deviation from those policies, procedures, laws or regulations may cause immediate termination of approval for this project.

Thank you for your cooperation. If you have any questions, please do not hesitate to contact me.

Project Expiration Date: September 30, 1997

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