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THE INFLUENCE OF SEX COMPOSITION AND TASK SEX-LINKAGE ON DECISION MAKING IN HIERARCHICAL TEAMS

By

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ABSTRACT

THE INFLUENCE OF SEX COMPOSITION AND TASK SEX-LINKAGE ON DECISION MAKING IN HIERARCHICAL TEAMS

By

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As the 21st century approaches, organizations will continue to be challenged by an increasingly diverse workforce and an expanding emphasis on work teams. These trends ultimately lead to increased group heterogeneity, the implications of which are not well known. The present study focused on the transition of men and women into traditionally male and female-dominated fields, examining the effects of varying sex compositions on group processes and performance. There is limited attention to group level variables in the existing sex composition literature, with the available research generating more confusion than knowledge. Two factors were suggested to contribute to this confusion: (1) a failure to distinguish among specific representations of the sexes at the level of the team (e.g., balanced vs. male-majority compositions), and (2) the influence of moderator variables. The sex-linkage of a task was proposed as relevant variable for understanding sex composition effects. The effects of sex composition and task sex-linkage were tested on hierarchical decision making teams which have traditionally been neglected in the literature. Eighty-seven teams participated in one of four sex compositions and two sex-linked tasks. Generally, male-dominated teams outperformed female-dominated teams on three key decision processes. In addition, male-majority teams performed worse than all-male teams on two of these variables. The inclusion of a single female member appeared

to negatively affect team members in the male-majority condition, particularly when the task was male-oriented. Despite differences in the decision making processes, there were no significant differences in team decision accuracy across compositions or tasks. Further examination suggested that male and female teams used different methods to arrive at comparable decision outcomes.

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Finally, I would like to summarize my experiences by quoting the poet Robert Frost:

Two roads diverged in a wood, and I--

I took the one less traveled by,

And that has made all the difference.

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INTRODUCTION

Two important issues will continue to face many organizations as they approach the 21st century. One is how to effectively manage the increasing diversity of the work force. Another is how to use teams effectively to perform organizational functions and obtain organizational goals. There is no doubt that teams have become an important part of organizations. Many organizations have redesigned jobs to increase task interdependence (Jackson, 1992), thereby creating teams whose members are interdependent. At the same time, the increasing diversity of the workforce leads to new configurations of employees. These changes create challenges to traditional work practices.

One of the many types of diversity that will impact organizations is gender diversity.[1] The number of women entering the work force continues to increase steadily (Johnston, 1991). By the year 2005, women are predicted to compose 63% of the workforce (Howard, 1995). Furthermore, women are increasingly entering fields traditionally filled by men (Jackson, 1992). A prominent example of this transition is women entering combat-related fields in the military. For example, the Navy, which implemented a gender neutral recruiting policy in 1994, saw an increase in female recruits from 12.6% to 22.2% between 1994 and 1995 (Hudson, 1995).

Although women entering male dominated fields is more common and controversial, there is a similar trend for males entering traditionally female dominated fields (Craig & Sherif, 1986). For example, an increasing number of males are entering the field of nursing (Floge & Merrill, 1986; Ott, 1989). As a result of these changes, work groups that were previously homogeneous in terms of the sex of their members will increasingly consist of members of both sexes.

The issues of diversity and teamwork inevitably converge because increasing diversity at the organizational level will most likely lead to increasing heterogeneity at the team level (Jackson, 1992). This heterogeneity has many potential implications for team performance since employees have traditionally worked with others who are similar to themselves. Traditional members may apply inappropriate stereotypes to non-traditional members, and even come to resent the increase of non-traditional members (e.g. females entering military academies). Given the many potential difficulties associated with diversity, an important task for researchers is to identify the effects of group heterogeneity and to recommend how to manage this heterogeneity to insure effective team performance.

Literature Overview

Although group heterogeneity is clearly an important issue facing many organizations and their employees, knowledge regarding its influence has been limited. With the continuing trends toward greater diversity and increased teamwork, researchers should begin to focus more attention on understanding the effects of heterogeneous work groups. Several limitations of the existing literature are identified along with attempts to address those limitations.

Focus on Individual Level Effects

The influence of diversity at the team level is most directly addressed by research on group composition. Unfortunately, the focus of much of this research is on the effects of composition on the behaviors of individuals within groups rather than on group level phenomena. There is an abundant literature that explores the effects of sex composition on male and female behaviors (e.g., Johnson & Schulman, 1989; Lockheed & Hall, 1976; Strodtbeck & Mann, 1956), and reactions to male and female minority members (e.g., Bradley, 1980; Craig & Sherif, 1986). Research addressing the influence of sex composition on group processes and performance, however, has been somewhat scarce. The intent of the present study is to understand the effects of group heterogeneity on critical team[2] level, rather than individual level variables, using the latter to help further investigate the nature of those effects.

The importance of focusing on the team level is that organizations are increasingly designing work around teams (Hackman, 1990; Ilgen, 1994). As a result, performance outcomes are a function of the combined, often interdependent, efforts of employees. Therefore, it is no longer reasonable to examine the performance of individuals in isolation. Further, group interaction may have different effects on individual behaviors than on group behaviors. For example, each member of a team may exhibit the highest level of task competency, yet the team as a whole does not exhibit the highest level of performance. The effects on group level behaviors are expected to have a more direct influence on group performance, and are, therefore, of primary interest.

Unexplained Inconsistencies

In addition to the limited attention to group level variables, the literature addressing the effects of sex composition on group and individual behaviors is full of inconsistencies. Many researchers argue that individual behaviors within groups follow general sex stereotypes such that males are more task-oriented and females more socio-emotional (e.g., Eagly, 1987). However, numerous studies indicate that this depends on the group's composition (e.g., Thameling & Andrews, 1992). Unfortunately, it is not clear exactly which compositions are associated with sex stereotypic or non-stereotypic behaviors.

One reason for some of this uncertainty is the failure to distinguish among various types of mixed-sex compositions. When researchers do differentiate between male-dominated and female-dominated mixed-sex groups, significant differences in individual and group behaviors are often found (e.g., Craig & Sherif, 1986; Mabry, 1989). Therefore, it is important to consider the representation of males and females within a group when examining the effects of group heterogeneity.

Unfortunately, inconsistencies still remain after taking into consideration the representation of the sexes. Some research suggests, for example, that male-majority groups make better decisions (Rogelberg & Rumery, 1994), while others find that female-majority groups perform better (Roberston & Kwong, 1994). Such inconsistencies suggest the influence of a moderator variable.

Limited Attention to Moderator Variables

A handful of studies have examined potential moderators such as the experience and status of group members (Lockheed & Hall, 1976; Wood & Karten, 1986). The most

frequently discussed moderator, however, is the task. Task requirements are often suggested to favor certain compositions over others (Deaux, 1984, 1985). Many inconsistencies in the sex composition literature are potentially attributable to the sex-linkage of the task. That is, many tasks are linked, or associated, more often with one sex than the other. As a result, males and females are expected to have different levels of competency for different tasks. For example, we assume that men are more knowledgeable about auto mechanics, and women more knowledgeable about child care. Similarly, secretaries are often assumed to be female and corporate executives male.

Unfortunately, the sex-linkage of tasks has often been ignored in studies examining sex composition effects. Typically, researchers suggest in hindsight that the nature of the task may have favored male or female members (e.g., Craig & Sherif, 1986). The task's sex-linkage may help explain many previous inconsistencies found in the literature.

Study Overview

The present study is designed to expand on the existing literature and address the limitations discussed above. First, since group processes and performance have received minimal attention in the literature, one purpose of this study is to examine the effects of sex composition on several group level variables related to the process of team decision making. Second, this study will focus on specific configurations of males and females which best reflect actual work environments (e.g., all-male, single-female), and which will enable a better understanding of how slight changes in composition affect group processes and performance. Finally, this study will attempt to address inconsistencies in the existing literature by examining the sex-linkage of the task as a potential moderator of the relationship between sex composition and the team decision making process.

Several bodies of literature are reviewed to help identify the potential effects of sex composition on team decision making effectiveness. This review will begin with a general discussion of diversity which suggests some potential consequences of increased group heterogeneity. Next, literature on sex stereotyping is discussed to identify the potential biases that members may bring with them to a group. This is followed by a review of research on sex composition, addressing both the individual and group level effects. Literature is also reviewed regarding the effect of the sex-linkage of tasks which has often been suggested to explain the inconsistent findings of prior research.

Following a review of the literature, a decision making task and an associated theory are presented which will be used to address the effects of sex composition and the task's sex-linkage. Based on the sex composition literature and the decision making theory presented, several hypotheses are developed regarding the effects of sex composition and the sex linkage of the task on team processes and performance. The method used to test the hypothesized relationships is then discussed, followed by a presentation of the data analytic results. Finally, a discussion of these results, study limitations and directions for future research is provided.

DIVERSITY

The term diversity has been used to refer to numerous ways in which individuals differ from one another. Diversity can refer to differences in demographic characteristics (e.g., age, sex, race, ethnicity), culture, personality, beliefs, ability, occupation, expertise, or tenure. The work force is becoming increasingly diverse along a number of dimensions, one of which is the sex of employees (Johnston, 1991).

Alternative Perspectives of Diversity

There are basically two organizational perspectives regarding diversity. The "value-in-diversity" approach, as suggested by Cox (1993), views diversity as an advantage to groups and organizations because it broadens the skills, abilities, and perspectives brought to a group. Maznevski (1994) refers to this as "role-related diversity." Role-related diversity is desirable because it brings together individuals with complementary skills and abilities which is often the goal of designing work around teams. Researchers have suggested that heterogeneous groups perform better on decision making and creative problem solving tasks than homogeneous groups due to the greater range of alternatives and perspectives that heterogeneous groups bring to the task (Hoffman, 1979; Hoffman, Harburg, & Maier, 1962; Triandes, Hall, & Ewen, 1965). However, diversity is not always associated with positive outcomes.

The alternative perspective of diversity suggests that by bringing together individuals who are distinct from one another, diversity can create numerous problems such as obstructing communications, inhibiting the contributions of certain members, and decreasing group cohesion (Jackson, 1992). Demographic forms of diversity, in particular, can be problematic because they highlight differences between people which can lead to stereotyping and discrimination. Assuming that increased diversity of the work force is inevitable, organizations should be concerned with understanding these potential problems and identifying ways to overcome them. Two processes help explain why diversity can create problems among work groups, social categorization (i.e., stereotyping) and ethnocentricity.

Social Categorization

Differences in attitudes, values, interactions styles, and cognitive ability are often associated with different demographic characteristics (Cox, 1993; Jackson, 1992). For example, females are seen as nurturing and males as aggressive. Although these associations may not always be valid, they are often used to evaluate the behaviors and performance of those who appear different from us. In heterogeneous groups, these differences become highly salient, thus increasing the likelihood that members will be categorized according to their distinguishing characteristics. Many negative effects of this categorization have been documented including isolation from the group (Kanter, 1977) and inaccurate performance evaluations (Ilgen & Youtz, 1986).

Ethnocentricity

Another issue associated with diversity is ethnocentricity. Ethnocentricity refers to the tendency to view members of one's own group more positively than other social

groups (Cox, 1993). There are consistent findings that people are more attracted to and feel more comfortable and satisfied with members who are similar to themselves (Ziller, 1973). According to Cox, there are certain benefits associated with working with similar others. People feel that the behaviors of similar others are more certain and predictable. In addition, people feel more satisfied that they are promoting the well-being of their own social group. Finally, working with similar people provides an initial common ground for establishing relationships with coworkers (Cox, 1993). Diversity, therefore, conflicts with general ethnocentric tendencies.

Summary

Given the potential problems associated with diversity, why is there a need to pursue such integration? First, there are political, legal and ethical reasons why jobs can no longer be restricted to those of a certain race and sex. Second, there are potential benefits in drawing from a wider range of perspectives, skills and abilities, which diversity can offer. For these reasons, employees will increasingly work with individuals who are different from, rather than similar to, themselves. Unfortunately, due to ethnocentricity and stereotyping, members of different racial, gender, and ethnic backgrounds may have a difficult time working together as a team. However, given the inevitability of these changes and the potential benefits, it is important to understand the effects of diversity and to identify potential barriers to effective team performance.

Since the present study focuses on gender diversity, the remaining discussion will be limited to issues that are primarily relevant to understanding the effects of mixed-sex work environments. A critical issue in understanding the effects of sex composition is sex

stereotyping. Sex stereotyping helps to explain why the transition of men and women into fields traditionally dominated by the opposite sex can be problematic.

SEX STEREOTYPING

Sex stereotypes are widely held beliefs about the appropriate behaviors of men and women (Broverman, Vogel, Broverman, Clarkson, & Rosenkrantz, 1972). There are widely held beliefs that women are more "communal" and men more "agentic" (Eagly, 1987). Communal refers to behaviors associated with concern for the welfare of others (e.g., nurturing, affectionate, expressive). Agentic behaviors include assertiveness, independence and instrumentality.

These stereotypes are reflected in the division of labor between the sexes. Women are disproportionately represented in occupations that are perceived to require communal qualities while men occupy positions associated with agentic qualities. For example, males are more likely to hold positions of leadership because they are perceived as having the qualities associated with effective leadership (e.g., assertiveness, instrumentality). Although many women now serve in leadership roles, there are still a disproportionate number of men in positions of authority (Eagly, 1987). Some have further suggested that the different characteristics attributed to men and women are promoted in order to rationalize these occupational inequities (Hoffman & Hurst, 1990).

Sex stereotypes influence our perceptions and behaviors in a variety of settings, including work. Although the roles of men and women have changed substantially in the past twenty years or so, there is evidence that traditional sex stereotypes persist (e.g.,

Heilman, Block, Martell, & Simon, 1989). In addition, the characteristics associated with men tend to be more highly valued in our society, and the roles they occupy tend to be associated with higher status (Broverman et al., 1972). As Eagly (1987) suggests, "A status and power difference as pervasive as the one that separates women from men is bound to have implications for gender stereotypes and roles" (p.23). The persistence of sex stereotypes is often attributed to the process of behavioral confirmation. The issues surrounding sex stereotypes are discussed further below.

Influence on Perceptions and Behaviors

Although sex segregation may be declining in many fields, there are still factors that attempt to maintain the barriers between the sexes. Men and women, for instance, are often reprimanded for violating sex-role norms (Costrich, Feinstein, Kidder, Marecek, & Pascale, 1975; Spence, Helmreich, & Stapp, 1975). Costrich et al. (1975) found that individuals who behaved counter to sex-role stereotypes were less popular. In addition, Spence et al. (1975) found that students indicated a preference for a masculine female on an objective questionnaire, but their preferences reversed on open-ended questions. These findings suggest that although individuals may publicly endorse less traditional views, their underlying beliefs may reflect more traditional stereotypes regarding males and females.

Men and women are also attributed with different traits and behaviors. Deaux and Emswiller (1974) found that for traditionally male tasks, successful performance by females was attributed to luck more than ability, whereas male success was attributed more to ability than luck. Similarly, Pazy (1986) found that the causes attributed to successful performance had a substantial impact on the ranking of both male and female employees. Given the same attributions for performance, males were ranked significantly

higher than females. Wiley and Eskilson (1983) obtained somewhat different results when considering promotions. Male promotions were less likely attributed to stable causes than female promotions. This suggests that respondents may have viewed women as requiring more skill and ability than men in order to be promoted.

Greater Value and Status Associated with Male Characteristics

Sex stereotypes also have an effect on distributions of power and perceptions of status. In general, women tend to be ascribed lower status than men (Eagly & Wood, 1982; Wharton & Baron, 1987; Wiley & Eskilson, 1982). For example, Eagly and Wood had subjects read scenarios in which a communicator was attempting to influence a recipient, and asked them to rate the predicted influence and status of each individual. Males were ascribed a higher status and believed to earn a higher salary than females. Subjects also perceived behavioral compliance to be greatest in the male communicator-female recipient condition. Most of these sex differences disappeared when information about job titles was provided, with the exception that males were still seen as earning a higher salary.

Wiley and Eskilson (1982) examined the effectiveness of male and female uses of reward-based or expert power in attempting to influence a male or female target. Overall for female targets, there was no difference in perceived status between male and female influencers. For male targets, however, male influencers were seen as having higher status than females. Females attempting to influence a male were seen as the least powerful, while males attempting to influence other males were seen as most powerful. Finally, males were seen as more effective when using expert influence, while females were perceived as more effective using reward-based power.

Finally, research has also shown that traits associated with females tend not to be associated with leadership. Schein (1973), for example, found a significant relationship between the stereotypes attributed to men and those attributed to managers, but there was no relationship between the attributes of women and managers. These findings were more recently replicated by Heilman et al. (1989) who further found that when subjects were asked to identify the characteristics of female managers, these were still less associated with the attributes of successful managers than were characteristics identified for male managers.

Behavioral Confirmation of Stereotypes

Finally, sex stereotypes persist because they are reinforced through the process of behavioral confirmation. That is, people often comply with the expectations held by others as well as themselves (Eagly, 1987). These expectations are conveyed through verbal and nonverbal means, and confirmatory responses are rewarded. For example, males may receive more opportunities to lead a group based on the assumption that they have more leadership skill. This results in more males serving in the role of leader, which is then perceived as indicating that males are better suited for leadership than females. Eagly further suggests that expectancy-confirming behavior is more likely to occur when the expectations are widely shared as is the case with sex stereotypes.

Summary

The literature on sex stereotyping suggests that an individual's sex can have extensive effects on our attitudes, beliefs, and behaviors. Further, these stereotypes have remained fairly consistent over time. Thus, it is likely that sex stereotypes will continue to influence the perceptions of men and women, and thus, their interactions with one another.

The effects of sex composition on the perceptions and behaviors of group members are discussed next.

SEX COMPOSITION EFFECTS

Research interest in the effects of group sex composition has a long history (e.g., Burtt, 1920), but few researchers recognized sex composition as an important variable in the design of their studies prior to the 1960s. In much of the early literature on groups, women were not even included as subjects (Dion, 1985). From the late 1960s through the 1970s, there was a surge in the number of studies that specifically addressed the effects of group sex composition. This interest seemed to coincide with increasing efforts to change societal perceptions of women. Research interest tapered off somewhat in the 1980s and 1990s. This might be considered an indication that sex stereotyping had diminished. However, given fairly recent evidence regarding the potency of sex stereotypes (e.g., Heilman et al., 1989), it is more likely that research interest simply discontinued in the topic. As a review of the literature will show, the literature on sex composition is laden with inconsistencies which may have been a major deterrent to researchers.

The review of sex composition effects begins with a discussion of several theories which attempt to explain how the composition of a group affects the behaviors of its members. This is followed by a review of the individual level effects of sex composition which comprises a majority of the sex composition literature. The effects of composition on the perceptions of male and female members (e.g., ratings of competence) and on individual behaviors (e.g., levels of participation) are discussed. The group level effects,

which represent a smaller portion of the sex composition literature, are reviewed next. A variety of group process and outcomes are addressed in this literature. Finally, the role of the task as a moderator of sex composition effects on individual and group level variables is discussed.

Sex Composition Theories

Several theories have been developed to address the effects of sex composition. These theories focus primarily on the individual level effects of varying compositions. That is, they attempt to explain how individual behaviors and perceptions are influenced by different representations of males and females.

Kanter's Theory of Tokenism

Kanter (1977) developed a theory of tokenism which suggests that the numerical representation of the sexes can influence the roles of men and women. First, she distinguishes between "uniform," "skewed," "tilted," and "balanced" mixed-sex compositions. "Skewed" compositions include less than 15% membership of one sex, "tilted" compositions closer to 35% of one sex, "balanced" groups are composed of equal proportions of males and females, and in "uniform" groups members are all of the same sex. The theory of tokenism focuses on skewed compositions which represent the extreme condition, and "one encountered by large numbers of women in groups and organizations in which numerical distributions have traditionally favored men" (Kanter, 1977, p. 966).

Tokenism refers to a very small representation of one sex. The minority member's social category is physically obvious. Further, the individual may be new to the setting as is the case in many occupations traditionally dominated by one sex. Tokenism, therefore,

has three primary effects. First, the visibility of minority members is heightened by their representation. Second, differences between the majority and minority members tend to be exaggerated, which can result in the isolation of the minority members. Third, the behaviors of minority members are distorted to fit stereotypes about that member.

Kanter's theory was developed based on the experiences of female tokens. She suggests that the concepts can be applied to other tokens, including males in female-dominated environments. Several studies, to be discussed in more detail later, have not found the same effects for male as for female tokens (Alexander & Thoits, 1985; Floge & Merrill, 1986). In fact, males sometimes experience positive effects as a result of their minority representation.

Kanter's theory also fails to explain the stereotypical behavior of majority members. In a study by Strotbeck and Mann (1956) cited to support the concepts of tokenism, men were more task-oriented and women more socio-emotional when working in mock jury decision making groups with a disproportionate representation of men. Kanter (1977) suggested that "it was women's scarcity in skewed groups that pushed them into classical positions and men's superiority that gave them the edge in task performance" (p.970). The stereotypical behavior of men under majority representation is not consistent with the tenets of tokenism.

Expectation States Theory

Expectation states theory suggests that there are general status differences associated with males and females in society (Berger, Fisek, Norman, & Zelditch, 1977), and, as a result, sex functions as a diffuse status characteristic (Lockheed & Hall, 1976; Meeker & Weitzel-O'Neill, 1977). In other words, general status differences in society

influence performance expectations in more specific settings (Meeker & Weitzel-O'Neill, 1977). Since men tend to hold positions of higher status than women, they are expected to be more competent in a variety of settings. This implies that, in work groups, men are often perceived as having more leadership skill and intelligence than women. This helps explain why the experiences of male tokens are typically not as negative as those of female tokens, and thus expands on Kanter's theory.

Distinctiveness Theory

Finally, distinctiveness theory, as proposed by McGuire, McGuire, and Winton (1979), provides another explanation for the effects of group sex composition on individual perceptions and behaviors. Unlike tokenism and expectation states theories, distinctiveness theory focuses on self-perceptions. Basically, the theory states that mixed-sex groups, particularly skewed groups, serve to highlight sex as a distinguishing characteristic of members (Cota & Dion, 1986; McGuire et al., 1979; Ruble & Higgins, 1976). This, in turn, increases the awareness of one's own sex and the likelihood that differences between one's own sex and that of other members are exaggerated.

Several studies provide evidence of such an effect. McGuire et al. (1979) found that both males and females were more likely to use sex as a characteristic in their self-descriptions the smaller the representation of their own sex was in their reference group (e.g., family). Similarly, Cota and Dion (1986) found that more individuals mentioned sex in their self-descriptions when their sex was in the minority than in the majority. Therefore, minority representation not only increases the likelihood that other members will take notice, it also makes one more aware of his or her own sex.

Summary

Both distinctiveness and tokenism theories suggest that the numerical representation of the sexes plays an important role in influencing perceptions and behaviors. Although it is fairly well accepted that the numerical representation of males and females affects individual behaviors, the negative effects of minority representation may not be experienced equally by the sexes. A major drawback of Kanter's theory is that it does not account for the different experiences often found for male versus female tokens. Expectations states theory, which suggests that general status differences in society between males and females transfer to specific settings, provides an explanation as to why men often experience minority representation more positively than females. Together, these theories suggest that minority representation will increase the likelihood that a member is viewed stereotypically, but whether that results in a negative or positive outcome may depend on the sex of that member.

Tests of the adequacy of these theories are found throughout the literature addressing the effects of sex composition. The effects of composition on individual behaviors and perceptions, and the effects on group processes and performance are reviewed below.

Individual Level Effects

Although understanding relationships between sex composition and group level variables is the goal of this study, most of the research addresses how the sex composition of a group affects behaviors and perceptions of individual male and female team members. Therefore, individual level effects will be reviewed. First, research examining the effects of different sex compositions on the perceptions of male and female members is reviewed.

Second, literature addressing the effects of sex composition on individual behaviors is discussed. This literature examines male and female differences in performance, communication, conformity, and influence. These studies identify individual level effects that can potentially influence group processes and outcomes.

Stereotypic Perceptions

Substantial evidence exists suggesting that men and women are viewed differently within mixed-sex as compared to same-sex groups. Several studies highlight the stereotypic assumptions made about group members and how these vary across compositions. Some of these studies focus on male versus female leaders, and provide good examples of consistent biases in the treatment of males and females.

Perceptions of coworkers. Several studies have examined the ratings of male and female coworkers (or performers) under different composition. Toder (1980) asked participants to evaluate journal articles on the topics of nutrition, education, urban planning and language that were authored by a male or female. Evaluations were made either in the context of all-female or mixed-sex groups. Women in the mixed-sex groups evaluated female authored articles less favorably than male-authored articles, but women in all-female groups evaluated male and female authors equally favorably. For the city planning and nutrition articles, female authors were generally rated lower. For the education article, lower ratings for female authors were given only by subjects who were assessed as having traditional sex-role attitudes. Finally, no differences were found for the language article. This study indicates that the group's composition can influence individual evaluations such that in the presence of men, women may rate other women less favorably. Furthermore, on at least two topics, female authors were perceived less favorably than

male authors, suggesting that other factors (e.g., task content) may be considered when making evaluations.

In a study by Nemeth, Endicott, and Wachtler (1976) subjects were asked to rate male and female members on several factors following participation in a jury decision making task. Each group was composed of six participants with no less than two persons of each sex. Across all groups, males were rated higher on a number of characteristics including intelligence, influence, confidence, independence and aggressiveness, and were perceived as the leader more often than females. Females were only rated as more likable than males.

The above studies (Nemeth et al., 1976; Toder, 1980) suggest a general bias in favor of males which may be influenced by the sex composition of the group. Unfortunately, these studies ignored the potential influence of different proportions of males and females. Nemeth et al. combined male-majority, female-majority and balanced-sex groups in their analyses, potentially masking certain composition effects. The studies discussed next take into consideration the proportion of males and females in a group, not just its heterogeneity.

Three studies addressed the relationship between composition and stereotypic perceptions in field settings. First, Izraeli (1983) compared skewed (20% or less women) and balanced groups (41 to 60% women) of part-time local union officers in Israel. This study assessed Kanter's (1977) theory of tokenism discussed earlier. Izraeli found that women in balanced groups rated other women as having more skill than men, but those in skewed groups viewed men as more skilled. Men rated other men more favorably than women, regardless of composition. Members of skewed groups were more likely than

members of balanced groups to feel that women were elected to represent other women, while men were elected to represent all members. Finally, women in the skewed groups felt less influential than women in the balanced groups. These findings suggest that skewed compositions can lead women to perceive themselves as less competent and less deserving of their positions.

A second study addressed the effects of different proportions of women on the responses of coworkers. South, Bonjean, Markam, and Corder (1982) examined the frequency of contact with and social support received from coworkers and male supervisors of groups that were part of a government inspection agency. They found that the greater proportion of female members in the group, the less contact females had with male coworkers, but the more contact they had with female coworkers. The proportion of females was not related to contact with male supervisors or the amount of social support received from male coworkers. As the proportion of females in the group increased, however, the less support received from female coworkers and male supervisors. Unfortunately these results may simply reflect a change in the base rate of females in the group. That is, increasing the proportion of females by chance alone should increase the opportunities for contact with female coworkers and decrease the opportunities for contact with male coworkers. However, these findings do raise the point that the number of females in a group can influence the responses of coworkers and supervisors toward female members.

Finally, Floge and Merrill (1986) studied the perceptual responses to male nurses and female physicians, which both fit Kanter's (1977) definition of "token" members. Both male nurses and female physicians were more visible than their opposite sex cohorts,

and experienced exclusion from the social networks of the majority. Male nurses, however, were more likely to be assigned leadership positions without the requisite skills. They were also treated more like coworkers by male physicians and perceived as more competent by those physicians than were female nurses. Further, female physicians were attributed with stereotypically feminine traits (e.g., compassion, warmth) and were treated differently than male physicians. These findings, although solely based on observations and interviews, suggest that tokens are treated differently than non-tokens. However, the nature of the treatment appears to vary such that male tokens are treated more favorably than female tokens.

Perceptions of leaders. Perceptions of male and female leaders further highlight the bias in favor of males. Webber (1976) compared the perceptions of members in male-majority and female-majority groups following participation for a semester in class project groups. In the male-majority groups, more men than women were seen as the task leader and the highest contributor to the group. Women were more often viewed as non-leaders, social leaders, and the lowest contributors than men. In the female-majority groups, men were again more frequently considered the task leader and the highest contributor than women. However, more women in the female-majority groups perceived the men to be non-leaders and the lowest contributor than in the male-majority groups. Women apparently varied in their perceptions of the single male member of their group. Finally, women in the female-majority groups were more likely to be viewed as the task leader and highest contributor than in the male-majority groups.

Yerby (1975) compared reactions to female leaders in all-female, single-female and balanced-sex groups. These groups were designed to have either initially all positive or all

negative attitudes toward female leadership. Balanced-sex groups with positive attitudes were most satisfied with their female leaders, while single-female groups with positive attitudes and balanced-sex groups with negative attitudes were the least satisfied. These studies clearly indicate that perceptions of male and female leaders are influenced by group composition. Although males are generally perceived as leaders more often than females, male-dominated groups tend to foster more negative attitudes toward female leadership than female-dominated groups.

Several studies further illuminate the differential treatment of male and female leaders. There is no variance in composition within these studies, but looking across them allows for some conclusion about sex composition effects. These studies also highlight additional distinctions between perceptions of male and female leaders.

Kushell and Newton (1986) had male and female leaders portray an autocratic or democratic style in mixed-sex groups working on survival task (NASA Moon Landing exercise). Female subordinates were more satisfied with democratic leaders, while male subordinates were more satisfied with autocratic leaders. However, there were no differences in how female and male autocratic or democratic leaders were perceived, or how female and male leaders were perceived in general.

A similar study by Korabik, Baril, and Watson (1993) found no main effect for sex in subordinate ratings of leader effectiveness in groups who worked on the Change of Work Procedure task. However, females using a dominating style were rated as less effective than males, and males using an obliging style were rated less effective than females. This finding suggests that individuals may be evaluated less favorably when their behaviors are incongruent with expectations regarding members of their sex.

Goktepe and Schneier (1988) examined the emergence of male and female leaders in mixed-sex groups working on case studies related to personnel and business policy issues. Slightly more males than females emerged as leaders, but there were no differences in the effectiveness ratings for male and female leaders. Male leaders, however, were perceived as more masculine and female leaders as more feminine. This study further suggests that although male and female leaders may be rated as equally effective, they are often perceived as performing different functions in the role as leader.

A study by Greene, Morrison, and Tischler (1981) also suggests that males and females are perceived as offering different skills as leaders. They compared male and female co-leaders of mixed-sex groups attending a two-day conference on group processes. In each condition, a leader of one sex served as an associate leader to the main leader of the opposite sex. Co-leader arrangements with female leader and male associate were perceived as more emotionally responsive than male leaders with female associates. Male co-leaders, regardless of their authority, were seen as significantly more active, instrumental, and insightful than female co-leaders. The characteristics attributed to male and female leaders reflect traditional sex-role stereotypes.

Similar findings were obtained by Butler and Geis (1990). They observed males and females serving as co-leaders or solo leaders of mixed-sex groups who worked on a survival task (NASA Moon Landing exercise). In general, subordinates were more pleased with male solo and co-leaders than with female leaders. Male and female leaders were evaluated as equally competent on the task, but male leaders were viewed as having more general skill, ability and intelligence than female leaders. Female leaders were rated as more emotional and sensitive, but also more bossy and dominating than male leaders.

Subordinates indicated that they wanted less contribution from female leaders than from male leaders. Subordinate sex had an effect on the ratings such that females responded more positively than males to female leaders. These results again suggest a sex bias favoring males such that they are perceived more favorably on dimensions related to leadership. It is also clear that individuals make distinctions between male and female leadership which are consistent with general sex stereotypes.

Butler and Geis (1990) suggested that the male bias found in their study may have been attributable to the nature of the task. In fact, many of the tasks used in the above studies can be considered male-oriented (e.g., NASA Moon Landing exercise). Therefore, the rating of males as better leaders may not simply reflect general stereotypes, but the additional consideration of the task.

Influence of the task. In support of Butler and Geis' suggestion, Wentworth and Anderson (1984) found that the emergence of male leaders more often than female leaders was dependent on the task. Balanced-sex groups worked on a problem involving the distribution of a large sum of money. The specific problem was designed to be either masculine (investing a young cousin's inheritance), feminine (paying for a wedding) or neutral (entertainment spending for a married couple). Males were more likely to emerge as leaders on the masculine task, but there were no significant differences in the emergence of male and female leaders on the neutral or feminine tasks. Females, however, did emerge more often as leaders in the feminine than in the masculine condition.

Task knowledge was also assessed and related to leadership emergence (Wentworth & Anderson, 1984). Males expressed more knowledge on the masculine task and females more knowledge on the feminine task. On the feminine task, there was a

significant relationship between knowledge and leadership emergence. On the neutral and masculine tasks, there was no relationship between knowledge and leadership. This suggests that while females had to demonstrate knowledge to obtain leadership status, males did not. Therefore, the bias in favor of males may be stronger on tasks which are perceived as male-oriented.

Summary. The above studies suggest that the perceptions of males and females, whether they are coworkers or leaders, tend to reflect sex stereotypes. In general, males tend to be rated higher than females on intelligence, instrumentality and leadership (e.g., Nemeth et al., 1976; Webber, 1976). In terms of leadership, males and females are often attributed with different qualities. Specifically, male leaders are seen as instrumental and female leaders as emotional and supportive (Butler & Geis, 1990; Goktepe & Schneier, 1988; Greene et al., 1981). These perceptions, however, can be influenced by the sex composition of one's reference group. For example, females are rated more favorably as their representation in the group increases (Israeli, 1983; Toder, 1980). Finally, there is evidence that these perceptions are influenced by the sex-relatedness of the task (Wentworth & Anderson, 1984).

These studies clearly indicate the role of sex stereotypes in individual perceptions. The question now becomes to what extent are these stereotypes also reflected in individual behaviors. Research addressing the effects of sex composition on individual behaviors tends to focus on variables for which there are well-established sex stereotypes (e.g., participation, influence, conformity). Therefore, the question most frequently addressed is the extent to which males and females behave stereotypically under different group compositions.

Individual Performance

A few studies have addressed male and female differences in performance across various group compositions. Two studies compared male and female performance in mixed-sex groups only and found no differences between males and females. Burtt's (1920) study examined the accuracy of judgments made alone or in mixed-sex mock juries regarding subjects who lied or told the truth. There were no differences between males and females in their individual judgment accuracy as a function of the group.

Timmons (1941) studied balanced-sex groups of high school students who discussed and ranked solutions to the topic of releasing convicts from prison. Both males and females improved in their ranking scores following group discussion, with a non-significant tendency for females to improve more than males. These studies suggest little difference in the performance of males and females, but are limited in their examination of composition effects.

In a more comprehensive study of sex composition effects, Alexander and Thoits (1985) found differences when they compared the achievement of males and females in male-dominated, female-dominated and balanced university departments. Departments were also classified as either skewed or tilted according to Kanter's (1977) definition. In male-dominated departments, the achievement of men and women did not differ when the composition was skewed, that is, when women represented less than 20% of the department, but women tended to perform better than men in tilted departments where there was 21 to 35% female representation. In female-dominated departments, men and women's achievements did not differ when the composition was tilted (21 to 35% male), but men tended to outperform women when the representation was skewed (less than

20% male). In balanced departments, there were no differences between the performance of men and women. These findings suggest that the performance of females may suffer from small representation. Males, however, do not experience similar performance deficits under minority representation, but instead may actually perform better under such conditions.

Although the research on individual performance is limited, some conclusions can be drawn. Both Alexander and Thoits (1985) and Timmons' (1941) findings suggest that the performance of males and females do not differ when the sexes are equally represented. Further, these findings were made over 40 years apart, suggesting some consistency in this effect over time. The contribution of Alexander and Thoits is to show the complexity of sex composition effects. The numerical representation of the sexes is clearly important in understanding the effects of composition. This is further suggested by research on participation and communication content.

Participation and Communication Content

The focus on sex stereotypic behavior is probably most apparent in research on individual participation rates and communication content. Much of this literature begins with the assumption that males and females generally behave stereotypically (i.e., males are more task-oriented and females more social), and examines the extent to which the composition influences this behavior. Therefore, the question typically addressed is whether mixed-sex compositions induce more or less stereotypic behavior. As will become clear through the following review, there is no definitive answer to this question.

Piliavin and Martin (1978) hypothesized that individuals would express less sex-stereotypic behavior in same-sex than in mixed-sex groups. They observed and coded

group discussions of social problems over three trials. During the second trial, one member in each group was encouraged to increase his or her participation by using a green light to indicate when they should speak. Prior to the intervention, same-sex groups were found to interact more stereotypically than mixed-sex groups, contrary to their prediction. Members of all-female groups engaged in more socio-emotional activity while those of all-male groups were more task-oriented. In mixed-sex groups, both males and females exhibited less stereotypic behavior.

Following the intervention, mixed-sex groups in which a female was targeted exhibited no significant sex differences in the amount of task or socio-emotional activity. However, when a male was targeted, there was an increase in stereotypic behavior. Males became significantly more task-related and females significantly more socio-emotional. In these male target groups, there appeared to be some conflict over male dominance which may have contributed to the more stereotypic behavior exhibited by both males and females. Finally, in same-sex groups, both males and females experienced an increase in task activities and a decrease in socio-emotional behaviors following the intervention (Piliavin & Martin, 1978).

Unlike Piliavin and Martin's (1978) results, Johnson and Schulman (1989) found individuals to initially behave more stereotypically in mixed-sex groups. Groups of varying sex compositions were observed while they discussed a scenario about a middle-aged businessman who is asked for information regarding his membership in the Communist party at age twenty. The authors compared the top and bottom activity levels (as rated by group members) across each composition. The top level of task activity for females decreased as their representation in the group decreased. The bottom activity

level for females, however, was not affected by composition. The top task activity level for males only decreased from balanced to single-male groups. The bottom level of task activity for males increased as their representation in the group decreased. In balanced-sex groups, the top male task activity was significantly higher than the top female task activity. For same-sex groups, there were no differences between top male and female task activity. Further, in all mixed-sex groups, the bottom level of male task activity was higher than the bottom level of female task activity.

In terms of socio-emotional activity, the top level of both male and female activity decreased as their representation in the group decreased. The bottom level of both male and female socio-emotional activity, however, increased as their representation in the group decreased. This study suggests that as the representation of one's sex in the group decreases, task activity levels, or at least ratings of task activity, conform more to sex stereotypes such that males become more active and females less active. However, males and females were affected similarly in their levels of socio-emotional activity by the group's composition.

Spangler, Gordon, and Pipkin (1978) obtained similar results in a field study comparing law students from two schools, one which had 20% women (skewed) and the other 33% women (tilted). In the skewed program, women were less likely to speak in class and more likely to consider quitting school than men. This was not true of the tilted program. In the skewed program, women also had more difficulty interacting with their professors than men, while no differences existed between men and women in the tilted program. There were additional differences between the two schools which may have contributed to the results. For example, one school was private, the other public.

However, these findings are consistent with other results suggesting that minority representation has a negative affect on females.

Aries (1976) examined differences in participation, dominance patterns, and communication content as a function of the group's composition. All-male, all-female, and mixed-sex groups were studied as they met over five sessions with the task of becoming acquainted. In mixed-sex groups, males both initiated and received more interaction than females. In all-male groups, positions of dominance and submissiveness were constant over time, but in all-female groups dominance was less stable. The amount of interaction addressed to the group as a whole versus individuals was also viewed as an indicator of dominance. Members of all-male groups addressed significantly more interactions to the group than members of all-female groups. In mixed-sex groups, however, males addressed less interactions to the group than they did in all-male groups.

In terms of content, Aries (1976) found that all-male group discussions reflected themes of competition and status, while all-female groups discussed issues of intimacy and interpersonal relations. In mixed-sex groups, males reduced the number of discussions relevant to competition and status, and instead were more personally oriented. The content of female discussions, however, only changed slightly in mixed-sex groups. Finally, in mixed-sex groups there was greater use of qualifications and more defensiveness by both males and females than in same-sex groups, suggesting less confidence on the part of both sexes in the mixed-sex condition. These findings suggest that some stereotypic behaviors increase in mixed-sex environments (e.g., higher male participation rates), while others decrease (e.g., male dominance and competitiveness). In

other words, there may not be a simple relationship between composition and the presence of sex stereotypic behaviors.

The behaviors exhibited toward other members may also reflect sex stereotypes. Smith-Lovin and Brody (1989) studied sex differences in interruptions during group discussions. Males were more likely to interrupt a female speaker than a male speaker, while females attempted to interrupt males and females at an equal rate. Composition had no effect on the number of interruptions attempted, but did influence the content of these interruption. Males used more supportive interruptions in all-male groups, but this declined as the proportion of women in the group increased. There were no differences in the number of negative interruptions made by males and females across groups, except that females were more likely to yield to negative interruptions from males. In mixed-sex groups, positive interruptions were successful only half the time, but in same-sex groups they were more than twice as likely to succeed. Finally, females had less success than males when trying to interrupt a male using neutral comments. These findings suggest that the behaviors of males and responses of females may reduce the opportunities for women to participate. Therefore, observed differences in behaviors may be the result of the stereotypes held by other members rather than actual sex differences.

Evidence of non-stereotypic behavior by women further supports the argument that observed differences reflect the influence of stereotypes rather than actual sex differences. Mabry (1989) observed groups composed of 60% females and 40% males who worked on a human relations task over five sessions. Women participated more than men and engaged in more socio-emotional and task-related interactions. Overall, women appeared to favor same-sex interactions and tended to dominate the group's interactions.

The latter is contradictory to many previous findings and is likely attributable to the greater proportion of females in the group. These results suggest that females and males may not always behave stereotypically.

Similar results were obtained by Thune, Manderschied, and Silbergeld (1980) who observed small therapy groups of either married couples or teachers. In the couples' group, which had an equal number of males and females, males interacted more frequently than females and exhibited more instrumental behaviors while females were more socio-emotional. In the teachers' group, which was composed of a female majority, females interacted more frequently than males and were more instrumental, while males were more socio-emotional.

Based on the above studies, it appears that males and females do not behave stereotypically across all situations. Some studies suggest that males and females behave more stereotypically in same-sex groups (Aries, 1976; Piliavin & Martin, 1978), while others indicate more stereotypic behavior in mixed-sex groups (Johnson & Schulman, 1989). Two studies suggest that when the group is female-dominated, both males and females engage in non-stereotypical behavior (Mabry, 1989; Thune et al., 1980). Therefore, the extent to which a group is dominated by males or females, rather than simply its heterogeneity, may determine how stereotypically its members behave. Research on conformity and influence provide further evidence that the numerical representation of the sexes can have a significant effect on individual behavior.

Conformity and Influence

Two frequently studied behaviors in the literature on sex composition are conformity and influence. This research highlights both the importance of the dominant

sex of the group as well as the task's role in moderating the effects of various compositions.

Conformity. Several studies have compared the conformity of males and females under different compositions and on a variety of tasks. In each study, the opinion of the majority is manipulated. First, Reitan and Shaw (1964) studied the conforming behavior of individuals in all-male, all-female or balanced-sex groups. The task involved either choosing a line with the same length as a standard line or the figure with the greatest area. The experimenter manipulated the responses of the other group members as they were seen by participants. Overall, females conformed more than males to the responses of other members. However, all subjects, regardless of sex, conformed more in balanced-sex groups. Subjects also expressed more concern about disagreements and were less confident of their accuracy in balanced-sex than in same-sex groups.

A similar study by Tuddenham, MacBride, and Zahn (1958) observed subjects who made judgments about either visual, information, or opinion problems. Again, the experimenter controlled the judgments seen by each participant. Overall, females conformed more than males, with larger sex differences observed in mixed than same-sex groups. On the information and opinion tasks, females conformed more in male-majority groups, while males conformed more in female-majority groups. On the visual task, males conformed more than females in male-majority groups. These two studies show that although females have a general tendency to conform more than males, this finding is dependent on the group's composition. Further, as shown by Tuddenham et al. (1958), differences in conformity may also vary as a function of the task. Two studies further examine the task's influence on conformity.

Feldman-Summers, Montano, Kasprzyk, and Wagner (1980) asked subjects to respond to discussions by either male majority or female majority groups on topics predetermined to be either male or female-related. The majority position was designed to be opposite of that held by most subjects. On female-related issues, subjects were influenced more by the female-majority, and on male-related issues they were more influenced by the male-majority. In addition, male subjects conformed more than females on the female-related issue, and female subjects had a tendency to conform more than males on the male-related issues.

Sistrunk and McDavid (1971) had subjects indicate their level of agreement or disagreement with items chosen to be masculine, feminine, or neutral. Indicated next to each item was a "majority response" which was used to assess conformity. Males conformed more on feminine items and females conformed more on masculine items. On average, there was no difference in conformity for neutral items. When the sex of the "majority response" was included, the only difference found was that females conformed more to female than male sources on masculine items. This finding may simply indicate that on unfamiliar topics, females respond in a similar way to other females.

The above studies suggest that both males and females rely more on the opinions of others when their sex is inconsistent with the topic under consideration. However, it is not clear whose opinion they are more likely to accept. Feldman-Summers et al. (1980) found that individuals conform to the majority whose sex is consistent with the task, while Sistrunk and McDavid (1971) found that individuals respond consistently with their own sex. This complexity is further emphasized by research on individual influence. Given the

findings regarding conformity, it is also expected that sex differences in influence will depend on the composition and task.

Influence. Similarly to research on conformity, several studies have assessed the amount of influence males and females have under different sex compositions. Three studies examined the influence of male and female confederates who argued a position opposite the rest of the group (Bradley, 1980, 1981; Thameling & Andrews, 1992). Another study examined the effect of confederates who attempted to influence group members responses on an association task (Ridgeway, 1982). Finally, Craig and Sherif (1986) manipulated the information given to certain members to study their influence on a group ranking task. Each study is discussed in detail below.

First, Bradley (1980) studied the influence and reactions to male and female confederate opinion deviates who expressed either high or low competence regarding the task. All groups were composed of four males and either a male or female confederate. Females who demonstrated low competence were less influential than high competence females and low competence males. Low competence males however, were less influential than males who demonstrated high competence. Statements directed toward females with low demonstrated competence were more dominant and hostile than those directed toward high competence females or low competence males. However, there were no significant differences in the behaviors directed toward high competence males and females. Finally, male opinion deviates were liked more than females opinion deviates regardless of competence. These results likely reflect the fact that groups were composed of mostly male members.

A second study by Bradley (1981) on the influence of opinion deviates used groups composed of two males and two females plus a male or female confederate. In addition, confederates provided either support for their arguments, qualifying phrases indicative of uncertainty, or both. Female opinion deviates who did not use supporting arguments were less influential than females who used support and their male counterparts who did not support their arguments. In addition, females who did not use support were rated as less intelligent and less knowledgeable than females who used support and males who did not use support. Females who used qualifying phrases were also seen as less intelligent and knowledgeable than females who did not use qualifiers and males who did. Finally, male opinion deviates were liked better than female opinion deviates regardless of the use of support or qualifiers.

A similar study by Thameling and Andrews (1992) examined the influence of male and female opinion deviates who used qualifiers or evidence. As in Bradley's (1981) study, the use of qualifiers was viewed as undermining perceptions of confidence, while evidence was expected to increase one's perceived credibility and influence. Confederate opinion deviates had little influence regardless of their sex or the behaviors used. However, statements directed toward female opinion deviates who spoke without evidence or qualifiers were more emotional than those directed toward comparable males. In addition, members were more cooperative with male deviates who spoke with or without evidence and without qualifiers, than females who acted in a similar manner.

Thameling and Andrews' findings, along with those of Bradley (1980; 1981), suggest a potential bias in the way group members respond to male and female opinion deviates. It appears that members respond more favorably to male deviates regardless of

the way they present their arguments. Although Thameling and Andrews did not find a difference in influence between male and female deviates, both of Bradley's studies did. Examining the content of the discussion topic provides a potential explanation. In the first study, groups discussed the culpability of alleged plagiarism in a journalism class (Bradley, 1980), while in the second study, the discussion topic involved the appropriateness of moderate drinking of alcoholic beverages (Bradley, 1981). The topic in Thameling and Andrews' study, however, was the issue of sexual assault on campus about which females may have been seen as more knowledgeable. This may explain why males were not more influential in the latter study.

In a slightly different approach, Ridgeway (1982) manipulated the motivations portrayed by a confederate who tried to influence the decisions of members on a word association task. Confederates presented themselves as either self- or group-oriented. It was proposed that females who presented themselves as group-oriented would have more success influencing members than those who were self-oriented. In male groups, female confederates who were group-oriented achieved much higher influence than self-oriented females, although females did not achieve as much influence as male confederates. In female groups, male confederates had more influence than group-oriented females, but self-oriented females had the highest influence. Finally, there were no differences in the ratings of male and female confederates on their competence or influence. These findings suggest that although males tend to have more influence, females can alter their behaviors to gain more influence, particularly in predominantly male groups.

Finally, in Craig and Sherif's (1986) study, groups ranked items needed for survival following a plane crash in the desert. In each group, one member, either a male or female,

was given a critical piece of information (i.e., an item of high rank) to be used to determine their level of influence. Males had more influence than females only in single-male groups. Females were more influential in balanced-sex than in single-male groups, and males were slightly more influential in single-male than single-female groups. In addition, the target item was ranked significantly higher in all-male than in the balanced-sex groups, and slightly higher than in the single-female groups. Overall, men were rated higher than women on leadership, influence and aggressiveness.

Craig and Sherif (1986) suggest that one reason males may have had less influence in the single-female groups is that they were distracted by competition for the female's attention, commonly referred to as the "rooster effect." The reason men did better in the single-male condition could be attributed to the nature of the task. The task was rated by participants as male-oriented, although both males and females were equally interested in the task. A single male in a group of females may have more influence when the task is seen as male-oriented, especially if he is also perceived as more knowledgeable about the task.

Summary. Research on conformity and influence stress the importance not only of composition, but also of the task, in affecting individual behaviors. Although females are generally found to conform more and have less influence than males, this difference appears to be limited to certain conditions. For example, males have been found to conform more than females in female-majority groups and on female-related tasks (Feldman-Summers et al., 1980; Tuddenham et al., 1958). Craig and Sherif's (1986) study exemplifies the complexity of the relationship between sex composition and individual behaviors. In their study, males were more influential in the single-male

condition (Craig & Sherif, 1986), while other research suggests that males are more likely to conform in the presence of a female majority (Tuddenham et al., 1958). As stated earlier, such inconsistencies are likely attributable to moderator variables. In addition to the task, other potential moderators have been explored in the literature.

Factors Moderating Stereotypic Perceptions and Behaviors

Several studies have examined conditions which may affect the extent to which sex stereotypic behaviors are observed in groups. Nemeth et al. (1976) studied groups with either balanced or skewed sex compositions who performed a jury decision making task in which they either read or heard criminal cases. In groups that read the case, there was a tendency for males to send and receive more communications than females. These differences were observed primarily in statements reflecting agreement, suggestions and opinions. When groups heard the cases, there were no significant differences in the frequency or content of communications between males and females. Nemeth et al. suggest that when information is readily available, as in the written condition, males may be more dominant, but when information must be stored in memory, as in the audio condition, everyone's contribution is considered important so that males and females participate more equally. Therefore, differences in the task demands can influence the amount of stereotypic behavior observed in mixed-sex groups.

Wood and Karten (1986) examined the extent to which behaviors are influenced by the specification of members' status on an aptitude test. They studied the interactions of mixed-sex groups who discussed what an individual should do about her roommate's suspected drug use. The status of male and female members was either specified as high or low, or unspecified. When status was unspecified, males spoke more than females,

engaged in more task-related behavior, and were perceived as more competent than females. Females, however, engaged in more socio-emotional activity. When status was specified, no differences were observed between male and female interactions. Instead, the behaviors of high and low status members reflected the differences between males and females found in the unspecified status condition. This suggests that unless otherwise specified, females are assumed to have lower status than males. In this study, this assumption was shown to have a substantial influence of the behaviors of males and females.

Experience is another variable that may override sex stereotypic assumptions. Lockheed and Hall (1976) studied the behaviors of males and females in balanced and same-sex groups. In balanced-sex groups, males were more likely to emerge as leaders, initiate more task-related acts and have more influence than females. Among same-sex groups, no differences were found between the behaviors of males and females. Following the first part of the study, subjects from same-sex group were reassigned to mixed-sex groups. Females who gained experience in all-female groups initiated higher task-related acts when placed in mixed-sex groups compared to females whose experience was initially in mixed-sex groups. These findings suggest that mixed-sex environments may inhibit the behaviors of women unless they are previously given an opportunity to gain experience in a same-sex environment.

Summary

There are inconsistent findings regarding the effect of composition on individual behaviors. Some studies indicate that males and females act less stereotypically in mixed-sex groups (Aries, 1976; Piliavin & Martin, 1978), while others suggest that stereotypical

behavior is more likely to be observed in mixed-sex environments (Lockheed & Hall, 1976; Wood & Karten, 1986). Although no definitive conclusions can be drawn about the effects of sex composition, it is clear from this literature that the behaviors of men and women do not necessarily reflect stereotypes about the sexes. There appear to be factors that moderate the extent to which these stereotypic behaviors are observed. Some studies suggest factors (e.g., status, experience) that reduce the reliance on sex stereotypes (Lockheed & Hall, 1976; Wood & Karten, 1987). Other studies suggest variables (e.g., the task) that actually may alter sex stereotypic behaviors (Nemeth et al., 1976; Wentworth & Anderson, 1984). Overall, this literature suggests that complex processes are involved in the relationship between composition and individual behaviors. The same is true of group level effects, which are discussed next.

Group Level Effects

A limited number of studies have examined the effects of different sex compositions on group performance. These studies include comparisons between all-male and all-female groups as well as those between same-sex and mixed-sex groups. Studies involving only same-sex groups constitute a large portion of this research and are primarily interested in differences between males and females, rather than between homogeneous and heterogeneous groups (Wood, 1987). Since the present study is interested in the effects of group heterogeneity, the focus of the remaining review will be research comparing mixed and same-sex groups.

Wood's (1987) meta-analytic review of sex composition effects included 13 studies that compared mixed and same-sex groups. Her review was based upon laboratory studies in which an objective measure of performance (e.g., accuracy,

creativity, time to completion, amount of motor activity) was obtained. In addition, she coded for task type based on Steiner's taxonomy (Steiner, 1972), and whether performance was dependent primarily on task or social activities. Unfortunately, not all of the studies included in her review examined group level outcomes. Studies by Burtt (1920), Swanson and Tjosvold (1979) and Timmons (1941) examined male-female differences in mixed-sex groups and thus were addressed earlier. In addition, three studies involved dyads (Kerr & Sullaway, 1983; Rosenthal, 1978; Swanson & Tjosvold, 1979) which potentially differ from larger groups. However, these studies are reviewed along with those involving groups of three or more individuals, but with awareness of their potential differences.

Wood's (1987) meta-analytic results suggested that overall, there is no significant difference between mixed-sex and same-sex groups in terms of performance. However, due to the small number of studies, a more accurate conclusion from this review is that there is substantial variance in findings across studies. Although characteristics of the task were coded for by Wood, it was not possible to test for moderators due to the small number of studies.

One potential explanation for the inconsistency across studies in Wood's review is that there is variance among different types of mixed-sex groups. For example, a group with a single male may perform very differently from a group with equal numbers of males and females. As discussed previously, distinctions can be made between "skewed," "balanced" and even "tilted" mixed-sex compositions (Kanter, 1977; Martin & Shanahan, 1983). Skewed compositions may have very different influences on groups than tilted or

balanced compositions. Further, as shown by the literature on individual level effects, male dominated groups may differ from female dominated groups.

Another possible explanation for the variance across studies reviewed by Wood (1987) is that characteristics of the task other than the configuration of members as suggested by Steiner (1972) may interact with the specific composition to have an impact on performance. As already seen in the individual literature, the task can have a significant influence on the results. Individual studies, including those not addressed in Wood's meta-analysis, are reviewed below. Inconsistencies in findings across studies are identified along with factors that may help to explain those inconsistencies.

Group Performance

Research on group performance involves a number of different outcome variables and has produced a variety of results. Three studies address the productivity of same-sex versus mixed-sex groups. Kent and McGrath (1969) examined the effect of composition across different measures of performance. Groups with members of the same-sex or a male or female majority were studied on production, discussion and problem solving tasks. For each task, several performance dimensions were measured (e.g., creativity, accuracy, productivity). Sex composition was significantly related to three of eight group product dimensions. First, all-female and female majority groups generated more action oriented products than male-dominated groups. Second, same-sex groups were more original than mixed-sex groups. Third, all-female groups were more optimistic than all-male or mixed-sex groups. In addition, the task type interacted with the sex composition for five performance dimensions, but the nature of these interactions was not reported.

Hoffman et al. (1962) examined the extent to which the group's composition affected the development of integrative, or creative, solutions in groups that role played the Change of Work Procedure problem. No differences were found between same and mixed-sex groups, but all-female groups had a smaller proportion of integrative solutions than either all-male or mixed-sex groups.

In a study by Kerr and Sullaway (1983) the amount of air pumped into a chamber was used as an indicator of task motivation. Mixed-sex dyads pumped more air into the chamber than same-sex dyads. However, same-sex dyads felt more confident than mixed-sex dyads of winning a prize for pumping the most air. There was no significant difference between same- and mixed-sex dyads in members' interest in working with the same partner again. These findings suggest that mixed-sex groups may have different motivational features than same-sex groups, thus increasing their productivity.

Based on the above three studies, it is difficult to arrive at any conclusion regarding the effect of composition on productivity. The findings range from female-dominated groups having the highest productivity to having the lowest productivity. Unfortunately, not enough information is provided about the task used in Kent and McGrath's (1969) study to compare to Hoffman et al.'s (1962) findings. The specific tasks used by Kent and McGrath may have been more female-oriented than the Change of Work Procedure task used by Hoffman et al., thus explaining the variable success of all-female groups in these two studies. Research addressing other performance measures have similar limitations.

Several studies examined group differences in the speed of task completion. Eskilson and Wiley (1976) found no significant difference in the speed of puzzle

completion across groups composed of all-male, all-female, single-male or single-female members. However, there was a tendency for single-male groups with a female leader to be faster than any of the other group compositions.

Rosenthal (1978) studied mixed and same-sex dyads, and found differences in the time taken to solve either a math or verbal problem. On the math task, all-male dyads solved problems faster than mixed-sex dyads who, in turn, were faster than all-female dyads. On the verbal task, mixed-sex dyads were faster than either all-male or all-female dyads. These findings suggest that differences in completion times across groups may vary as a function of the task. Assuming that sex differences are associated with math and verbal tasks, this study provides support for the influence of task sex-orientation.

South (1927) examined both the speed and accuracy of all-male, all-female and balanced groups on four different tasks. Only minimal information was provided about these tasks, and no significance tests were reported. Therefore, only general conclusions are presented here. On two tasks, same-sex groups were faster while on the other two mixed-sex groups were faster. All-female groups were more accurate on a task which involved interpreting emotions portrayed in photographs and a task which involved judging English compositions. On these two tasks, balanced-sex groups and all-male groups were equally accurate. All-male groups were better on a task involving multiple choice problems which the authors considered more abstract. Balanced-sex groups were the least accurate on this task. On the fourth task, called the Bridge Problem, there were no differences in the quality of problem solving across groups. This study further shows that the effect of the composition on speed may depend on the task, and that the same holds true for accuracy.

Clement and Schiereck (1973) studied the accuracy of same-sex and balanced-sex groups who worked on a visual signal detection task. The seating arrangements of group members was also manipulated such that male and female members were either alternated around a table, or were seated next to someone of the same sex. Balanced-sex groups in which same-sex members sat adjacent to one another had significantly lower detection accuracy than same-sex groups. Balanced-sex groups with adjacent seating, however, did not differ significantly from groups with alternative seating. In addition, there were no differences in accuracy between all-female and all-male groups. These results suggest one potential explanation for differences in accuracy between mixed and same-sex groups. That is, coalitions may have formed among same-sex pairs in the adjacent seating condition which may have hindered effective group performance.

Finally, three studies were identified that examined the quality of decision making across different compositions. First, although sex composition was not the focus on their study, Hoffman and Maier (1961) found that groups containing one or more females produced higher quality solutions than all-male groups across two tasks. One task involved developing a method for permitting five men to cross a heavily-mined road (the Mined Road problem) and the other was the Change in Work Procedure problem discussed previously. The focus of the study was the comparison of groups that were homogeneous or heterogeneous in terms of personality. In the Mined Road problem differences were only found for all-male groups, with groups heterogeneous in personality performing better. The opposite was true for the Change of Work Procedure problem, where differences occurred only among groups with one or more females. These findings

suggest that relationships among other variables may be influenced by the group's composition and the task.

A more recent study by Rogelberg and Rumery (1994) compared same, balanced, and skewed-sex groups. Four-person groups worked on a survival task (the Desert Plane Crash exercise). Groups were compared on the quality of their decisions (assessed using expert rankings), the time spent on the task, and group cohesion. Single-female groups had the highest quality decisions. Balanced-sex and all-male groups had the next highest performance, followed by single-male and all-female groups. No significant differences were obtained for time spent on task or interpersonal cohesion across these compositions.

The authors suggested that the task was male oriented because male individuals performed significantly better than females. However, the all-male teams did not have the highest performance, which the authors attributed to some type of "process loss." The male-dominated groups with a single female were able to outperform their all-male cohorts, but it is unclear what processes may have contributed to this result. Interestingly, this finding is inconsistent with an earlier study which suggested that males in single-female groups tend to be less effective because they are distracted by competition for the attention of the female (e.g., Craig & Sherif, 1986).

Finally, a field study was identified that examined the effect of composition on the quality of group decisions. Robertson and Kwong (1994) studied the effect of group heterogeneity on the decision making effectiveness of school leadership councils. They found a marginally significant effect for sex composition, indicating that as the number of men in the group increased, decision making effectiveness as measured by self-reports,

decreased. This study further highlights the inconsistencies in findings regarding the effect of composition on performance.

Overall, the literature on group performance suggests that same-sex groups are sometimes more creative, productive, accurate, and faster than mixed-sex groups (e.g., Kent & McGrath, 1969; South, 1927), and others times they are not (e.g., Kerr & Sullaway, 1983). Some studies showed that this relationship depended on the dominant sex of the group (e.g., Hoffman et al., 1962) or the nature of the task (e.g., Hoffman & Maier, 1961; South, 1927). Studies addressing decision quality exemplify this complexity, with some finding that male-majority groups made better decisions (Rogelberg & Rumery, 1994), and others finding that female-dominated groups performed better (Robertson & Kwong, 1994).

Group Processes

Research focusing on group processes exhibits similar inconsistencies. In terms of participation, Patterson and Schaeffer (1977) found no differences between same and balanced-sex groups in the duration of their interactions or rates of participation. However, differences were found in their interaction distance. All-male groups interacted most distantly, all-female groups most closely, and balanced-sex groups at an intermediate distance.

Skvoretz (1988) similarly failed to find differences in participation equality across groups. He developed mathematical models to test the effects of sex composition on the equality of participation. He found that in no groups was participation distributed equally, but that these distributions were not explained well by differences in composition. However, there was a positive correlation between sex and participation indicating that

men participated more than women and suggests that the model may not have adequately captured the effects of sex composition on participation. Another study by Johnson and Schulman (1989) also failed to find differences in participation equality for both task and socio-emotional activity. These findings seem inconsistent with the differences found at the individual level between the participation rates of males and females.

Two studies examined differences between groups in terms of the specific content of the communications. Piliavin and Martin (1978) studied the interaction content of groups who discussed various social problems. All-female groups had the highest percentage of socio-emotional acts and all-male groups the highest percentage of task-related acts, as defined by Bales' (1970) Interaction Process Analysis. The percentages of task and socio-emotional acts in balanced-sex groups fell in between those of all-male and all-female groups.

Mabry (1985) compared the interactions of all-male, all-female, male-majority and female-majority groups on two types of tasks. The first task, considered low structured, involved discussing a human relations case. The second task, considered high structured, involved rank ordering behaviors according to the level of interpersonal competence they were perceived to represent. Interactions were again coded according to Bales' (1970) Interaction Process Analysis. A significant interaction of task and composition was found for the category "gives suggestions." All-male groups working on the structured task gave significantly more suggestions than all other groups, with the exception of male-majority groups. Male-majority groups working on the unstructured task gave the lowest number of suggestions. Mabry suggested that this finding might be attributable to the reference to a woman in the unstructured task which may have led groups to rely more on

the single female member, thus reducing the number of suggestions given by males in the male-majority groups.

In addition to the interaction of task and composition, there were main effects for composition (Mabry, 1985). All-female groups had significantly fewer disagreements than all other compositions. All-male groups had fewer disagreements than male-majority groups, but still more than all-female groups. Finally, no significant differences were found across groups in the amount of task-related interactions. This study shows that differences may be found when communications are categorized by content area, and that these differences may vary as a function of the task.

Summary

The above findings highlight the complexity of the relationship between sex composition and group processes and performance. Subtle distinctions in group composition (e.g., all-male versus single-female) seem to produce very different outcomes. In addition, differences have been found within and across studies for different tasks (e.g., Hoffman & Maier, 1961; Kent & McGrath, 1969; Rosenthal, 1978; South, 1927). The exact nature of the task's effect, however, is unclear. The sex-orientation of the task has been discussed by some (e.g., Hoffman & Maier, 1961; Rogelberg & Rumery, 1994) as having an influence on these findings. Specifically, some tasks may be seen as more appropriate or associated more with one sex than the other. As a result, group members may respond in accordance with stereotypes about the competencies of men and women on different tasks. Literature addressing the influence of the task is reviewed next.

Role of the Task

Many tasks are associated primarily with members of one sex or the other, which leads to expectations about the appropriate sex to perform a task (Ruble, Cohen, & Ruble, 1984). Men may be assumed to be more competent and put forth more effort on tasks traditionally performed by men (e.g., auto repair), while women are expected to be more competent and more motivated on tasks traditionally performed by women (e.g., child care). However, an increasing number of men and women are entering fields traditionally associated with the opposite sex. This creates an incongruency between stereotypes about the individual and stereotypes about the task. As a result, "non-traditional" members may be ignored by or isolated from the majority since they are assumed to have less task-related competency. In addition, certain members may have higher status in the group simply because their sex has been traditionally associated with the task (Ridgeway, 1982).

There is a fair amount of evidence that the type of task interacts with sex composition to influence group performance (Martin & Shanahan, 1983). As suggested by Deaux (1984), "Many observed sex differences are not durable main effects, but rather are influenced by task characteristics, resulting in frequent interactions between sex of subject and sex-linkage of task" (p.107). Unfortunately, with the exception of the literature on individual conformity, the sex-linkage of the task has generally been neglected by researchers. Further, most of the research on the effects of sex composition have been studied using masculine, or traditionally male, tasks (Eagly & Carli, 1981). Therefore, the majority of findings may not generalize beyond male-oriented contexts.

Several studies suggest that the sex-linkage of the task can have significant effects on individual perceptions and behaviors. Barnes-Farrell, L'Heureux-Barrett, and Conway

(1991) found that task performance was evaluated more accurately when the task behaviors were congruent with the sex-type of the job. In other words, behaviors on male-typed tasks were evaluated more accurately in the context of male-typed occupations, and female-typed tasks evaluated more accurately in female-typed occupations.

Mabry (1985) also suggested that the reference to a women in a task description may affect behaviors in the group. She found that men were less dominant in mixed-sex groups only on the task that referenced a women. As a result of this reference, males may have conceded to the expectation that female members were more knowledgeable about the task.

Ward (1991) directly tested the notion of the sex-appropriateness of tasks. Subjects were asked to make judgments about the occupational suitability of male and female applicants. They found that sex-congruent applicants were rated significantly more suitable than sex-incongruent applicants.

The expectations of one's own behavior may also depend on the task. Karabenick, Sweeney, and Penrose (1983) found that women expected their performance to be higher on feminine tasks while men expected higher performance on masculine tasks. Similarly, Baucom and Danker-Brown (1984) found that women who scored low on masculinity were more likely to give up and waste time on male-stereotyped tasks.

As the work force becomes increasingly diverse, not only are groups becoming increasingly heterogeneous in terms of sex, they are doing so in a way that conflicts with traditional stereotypes about the roles of men and women. It is clear, however, that the sex-linkage of the task has an affect on both the expectations and behaviors of men and

women. Throughout the review of sex composition, the task was frequently cited as a potential factor explaining inconsistencies within and across studies. Given that many relationships in this literature are unstable, additional variables need to be considered that may influence the results. There is reasonable evidence that the sex-linkage of the task plays such a role. Therefore, it should prove valuable in understanding the effects of the group's composition on team processes and performance.

Conclusion

There are strong and pervasive stereotypes regarding the appropriate characteristics of males and females. These stereotypes affect performance attributions (Deaux & Emswiller, 1974; Wiley & Eskilson, 1983), the perceived status and influence of men and women (Eagly & Wood, 1982; Wiley & Eskilson, 1982; Wharton & Baron, 1987), and help maintain sex segregation in the workplace through the discouragement of sex-inappropriate behavior (Costrich et al., 1975).

Research on the perceptions of males and females has generally found that males are more often seen as leaders (Greene et al., 1981; Nemeth et al., 1976; Webber, 1976), and are evaluated more favorably than females on a number of dimensions, including intelligence and influence (Butler & Geis, 1990; Toder, 1980). These effects, however, are not consistent across all situations. Similarly, individual behaviors sometimes reflect sex stereotypes and other times do not.

These behaviors and perceptions are often dependent on the sex composition of one's reference group. Composition can influence the salience of sex as a distinguishing characteristic of members in the group (Kanter, 1977; McGuire et al, 1979). Certain representations may increase stereotypic perceptions of males and females. There is

substantial evidence that the sex composition of a group affects individual as well as group level behaviors. The nature of this influence, however, is not always clear.

In terms of individual behaviors, some studies have found males and females to act more stereotypically in same-sex groups (Aries, 1976; Mabry, 1989; Piliavin & Martin, 1978), while others have shown that individuals behave more stereotypically in mixed-sex groups (Johnson & Schulman, 1989; Smith-Lovin & Brody, 1989). For example, several studies found a general bias in favor of males such that males were more influential regardless of composition (Bradley, 1980, 1981; Thameling & Andrews, 1992). However, in another study males were only more influential than females when they were the minority member in the group (Craig & Sherif, 1986).

At the group level, there is also much variance in findings across studies that compare the performance of mixed and same-sex groups. Both mixed-sex and same-sex groups have been found to be more creative, accurate, productive, and faster (e.g., Clement & Schiereck, 1973; Hoffman et al., 1962). Differences are also found among various types of mixed-sex compositions (e.g., male-majority, female-majority). However, no consistent trend has emerged in the types of compositions that perform best (Kent & McGrath, 1969; Hoffman & Maier, 1961; Rogelberg & Rumery, 1994; Robertson & Kwong, 1994). Similar inconsistencies are found when examining group processes such as communication content (Mabry, 1985; Piliavin & Martin, 1978) and participation equality (Johnson & Schulman, 1989; Skvoretz, 1988).

Attempts to explain these inconsistencies have identified several potential moderators of the effects of sex composition. These include the sex-orientation of the task (Wentworth & Anderson, 1984), the specification of status (Wood & Karten, 1986),

experience (Lockheed & Hall, 1976), and the proportion of males and females in the group (Alexander & Thoits, 1985; Spangler et al., 1978). For example, men and women may only act stereotypically when the task favors men (Wentworth & Anderson, 1984), when the status of members is unknown (Wood & Karten, 1986), or when the representation of females in the group is relatively small (Alexander & Thoits, 1985).

Of these variables, the task seems to be most promising in explaining the majority of inconsistencies found in the literature. Expectations about one's own competency and the competency of others may depend on the congruency between the sex-linkage of the task and the sex of the individual (Karabenick et al., 1983; Ward, 1991). Research on individual conformity, in particular, exemplifies the influence of the sex-relatedness of the task (Feldman-Summers et al., 1980; Sistrunk & McDavid, 1971). In general, individuals conform more to majority influence, especially when the sex of the majority is consistent with the sex-linkage of the task.

To summarize, three main conclusions can be drawn from the literature on sex composition. First, individuals often think and behave according to sex stereotypes. For example, men are often perceived to be more task-oriented and women more socio-emotional (e.g., Butler & Geis, 1990; Heilman et al., 1989). Second, these behaviors and perceptions are influenced by the sex composition of groups. At the individual level, differences in participation rates and conformity between males and females have been found to vary depending on the group's composition (e.g., Feldman-Summers et al, 1980; Mabry, 1989; Piliavin & Martin, 1978; Reitan & Shaw, 1964). At the group level, composition affects the content of communications and performance (e.g., Mabry, 1985; Robertson & Kwong, 1994). Finally, there are numerous inconsistencies within and

across studies. Rather than attempt to resolve these inconsistencies, it appears that many researchers have moved on to other topics. Therefore, the question remains as to the source of these discrepancies. This study attempts to address this question by examining a potential moderator of sex composition effects. There is evidence that the sex-linkage of the task can influence individual perceptions and behaviors (e.g., Karabenick et al., 1983), and potentially moderate the effects of sex composition.

SEX COMPOSITION AND TEAM DECISION MAKING

The review of prior research suggests three issues that should be considered when studying the effects of sex composition on teams. First, given the wide range of groups that can be studied, there is a need to set boundary conditions on the type of groups to be addressed. Second, it is important to identify what variables should be studied given what is known and not known from the existing literature. Finally, there is a need to focus on an aspect of the task which offers the most promise of gaining a better understanding of sex composition effects.

Decision Making Teams

Research on group decision making has a long and diverse history, examining issues like group size, group polarization and free discussion (Davis, 1992). The focus of much of this literature is on consensus decision making in which members typically share common information and are expected to reach agreement about a course of action. In many teams, members do not share a common knowledge base, but instead are assigned to various areas of expertise. In such groups, agreement is often not feasible or even desirable. Therefore, many groups have a leader who is responsible for making the decision on behalf of the group. Since many work groups do not fit the model of consensus decision making, there is a need to explore alternative group structures. Therefore, this study will focus on teams in which knowledge is distributed and one

member is primarily responsible for making the group's decision. Such groups will be referred to as hierarchical decision making teams.

Identification of Relevant Group Processes

In addition to the limited focus on certain types of decision making, there has also been insufficient attention to group processes in the team decision making literature. As shown by the previous review of sex composition effects, individual behaviors have been more widely considered than group behaviors. The more frequently studied group behaviors are participation rates and communication content. The importance of these behaviors to effective group decision making is rarely addressed. Researchers have shown that certain group processes, such as information sharing and coordination, are significantly related to performance (e.g., Stasser, Taylor, & Hanna, 1989). Therefore, any influence that the group's composition has on these variables may ultimately affect group performance. For example, mixed-sex compositions may inhibit effective communication among group members which may reduce the amount of information that is shared. Groups will be less likely to arrive at a proper decision if information is not shared.

There are numerous variables which may be influenced by a group's composition, but it is important to focus attention on those which affect performance and are relevant to the teams being studied. This study will examine the effects of group sex composition on several group processes associated with effective decision making in hierarchical teams.

Task Effects

Prior research has found that the task appears to influence the effects of sex composition on individual and group level behaviors. The tasks used, with some

exception (e.g., individual conformity), seem to be chosen with little consideration of their potential influence. Of the studies involving multiple tasks (e.g., Hoffman & Maier, 1961; Toder, 1980), there is little attention to the characteristics of these tasks that might have contributed to the findings. Although it is important to examine task characteristics such as complexity, abstractness, and structure, the sex-linkage of the task is a characteristic that is uniquely important in this literature. Many researchers have already suggested that the male or female orientation of a task may explain inconsistent findings within and across studies. However, only research on conformity has specifically tested the effects of task sex-linkage. Others have used tasks which may reflect this variable (e.g., math versus verbal tasks), but these tasks may differ on other characteristics such as structure or complexity, thus confounding the results. In order to test the effect of the task's sex-linkage, one need only change the content from male to female-oriented (e.g., Butler & Geis, 1990). Examining the sex-linkage of the task will hopefully provide an explanation for the inconsistent results found in the literature.

Hierarchical Team Decision Making

One of the advantages of focusing on hierarchical team decision making is that both a theory and a task have been developed to address these types of teams. Hierarchical decision making teams have certain characteristics that distinguish them from consensus decision making teams. First, they are composed of a leader and staff members who together are responsible for making team decisions. The staff members are responsible for evaluating information and making recommendations based on that information. The leader is primarily responsible for incorporating staff member recommendations into a team decision.

Second, knowledge regarding the relevant information is distributed within the team such that members have different expertise. Expertise reflects the portion of available information that a member is primarily responsible for evaluating. All information available to the team, however, is relevant to the decision, and, therefore, each member's contribution is important for the team to perform effectively. For example, one member's information may be critical to the decision making if that information leads to a different conclusion than the rest of the team. The failure of one member to contribute his or her knowledge to the leader may result in a poor team decision.

Third, these teams are characterized by interdependence. That is, members rely on one another for obtaining some of the information relevant to their expertise. Access to the pool of information available to the team varies such that members can directly obtain some, but not all, of the information. Members are responsible for gathering and sharing information with one another prior to reaching a decision. Therefore, interaction among team members is needed to make effective team decisions.

The Multilevel Theory

A theory was developed which attempts to predict and explain the effectiveness of decision making in teams with the above characteristics (Hollenbeck, Ilgen, Sego, Hedlund, Major, & Phillips, 1995). This theory requires that a criterion exists for assessing the accuracy of each decision, and that this criterion reflects some integration of the information on which the decision was made. The multilevel theory then identifies factors that are expected to directly influence decision accuracy, referred to as the core constructs of the multilevel theory (see Figure 1). These core constructs are based on the defining characteristics of hierarchical decision making teams. First, it is necessary that

staff members obtain all of the information relevant to their expertise. Therefore, the first core construct, team informity, reflects the extent to which the team as a whole is informed on all the relevant information. Second, it is important that staff members interpret the information accurately according to their expertise and supply the leader with useful recommendations. The variable which captures this effectiveness is staff validity, or the extent to which members' recommendations, on average, predict the correct team decision. The third core construct addresses the hierarchical nature of the teams. Leaders are responsible for making the final decision for the team, and, therefore, can affect the accuracy of decisions in the way they incorporate staff members' recommendations. For example, a leader may perceive a staff member as less competent than the other members, and give less weight to that member's recommendation. Depending on the validity of that member's recommendations, the leader's weight may or may not have been appropriate. The third core construct, hierarchical sensitivity, assesses how appropriately the leader weighs staff members' recommendations in arriving at the team decision.

Each of these team-level constructs is an aggregate of a variable at a lower level of analysis. These lower level constructs often help to explain phenomena at the team level. Decision informity is the amount of relevant information the team as a whole has obtained for a particular decision object. Individual validity is the predictive validity of any one staff member's recommendations. Finally, dyadic sensitivity is the appropriateness of the weight given by the leader to any one staff member's recommendations.

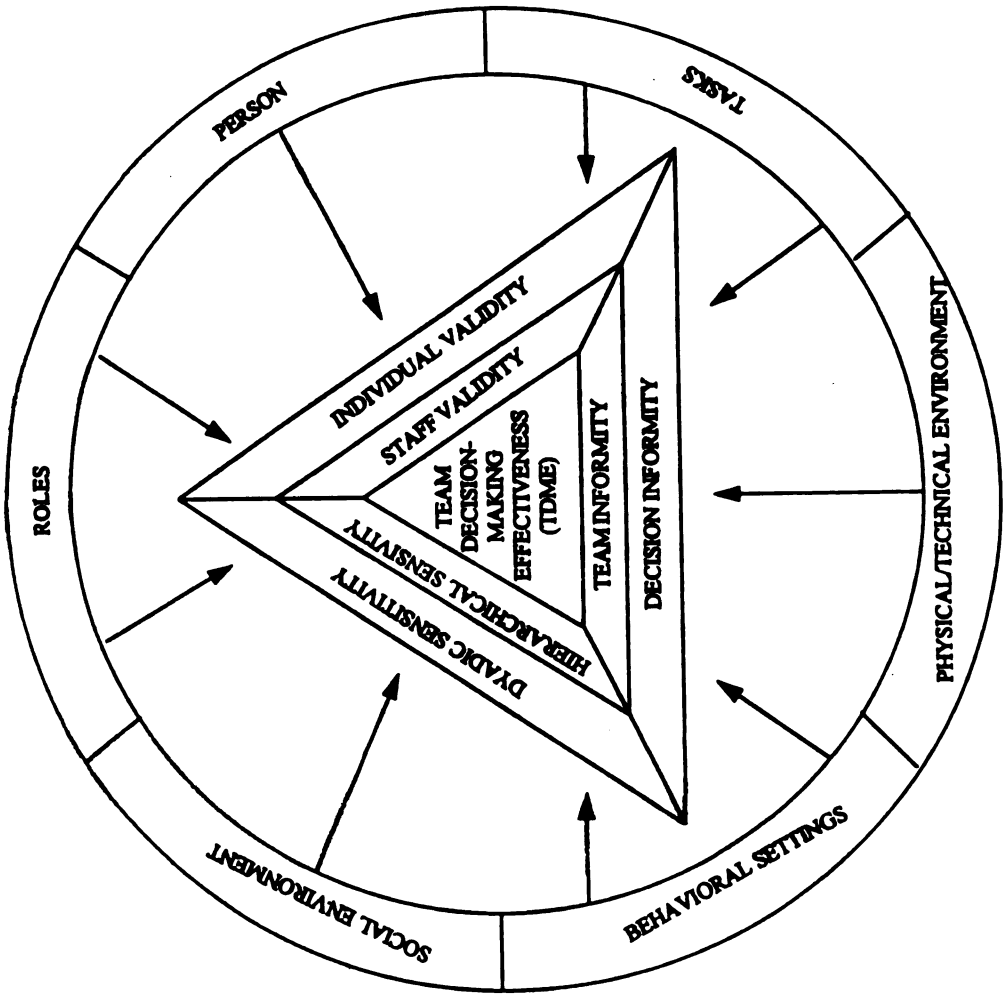


Figure 1. The multilevel theory of hierarchical team decision making.

The multilevel theory proposes that all other variables (e.g., task characteristics, cognitive ability) affect team decision accuracy through the three core constructs. In other words, the core constructs are viewed as mediators. As shown in Figure 1, these other variables are categorized into six sets of constructs based on a framework developed by McGrath (1976). The theory further suggests that certain categories are likely to influence some core constructs more than others. Research testing the multilevel theory has repeatedly found all three core constructs to be significantly related to decision accuracy, and in combination to account for between 27% and 43% of the variance in team decision accuracy (Hedlund, 1993; Hollenbeck et al., 1995). The role of the core constructs as mediators of the relationship between variables commonly addressed in the group decision making literature (e.g., cohesion, familiarity) and team decision accuracy has also been supported. For instance, a study on computer-mediated communication found that the effect of the communication medium on team decision accuracy was completely mediated by the core constructs (Hedlund, 1993). That is, the communication medium only had an indirect effect on team decision accuracy through its influence on the core constructs. The isolation of the three core constructs improves knowledge of the process by which teams arrive at their decisions and allows for the identification of different and possibly conflicting ways in which they do so.

The TIDE^2 Simulation

The Team Interactive Decision Exercise for Teams Incorporating Distributed Expertise (TIDE^2) task was developed to study hierarchical decision making teams (Hollenbeck, Sego, Ilgen, Major, Hedlund, & Phillips, in press). TIDE^2 is a computer simulation designed to study decision making contexts involving multiple cues which are

often distributed among members of a team. Members communicate through networked computers which virtually record every keystroke, message, and decision made by every member. A team can consist of as many as four individuals, and up to nine decision making criteria (i.e., cues) can be assigned to the team. Decisions can be compared to a "true score" which is based on the method employed for combining the cues into a decision.

The TIDE^2 program allows for flexibility in terms of the content area about which decisions are made. For example, a selection task could be simulated in which members are asked to consider the experience, education, and ability test scores of applicants. Different members could be assigned the responsibility for evaluating each piece of information. Further, these cues could be weighed differently in making the decision such that experience received more weight than test scores. The TIDE^2 task not only provides an ideal tool for studying the types of teams of interest, it is also a favorable mechanism for manipulating the sex-linkage of the task.

Hypotheses

The following hypotheses address the effects of sex composition and task sex-linkage on team decision making. The compositions of interest include all-male, male-majority, female-majority, and all-female membership. The sex-linkage of the task reflects the issue about which a decision is made, and is either male or female-linked. The female version involves a nursing task in which decision are made about infants. The male version is a military task in which decisions are made about aircraft. The teams are all hierarchically structured with expertise distributed among staff members.

The multilevel theory of hierarchical team decision making is used as a framework for predicting the effects of sex composition and the task sex-linkage on team decision making (see Figure 2). In addition to the three core constructs identified by the multilevel theory, participation equality is also viewed as a critical group process. For the task used in this study, each member has an equally important role in the team. Decisions are based on all of the information available to a team, and therefore, effective decision making depends on the contributions of all team members. Equal participation can help to insure that all members obtain the information they need to make good recommendations, and that members have an equal influence on the final team decision. Participation equality is also expected to be highly influenced by the sex composition of a team, and thus is a relevant variable to this study.

As shown in Figure 2, sex composition is expected to affect team decision accuracy through its effects on the three core constructs and participation equality. The sex-linkage of the task is viewed as a moderator of the relationship between sex composition and the decision making processes. The core constructs and participation equality are expected to directly influence team decision accuracy.

Predictions of the multilevel theory are used along with the literature on the effects of sex composition to develop specific hypotheses regarding the effects of sex composition and the task sex-linkage on the team decision making process. Since there is a greater abundance of knowledge regarding individual level effects of composition, these findings are used to form hypotheses regarding group level effects. The hypotheses, however, only address relationships among group level variables as this is the level to which conclusions about sex composition effects will be drawn. The variables identified

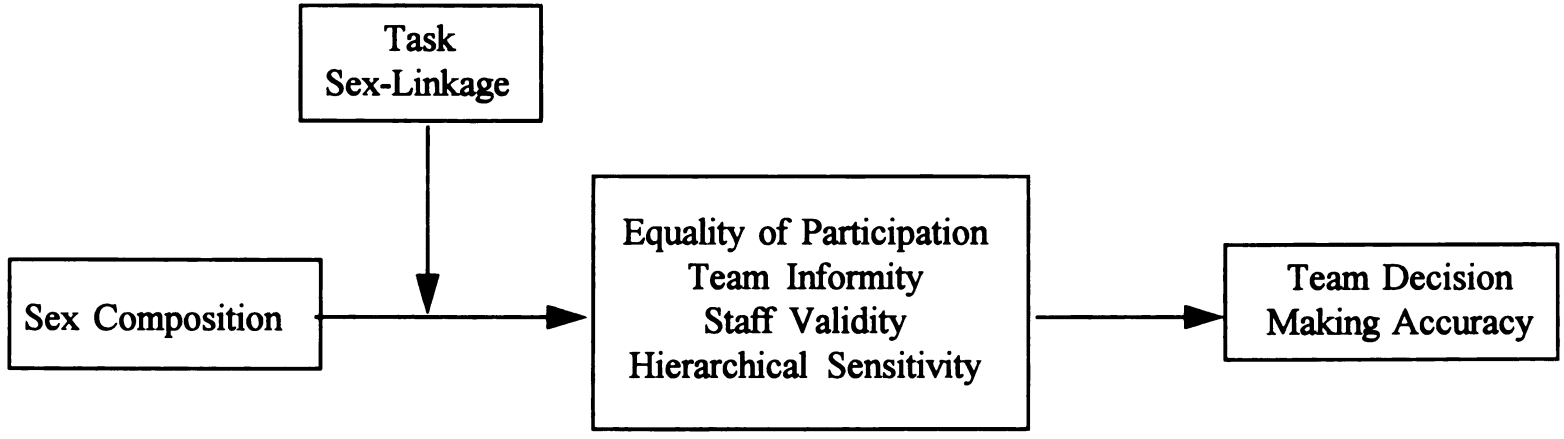


Figure 2. **Predicted effects of sex composition and task sex-linkage on hierarchical team decision making.**

by the multilevel theory (i.e., team informity, staff validity, hierarchical sensitivity) have not been directly addressed in the sex composition literature. Therefore, attempts are made to draw on knowledge of related constructs in developing the hypotheses.

Participation Equality

At the group level, researchers have failed to find differences in participation equality as a function of sex composition. However, individual participation rates do vary as a function of the composition, suggesting that it is reasonable to expect differences at the group level. In mixed-sex groups, males are often found to participate at a higher rate than females (Aries, 1976; Johnson & Schulman, 1989). There is also evidence that females participate more than males when the group has a female majority (Mabry, 1989; Thune et al., 1980). Therefore, it is reasonable to expect that both male and female-majority teams will experience unequal participation.

Differences in participation equality between male and female-majority teams will likely emerge as a function of the sex-linkage of the task. That is, on the male task, male-majority members will be more likely to dominate the single female member than they would on the female task. Similarly, a female-majority is expected to dominate the group's interaction more on the female than the male task. As illustrated in Figure 3, it is hypothesized that:

Hypothesis 1a: In general, same-sex (homogeneous) teams will participate more equally than mixed-sex (heterogeneous) teams.

Hypothesis 1b: Within mixed-sex teams, male-majority teams will participate less equally than female-majority teams on the male task, and female-majority teams will participate less equally than male-majority teams on the female task.

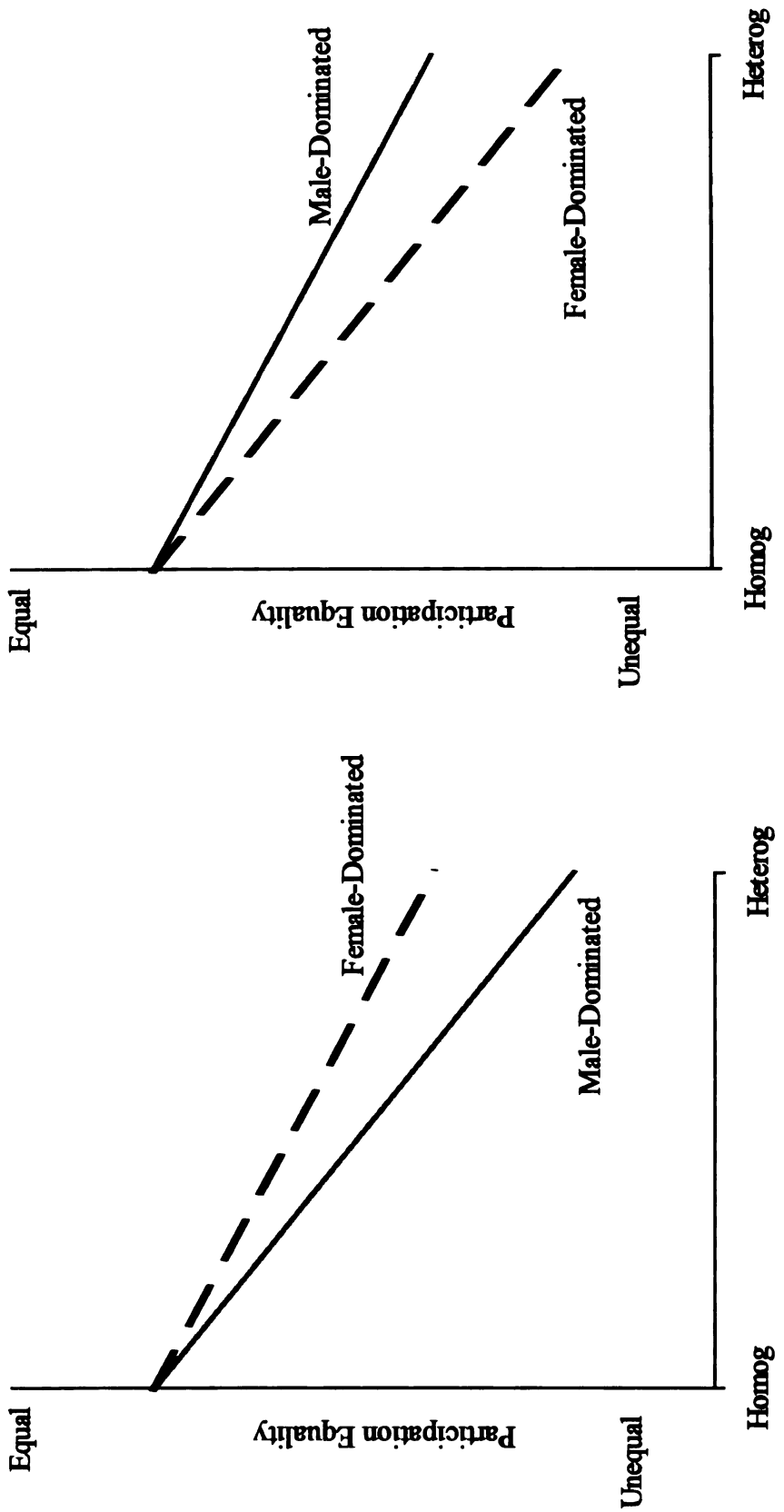


Figure 3. Hypothesized effects of sex composition and task sex-linkage on participation equality.

Team Informity

The most closely related variable to team informity in the sex composition literature is the amount of task-related activity engaged in by a team. At the group level, research findings are inconclusive regarding between group differences in task-related activity. Some studies found between-group differences in task-related activity (Piliavin & Martin, 1978), while others found these differences to depend on task characteristics (Mabry, 1985). At the individual level, males have a tendency to engage in more task-related activity in same-sex and balanced-sex groups (Johnson & Schulman, 1989; Thune et al., 1980), while females are more task-oriented in female-majority groups (Mabry, 1989; Thune et al., 1980). Together, the group and individual findings suggest that all-male groups should have the highest level of task-related activity followed by mixed-sex and all-female teams.

The amount of task-related activity alone, however, does not insure that information is being shared. High team informity also requires that every member receives the information that he or she needs. Therefore, participation equality will also likely influence team informity. Same-sex teams are expected to participate more equally than mixed-sex teams, and thus should distribute information more effectively. Combined with the findings regarding task-related activity, this suggests that, overall, all-male teams should have the highest team informities. The extent to which differences emerge among all-female and mixed-sex teams will likely depend on the task.

The sex-linkage of the task has been shown to affect perceptions of task-related competency (Karabenick et al., 1983; Ward, 1991). For example, female members are generally perceived as less knowledgeable about male-oriented tasks. These perceptions

may influence the distribution of information to certain members, as well as attempts made by members to obtain information. This failure to provide all members with the information they need will ultimately reduce a team's overall informity.

It is expected that the task will influence the distribution of information to single male and single female members. Specifically, on the male task, male-majority members will fail to share information with the single female member, thus reducing their overall team informity. Similarly, in female-majority teams, single males are not expected to obtain all relevant information when working on the female task. Teams are not expected to be negatively affected when the sex-linkage of the task is consistent with the sex of the single male or female. Therefore, on the female task, the team informity of male-majority teams should not differ significantly from all-male teams. The sex-linkage of the task is also expected to affect all-female teams such that they are not expected to have significantly lower informity than all-male teams when working on the female task. As illustrated in Figure 4, it is hypothesized that:

Hypothesis 2: On the male task, all-male teams will have higher team informity than all-female and female-majority teams, with male-majority teams having the lowest team informity. On the female task, all-male, all-female, and male-majority teams will have higher team informity than female-majority teams.

Staff Validity

Staff validity reflects the ability of members to make useful recommendations based on the information they have obtained. The literature on individual level performance within groups is most informative regarding the effects of sex composition on staff validity. From the limited research on individual performance, there appear to be

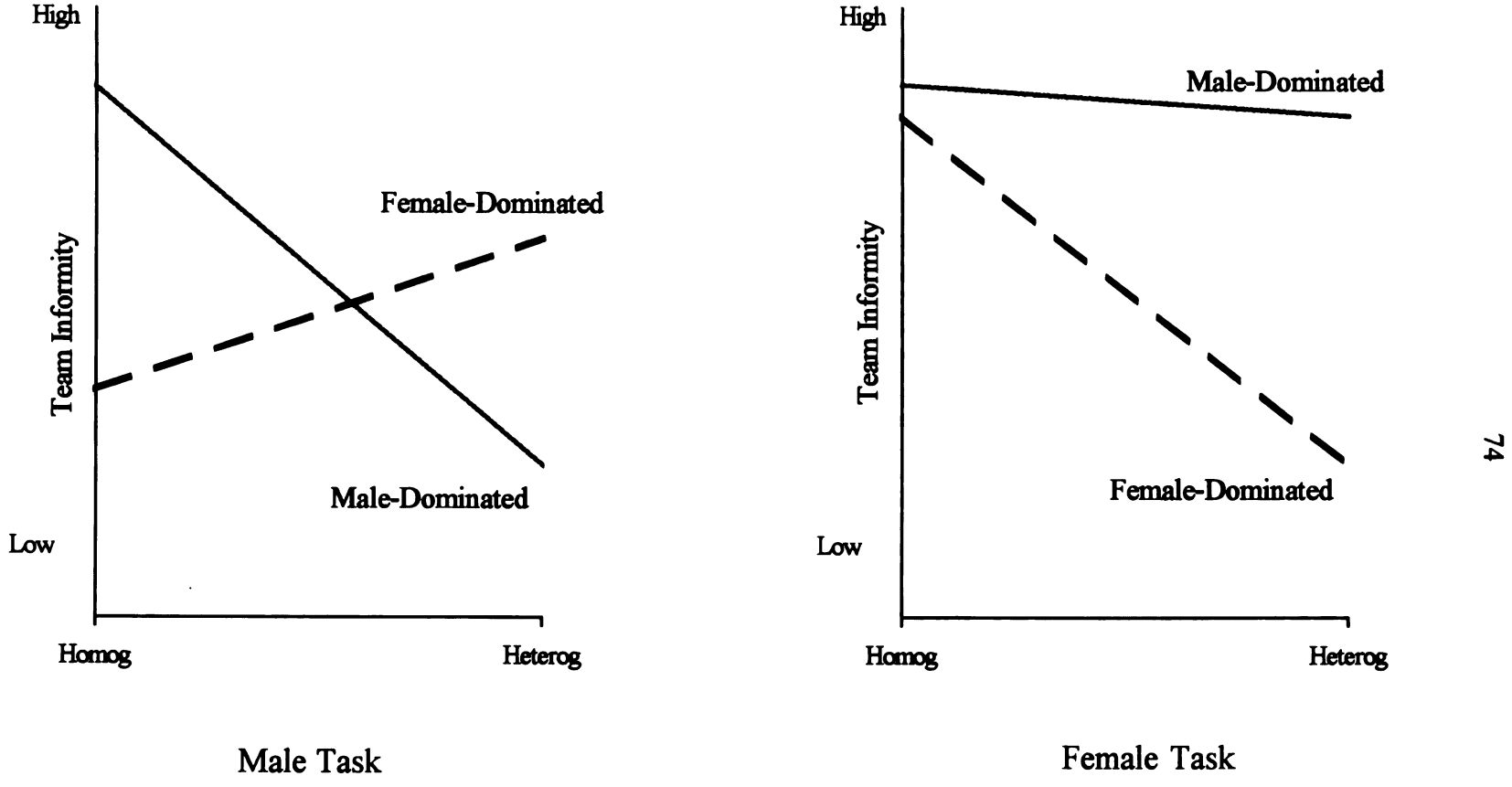


Figure 4. Hypothesized effects of sex composition and task sex-linkage on team informity.

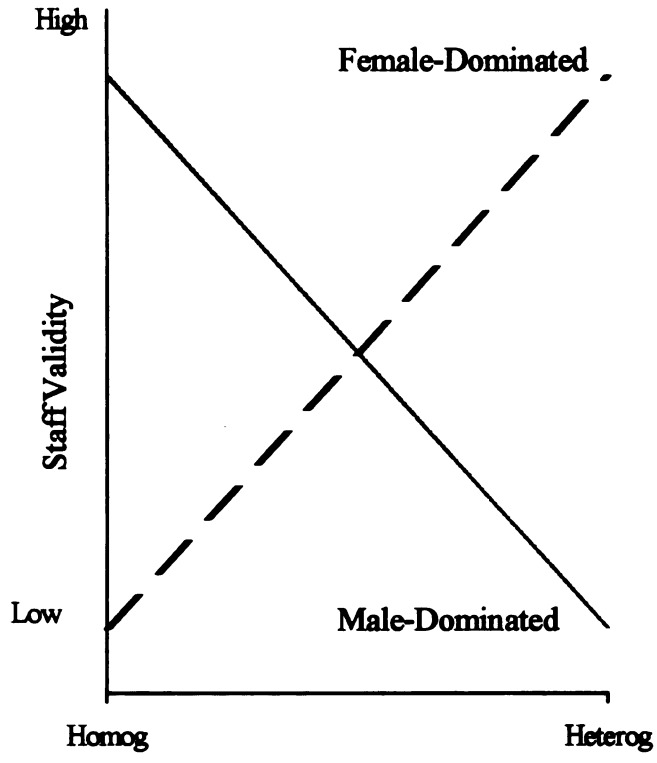
complex relationships between sex composition and sex differences in performance. In general, males seems to perform better than females under minority representation, while females fare better than males under majority representation (Alexander & Thoits, 1985). These findings suggest that the performance of both males and females should be enhanced in female-majority groups, which should transfer to higher staff validity at the group level.

Team informity is also relevant to staff validity since being well informed increases the chance of making good recommendations. Therefore, the expected effects on team informity are considered, along with findings regarding male and female performance, to make predictions regarding staff validity. On the male task, the effects of sex composition on staff validity are expected to be similar to those for team informity, with the exception that female-majority teams should also benefit from the enhanced performance of male and female members. The advantage of female-majority teams is also expected on the female task, which should reduce the difference between male and female-majority teams that was predicted for team informity. Thus, as shown in Figure 5, it is hypothesized that:

> Hypothesis 3: On the male task, all-male and female-majority teams will have higher staff validities than all-female and male-majority teams. On the female task, teams will not differ in terms of staff validity.

Hierarchical Sensitivity

Hierarchical sensitivity is a variable that is particular to the types of teams of interest in this study. Effective team performance is dependent on the leader's ability to appropriately weigh staff members' recommendations according to their validities. Those weights, however, may be influenced by other factors, like a member's sex, which may not



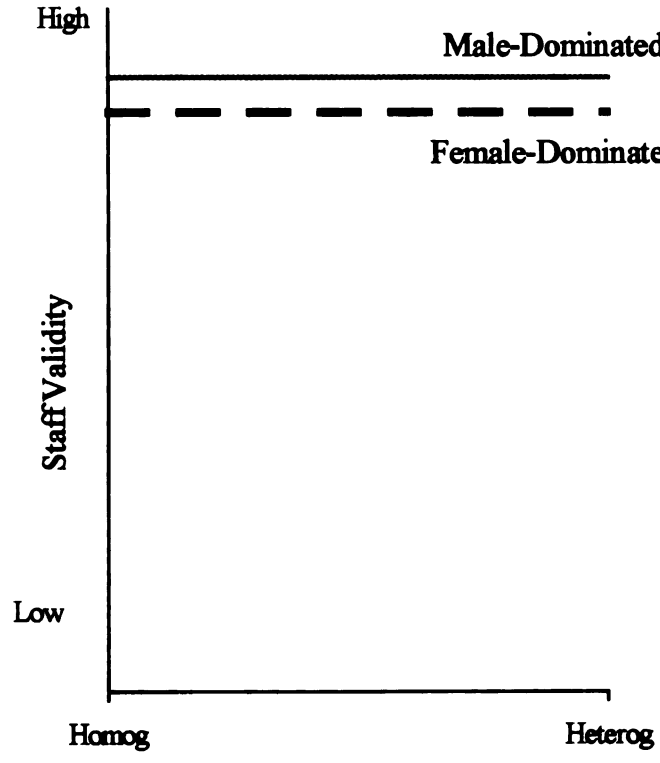


Figure 5. Hypothesized effects of sex composition and task sex-linkage on staff validity.

be a reliable indicator of ability. Although there is no research that is directly relevant to understanding the effect of sex composition on hierarchical sensitivity, the literature on conformity and influence provide some direction regarding this effect.

Research on conformity suggests that both males and females conform more in mixed than same-sex groups (Reitan & Shaw, 1964; Tuddenham et al., 1958). The more interesting finding from this literature is that conformity depends on the sex-relatedness of the task. Specifically, males conform more on male-related tasks while females conform more on female-related ones (Feldman-Summers et al., 1980; Sistrunk & McDavid, 1971). In regards to influence, males tend to have more influence than females, but this appears to be limited to male-oriented tasks (Bradley, 1980, 1981; Craig & Sherif, 1986). These findings suggest that both the sex-linkage of the task and the sex of the individual may be considered when evaluating the validity of a member's recommendation. For example, if a task requires knowledge of how to sew a button hole, a single female's opinion will likely receive more weight than that of any male member.

Research on conformity and influence suggests that the weights leaders assign to different members will likely be influenced by the sex of the member and the sex-linkage of the task. At the group level, this implies that leaders of mixed-sex teams will weigh members' recommendations less appropriately than leaders of same-sex teams since their evaluations are more likely to be clouded by irrelevant information (i.e., sex). Leaders of male-majority teams are expected to underweigh the recommendations of single female members on the male task, and to overweigh their recommendations on the female task, thus reducing their overall hierarchical sensitivity. It is further expected that the act of underweighing recommendations will be greater than the act of overweighing

recommendations, and thus, have a more negative effect on sensitivity. Leaders of female-majority groups are similarly expected to weigh the recommendations of single male members inappropriately, thus lowering their hierarchical sensitivity. As shown in Figure 6, it is hypothesized that:

Hypothesis 4a: In general, same-sex teams will have better hierarchical sensitivity than mixed-sex teams.

Hypothesis 4b: Within mixed-sex teams, male-majority teams will have poorer hierarchical sensitivity than female-majority teams on the male task. Female-majority teams will have poorer hierarchical sensitivity than male-majority teams on the female task.

Team Decision Making Accuracy

Research examining the effect of sex composition on group decision making does not provide any clear direction regarding the effect of composition on team decision accuracy. In some cases female-dominated groups make better decisions (Robertson & Kwong, 1994), while in other cases male-majority groups perform better (Rogelberg & Rumery, 1994). Similar inconsistencies exist for other outcome variables such as creativity and productivity. Although the sex composition literature provides little direction, the predictions of the multilevel theory of hierarchical team decision making (Hollenbeck et al., 1995) can be used to generate hypotheses regarding the effects of sex composition and task sex-linkage on team decision accuracy.

The multilevel theory proposes that the core constructs will mediate the effects of sex composition and the task sex-linkage on team decision accuracy. Therefore, the previous four hypotheses can be used to speculate on the nature of these effects. Same-

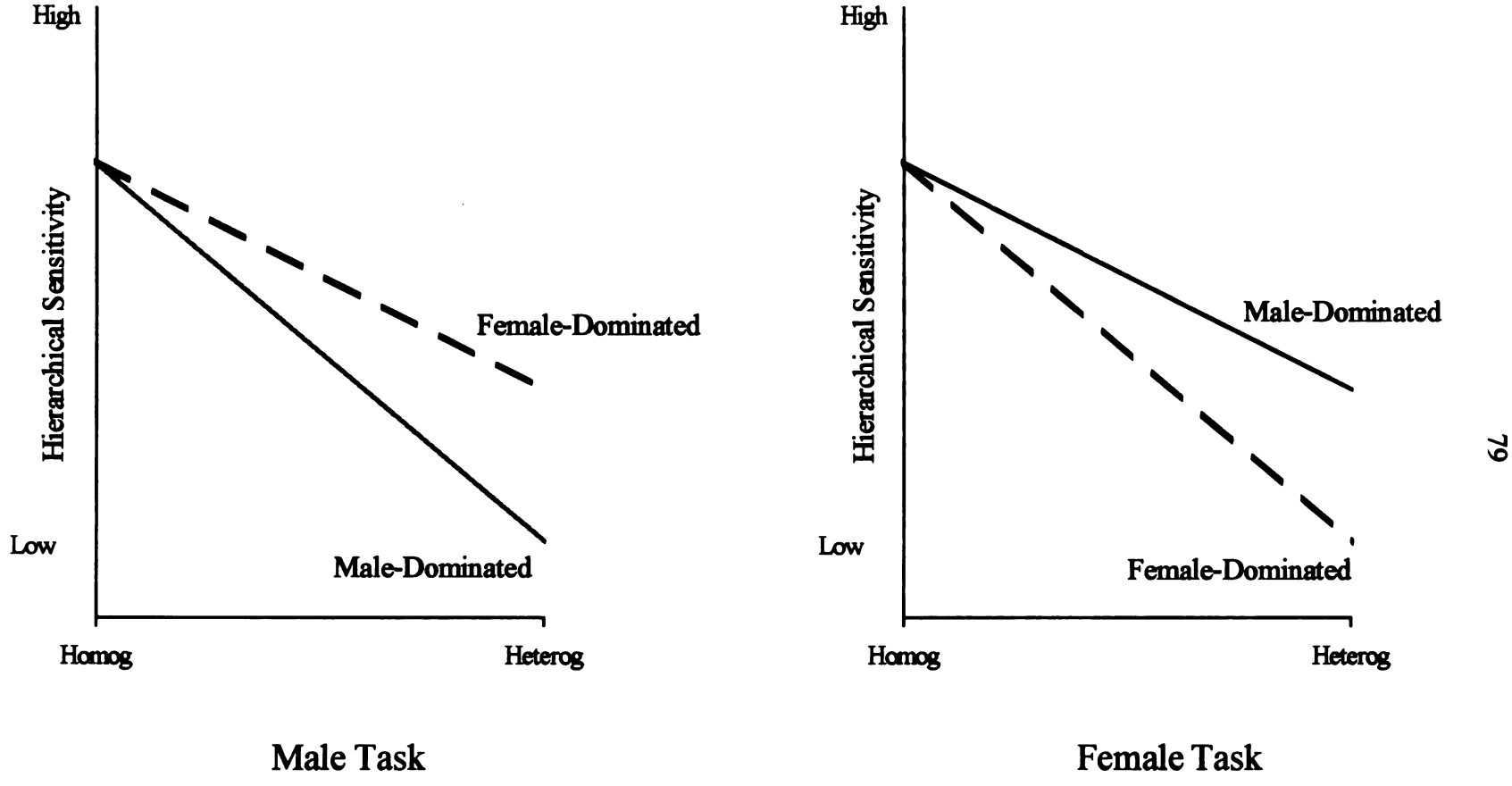


Figure 6. Hypothesized effects of sex composition and task sex-linkage on hierarchical sensitivity.

sex teams were generally predicted to participate more equally, have higher team informity, staff validity, and hierarchical sensitivity than mixed-sex teams which should result in higher decision accuracy. The exception was all-female teams who were hypothesized to have lower team informity and staff validity when working on the male task. It was also proposed that male-majority teams would be lower than female-majority teams on all four decision processes when working on the male task. Female-majority teams were expected to be lower than male-majority teams on these same decision processes when working on the female task, with the exception of staff validity. Therefore, male-majority teams should have lower decision accuracy than female-majority teams on the male task, while the opposite is expected on the female task. Based on these predictions, illustrated in Figure 7, it is hypothesized that:

Hypothesis 5: On the male task, all-male teams will have the highest decision accuracy, followed by all-female and female-majority teams. Male-majority teams will have the lowest decision accuracy. On the female task, all-male and all-female teams will have the highest team decision accuracy, followed by male-majority teams. Female-majority teams will have the lowest decision accuracy.

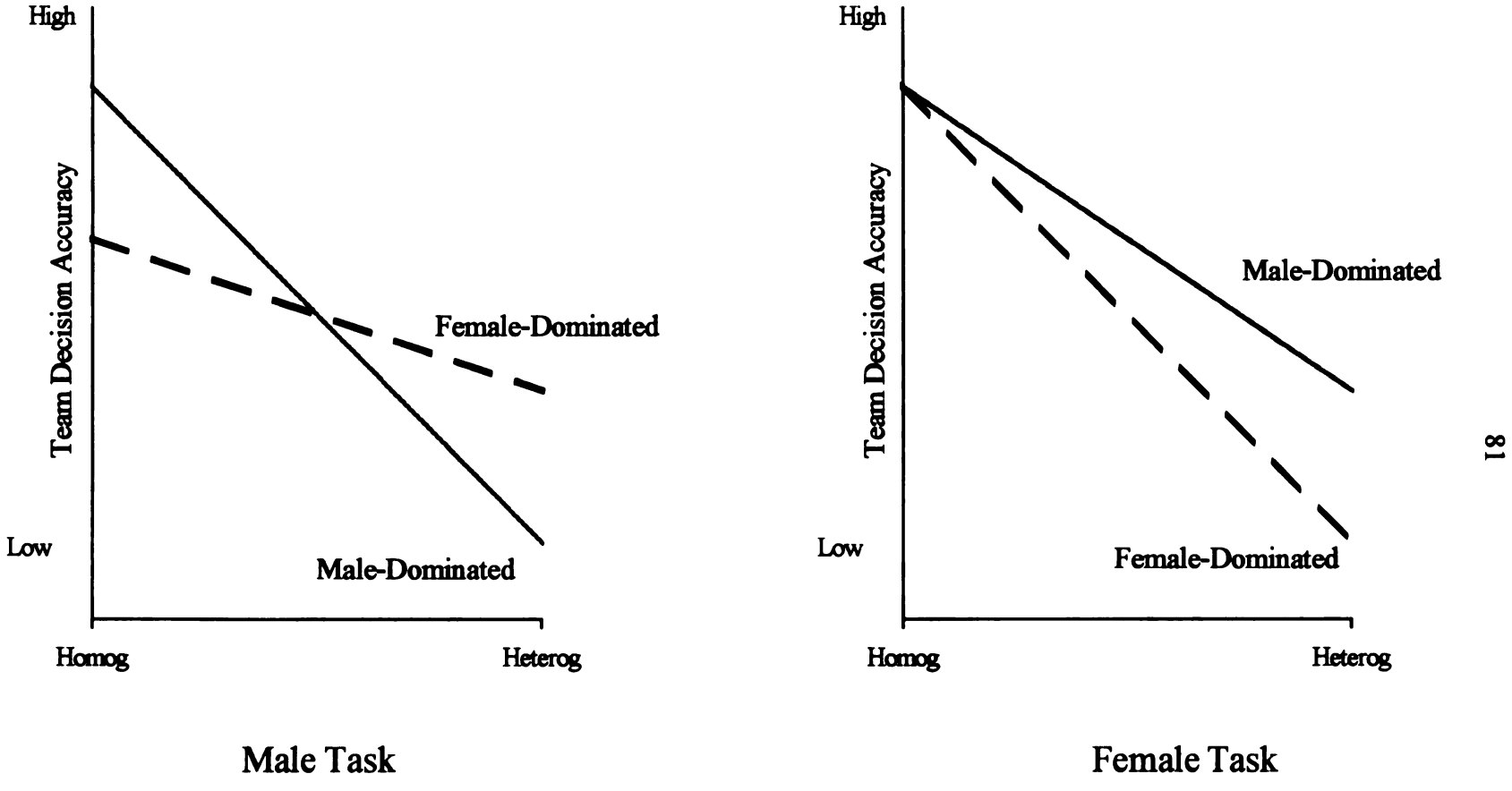


Figure 7. Hypothesized effects of sex composition and task sex-linkage on team decision accuracy.

METHOD

Design

This study involves a 2 (group homogeneity) x 2 (male/female dominance) x 2 (sex-linkage of task) between-subjects design as shown in Table 1. Participants were assigned to teams to create one of four sex compositions (i.e., all-male, all-female, male-majority, female-majority), and randomly assigned to one of two sex-linked tasks.

Participants

A total of 348 participants were recruited from undergraduate management and psychology classes to form 87 four-person teams. They received course credit for their participation. Information was obtained regarding demographic characteristics prior to participation (e.g., age, sex, race, major, status in school) which was used to control, as much as possible, for other types of heterogeneity among team members. The sample characteristics were: *sex*: 47% males, 53% females; *race*: 81% Caucasian, 23% African American, 5% Asian and 6% other; *status in school*: 5% sophomore, 55% junior, 35% seniors, and 5% other; *major*: 58% business, 15% social science, 7% human ecology, 5% communications, 14% other; *age*: 66% ages 19 to 21, 22% ages 22 to 25, 7% age 26 and over, 5% undisclosed. Attempts were made to balance the number of cases in each of the 8 cells of the design (see Table 1), but due to characteristics of the student population and high absenteeism rates, some cells have fewer cases.

Table 1
Study Design and Sample Distribution

	Homogeneity	
Dominance	Homogeneous	Heterogeneous
	Male task	
Male	All-Male (9)	Male-Majority (11)
Female	All-Female (11)	Female-Majority (12)
	Female task	
Male	All-Male (9)	Male-Majority (11)
Female	All-Female (12)	Female-Majority (12)

Manipulations

Sex Composition

Teams were composed of members who were all-male, all-female, one male and three females, or one female and three males, fulfilling each cell of the homogeneity x dominance design. No balanced-sex teams were included because the intent of the study was to assess the effects of unequal representations of males and females which best reflect the reality of traditionally male and female-dominated fields. In all conditions, the leader was a member of the majority sex since leadership by a minority member raises additional issues which cannot be adequately addressed within the realm of this study.

Task Sex-Linkage

The task used in this study was the TIDE^2 simulation (Hollenbeck et al., in press) discussed earlier. The basic structure of this task involves four-person teams who are responsible for evaluating and making decisions based on nine pieces of information. This information can reflect any topic of interest (e.g., deciding where to go to college). Therefore, almost any decision making situation can be simulated using the TIDE^2 task. For this study, task sex-linkage was manipulated by creating two situations which reflect traditionally male and female-dominated fields. The male-linked task involved a military command-and-control exercise while the female-linked task involved neonatal nursing care. The task is first described in detail based on the male version. The female version, which only involved changes to the task's content, is then described.

The male version involved a naval command and control exercise in which team members were responsible for monitoring aircraft targets. These aircraft ranged in their level of threat from friendly to hostile. The team's objective was to evaluate the aircraft's

level of threat on a number of dimensions and to decide how to respond to the aircraft. There were nine pieces of information, or cues, to be used in determining the threat level of an aircraft. In addition, there were three rules for combining these nine cues. These rules were used to make one of seven decisions, ranging from ignoring the aircraft to defending against it (see Appendix A).

Each member was assigned to a specific role in the team. These were the commanding officer of the Coastal Air Defense (CAD), a reconnaissance aircraft (AWACS), a Cruiser, and a Carrier who served as the team's leader. The three subordinate members were each responsible for two of the three rules, one of which was their primary expertise. For example, the AWACS was responsible for the motion rule and the location rule, which was also the responsibility of the CAD. This provided some overlap in expertise which allowed the team to potentially ignore certain members and still perform reasonably well. Since each rule involved three cues, each member was responsible for obtaining six pieces of information and making an evaluation based on that information. Only members who were responsible for a rule knew how to interpret the three cues associated with that rule. However, each member initially had access to only some of those cues; the other cues had to be obtained from another team member, thus creating interdependence within the team.

Once each member evaluated his or her information, a recommendation was sent to the leader. The leader's specific role was to combine these recommendations, which were in the form of decision alternatives, into a final decision for the team. The leader also had access to some of the cues, as well as knowledge of which members had access to what cues, and therefore, could assist in the dissemination of information. The leader,

however, did not know how to interpret any of the nine cues, and, therefore, relied on the recommendations of his or her staff. Once a decision was made by the leader, the team received feedback regarding the accuracy of its decision.

In terms of the mechanics of the task, teams responded to a series of aircraft that appeared sequentially on their computer screens. Each member had a menu from which to select one of several functions. These included "measure," "query," "transmit," "text" and "receive." Measure enabled members to obtain information available to them, query allowed them to ask for information, transmit was used to directly send information, text was an option to send typewritten messages, and receive allowed members to read any communications sent to them. There was also a menu for sending in recommendations, or a decision in the case of the leader.

For the female version of the simulation, the mechanics and requirements of the task were held constant. That is, members were responsible for evaluating sets of information based on rules to which they were assigned, and they used a menu to measure, query, transmit and receive messages. The decision task involved a nursing team working in a neonatal ward. Instead of aircraft, teams were responsible for monitoring the severity of health problems of newborns. As with the male version, nine pieces of information and three rules were used to make decisions regarding the treatment of the infant. The information was adapted to reflect cues and decision alternatives appropriate to neonatal care (e.g., respiration, heart rate). Each member was assigned a specific role. The three staff nurses each specialized in a different area of medicine (e.g., metabolic vs. respiratory), and the leader was referred to as the nursing supervisor. Instructions for the nursing task are displayed in Appendix B.

Procedure

Participants signed up for a particular time to report to the experiment. Upon arrival, they were asked to sign in and read and sign a consent form. They were then assigned to a team and brought into a room with four computers. Each person was handed a set of instructions to read that described the general purpose of the task, and the role of the team (see Appendices A and B). Specific role instructions were also provided that included the information each member needed to perform the task (see Appendices A and B). At this point, participants were asked to introduce themselves by stating their name and role in the team. They were asked to enter the names of the other team members next to their assigned role on a form at each station. These forms helped to identify each participant while members worked on the computer. Participants were then given 10 minutes to read over the materials. At the end of the 10 minutes, the research assistant answered any questions.

Next, participants were trained on how to use the computers to perform the task. This training involved a 10 minute trial in which a research assistant, using a script, pointed out the different components of the computer screen and talked participants through the use of all the functions in their menu bars (see Appendix C). Following the training trial, participants were given two more trials on which to practice. At this point, the research assistant answered any further questions and made sure everyone understood how to use the computer. Throughout the training and the simulation, participants were asked not to talk to one another so that all their communications would be captured by the computer. To ensure they did not talk, teams were monitored by an intercom.

At the end of the third practice trial, the simulation was paused and participants were instructed to take 5 more minutes to read over their instructions. After 5 minutes, the general task instructions were taken from participants and they were asked to turn their specific role instruction sheets face down. At this time, they were given a questionnaire that tapped their task knowledge, reactions to the previous training, and performance expectations for use in research unrelated to this study. Once these measures were collected, participants were again allowed to refer to their role instruction sheets. The simulation was started and teams were left to work on their own. Once the team has completed all trials in the simulation, they were asked to complete a questionnaire as part of an unrelated study, and then were debriefed and dismissed.

Measures

Participation Equality

Participation equality was measured as the standard deviation of total communications (queries, transmits, messages) sent by members within the team. A log transformation was performed to normalize the distribution of these standard deviations before using them in the analyses.

Team Informity

Team informity involved measuring for each trial the proportion of information obtained by all staff members relative to the information needed by those members to perform their specific roles. For example, if CAD needed range and corridor status, AWACS direction and angle, and Cruiser IFF and radar (see Appendix A), but each only obtained one of the two pieces of information, then as a team they only obtained 50% of the necessary information and thus received a score of .50 on decision informity. These

decision informity scores were then averaged across all trials to obtain a measure of team informity.

Staff Validity

Staff validity was operationalized as the average correlation between staff members' recommendations and the correct team decision (true score). Each member performed 33 trials, responding to either 33 aircraft or 33 infants. For each trial, every member made a recommendation regarding the decision object. Failure to reach a decision in time was considered a "no call" decision which was equated with the least aggressive decision in the respective task ("ignore" or "release"). The decisions were scored on an ordinal scale from "1" for the least aggressive to "7" for the most aggressive action (see Table 2). Each decision object had a predetermined correct value based on the values assigned to informational cues and the rules for combining those cues. The recommendations of each staff member were correlated with the true scores over all trials to produce individual validity scores. At the end of the session, three such validities (one for each staff member) were calculated, and then these individual validities were averaged to obtain a measure of team staff validity.

Hierarchical Sensitivity

Hierarchical sensitivity was determined by comparing two regression equations. One involved regressing the correct decision on the staff members' recommendations, the other regressing the leader's decision on those recommendations. The regression weights were then compared across these two equations to assess the appropriateness of the weights assigned to each member by the leader. Hierarchical sensitivity was then

Table 2
Outcome Matrix for Determining Team Decision Accuracy

	Correct decision						
Decision recommendation	1	2	3	4	5	6	7
1. Ignore / Release	0	1	2	3	4	5	6
2. Review / Downgrade	1	0	1	2	3	4	5
3. Monitor / Monitor	2	1	0	1	2	3	4
4. Warn / Incubate	3	2	1	0	1	2	3
5. Ready / Therapy	4	3	2	1	0	1	2
6. Lock-on / Medicate	5	4	3	2	1	0	1
7. Defend / Operate	6	5	4	3	2	1	0

measured by computing the average of the difference in beta weights across staff members. A smaller value reflects better hierarchical sensitivity.

Team Decision Making Accuracy

Team decision accuracy was assessed by comparing the team's decision to the correct decision for each trial. The correct decision, or true score, was determined using an equation which represented the set of rules on which decisions were based. These rules describe weighting schemes for combining the cues into an overall evaluation. For example, in the military task, the "movement rule" stated that an aircraft with high speed, descending at a sharp angle and coming at a straight direction toward the carrier ship should be considered highly threatening. The equation was applied to the values assigned to the cues (e.g., speed of 700 mph) to determine the true score for each aircraft or infant. The output of the equation was scaled from 1 to 7 to represent the seven decision alternatives (see Table 2). Difference scores were computed between the team's decision and correct decision for each trial. The differences were then averaged across all trials to obtain an overall measure of team decision accuracy.

Sex Composition

Sex composition is treated as two variables in the analyses, one that represents the homogeneity of the team and the other which represents whether the team is male or female-dominated. This allows both differences between same and mixed-sex teams, as well as differences between teams with male and female majorities to be addressed. Each of these variables was contrast coded (.5, -.5) for the analysis based on Cohen and Cohen (1983). That is, homogeneity was coded -.5 for same-sex teams and +.5 for mixed-sex

teams. Teams were coded -.5 if they were dominated by male members and +.5 if they were female-dominated.

RESULTS

The means, standard deviations and correlations for all of the variables are presented in Table 3. Some basic relationships among the variables are readily observed from the correlation matrix. Of the two sex composition variables, only dominance is significantly related to any of the decision making processes or performance. These correlations suggest that, in general, male-dominated teams performed better on team informity, staff validity and hierarchical sensitivity than female-dominated teams. The sex-linkage of the task is significantly correlated with participation equality and staff validity. The three core variables from the multilevel theory are each significantly related to team decision accuracy, and also exhibit significant relationships with one another. Participation equality, however, is not related to any of these variables or team decision accuracy.

Hierarchical moderated regression analyses were used because the goal was to understand the relationship between sex composition and the decision making variables rather than simply to identify mean differences between groups. Regression was also useful for testing both the individual hypotheses and the overall theory. For each dependent variable, the main effects for task sex-linkage, composition homogeneity, and dominance were entered first, followed by the two-way and three-way interactions. The variables of homogeneity and dominance were contrast coded as described above. Task

Table 3
Means, Standard Deviations, and Intercorrelations Among Variables (N=87)

Variable	M	SD	1	2	3	4	5	6	7	8
1. Task sex-linkage	1.50	.50	--							
2. Homogeneity	0.03	.50	-.01	--						
3. Dominance	0.04	.50	.01	-.04	--					
4. Participation equality[a]	3.61	.68	-.33***	.06	-.08	--				
5. Team informity	0.54	.21	.03	-.13	-.33***	.13	--			
6. Staff validity	0.48	.12	-.20*	-.03	-.21**	-.01	.39***	--		
7. Hierarchical sensitivity[a]	0.18	.08	.08	.07	.20*	-.09	-.23**	-.21**	--	
8. Team decision accuracy[a]	1.21	.21	-.05	.09	.09	.12	-.46***	-.62***	.36***	--

[a] A lower value on this variable represents a better score.

* $p < .10$. ** $p < .05$. *** $p < .01$.

sex-linkage was dummy coded with 1 representing the male-linked task and 2 for the female task. The results of the hierarchical regression analyses are summarized in Table 4 and described in detail below.

Participation Equality

It was hypothesized that same-sex teams would participate more equally than mixed-sex teams, and that male-majority teams working on the male task and female-majority teams working on the female task would participate the least equally. The analyses revealed a significant main effect for task ($\Delta R^2 = .11, p < .01$) with the direction of this effect indicating that teams participated more equally on the female than the male task. There were also significant interaction effects for task and homogeneity ($\Delta R^2 = .04$, $p < .05$), and for dominance and homogeneity ($\Delta R^2 = .06, p < .01$). An interpretation of the interaction of task and homogeneity revealed that same-sex teams participated more equally than mixed-sex teams on the male task, but on the female task mixed-sex teams participated more equally (see Figure 8). There was more variance in participation equality across tasks for mixed than same-sex teams. A plot of the interaction of dominance and homogeneity showed that although all-female teams participated more equally than all-male teams, there was more equal participation in male-majority than female-majority teams (see Figure 9). Comparing these findings to the hypothesized relationships (see Figure 3), there were differences between same-sex as well as mixed-sex teams in that all-female teams participated more equally than all-male teams. Further, the task only moderated the influence of the team's homogeneity not its dominance by male or female members.

Table 4

Summary of Hierarchical Regression Analyses for all Dependent Variables (N=87)

Step	Independent Variable	Total R^2	ΔR^2	Total R^2	ΔR^2	Total R^2	ΔR^2	Total R^2	ΔR^2	Total R^2	ΔR^2
		Participation equality		Team informity		Staff validity		Hierarchical sensitivity		Team decision accuracy	
1	Task sex-linkage (T)	.11***	.11***	.00	.00	.04*	.04*	.00	.00	.00	.00
2	Homogeneity (H)	.11***	.00	.02	.02	.04*	.00	.01	.01	.01	.01
3	Dominance (D)	.12***	.01	.13***	.11***	.09**	.05**	.05*	.04*	.02	.01
4	T x H	.16***	.04**	.13***	.00	.09**	.00	.05*	.00	.02	.00
5	T x D	.17***	.01	.16***	.03	.09**	.00	.05*	.00	.02	.00
6	H x D	.23***	.06***	.18***	.03	.09**	.00	.09**	.04*	.03	.01
7	T x H x D	.25***	.02	.23***	.05**	.09**	.00	.09**	.00	.03	.00

* $p < .10$. ** $p < .05$. *** $p < .01$.

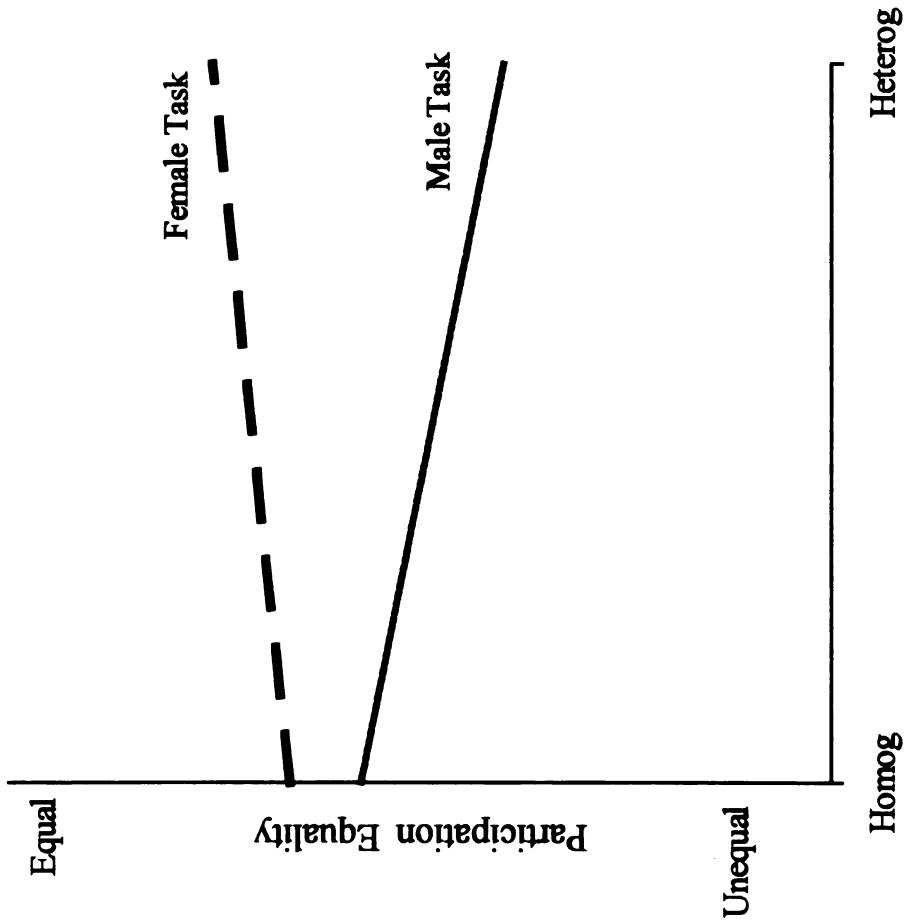


Figure 8. Interaction of task sex-linkage and homogeneity on participation equality.

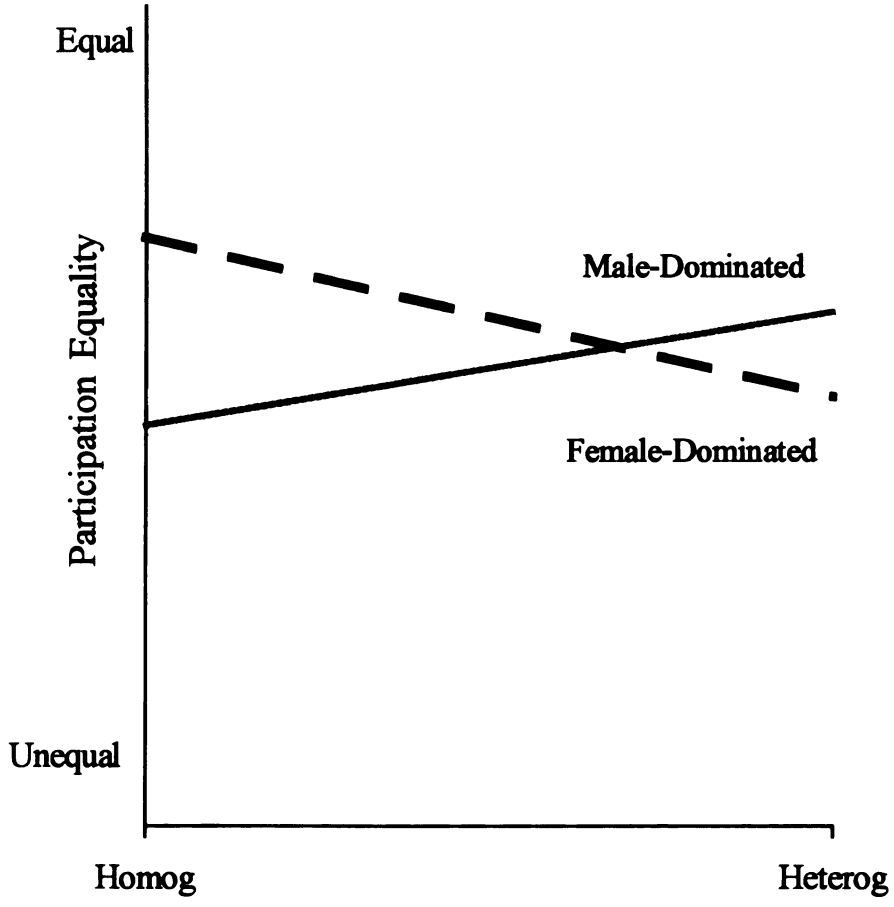


Figure 9. Interaction of dominance and homogeneity on participation equality.

Team Informity

Next, it was hypothesized that all-male teams would have higher team informity than all other compositions, except for all-female and male-majority teams working on the female task. Male-majority teams were expected to have the lowest informity on the male task and female-majority teams the lowest informity on the female task. A significant main effect for dominance ($\Delta R^2 = .11, p < .01$) and a significant three-way interaction of dominance, homogeneity, and task sex-linkage ($\Delta R^2 = .05, p < .05$) was found. Overall, team dominated by males (i.e., all-male and male-majority teams) had higher informity than those dominated by females (i.e., all-female and female-majority teams). This effect, however, was dependent on the task and the team's homogeneity (see Figure 10). On the female task, male-dominated teams had higher team informity than female-dominated teams, regardless of homogeneity. On the male task, however, all-male teams had higher team informity than all-female teams, but the inclusion of a single female member in the team resulted in a significant decrease in informity such that male-majority teams were less informed than all-male teams. At the same time, the inclusion of a single male in female-dominated teams led to an increase in team informity in comparison to all-female teams. These results are consistent with the hypothesized relationships (see Figure 4), with the exception that all-female teams had lower team informity than predicted for the female task.

Staff Validity

It was proposed that all-male and female-majority teams would have higher staff validity than all other teams, except for all-female teams working on the female task. There was a marginally significant effect for the task ($\Delta R^2 = .04, p < .10$), and a

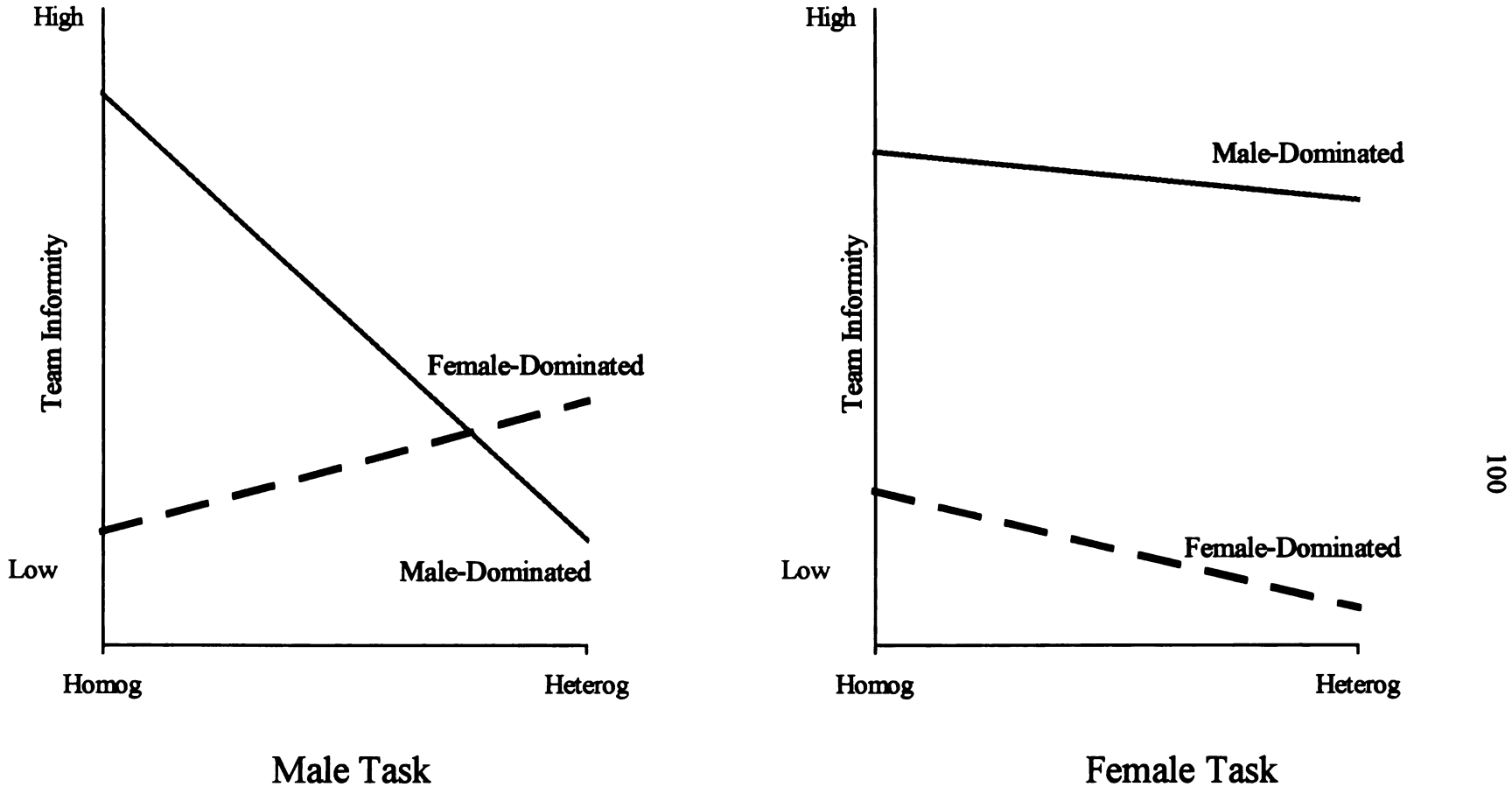


Figure 10. Interaction of dominance, homoegeneity, and task sex-linkage on team informity.

significant effect for dominance ($\Delta R^2 = .05, p < .05$). The direction of these effects indicated that teams generally had higher staff validities when working on the male than the female task. Further, male-dominated teams had higher staff validities than female-dominated teams. None of the predicted interactions were significant.

Hierarchical Sensitivity

The hypothesis regarding hierarchical sensitivity suggested that, overall, same-sex teams would have better hierarchical sensitivity than mixed-sex teams. Male-majority teams were predicted to have the poorest sensitivity on the male task and female-majority teams the poorest sensitivity on the female task. There were marginally significant effects for dominance ($\Delta R^2 = .04, p < .10$), and for the interaction of homogeneity and dominance ($\Delta R^2 = .04, p < .10$). Male-dominated teams had better hierarchical sensitivity than female-dominated teams. The dominance effect, however, was greater in homogeneous than heterogeneous teams. That is, all-male teams had better hierarchical sensitivity than all-female teams, but there was little difference in the hierarchical sensitivity of male-majority and female-majority teams (see Figure 11). Contrary to the hypothesized effects (see Figure 6), there were differences between all-male and all-female teams rather than differences between male and female-majority teams, and there was no apparent advantage for same-sex teams in terms of hierarchical sensitivity.

Team Decision Accuracy

Based on Hypotheses 1 through 4, it was proposed that same-sex teams would make more accurate decisions than mixed-sex teams. Male-majority teams were expected to have the lowest team decision accuracy on the male task, and female-majority teams the

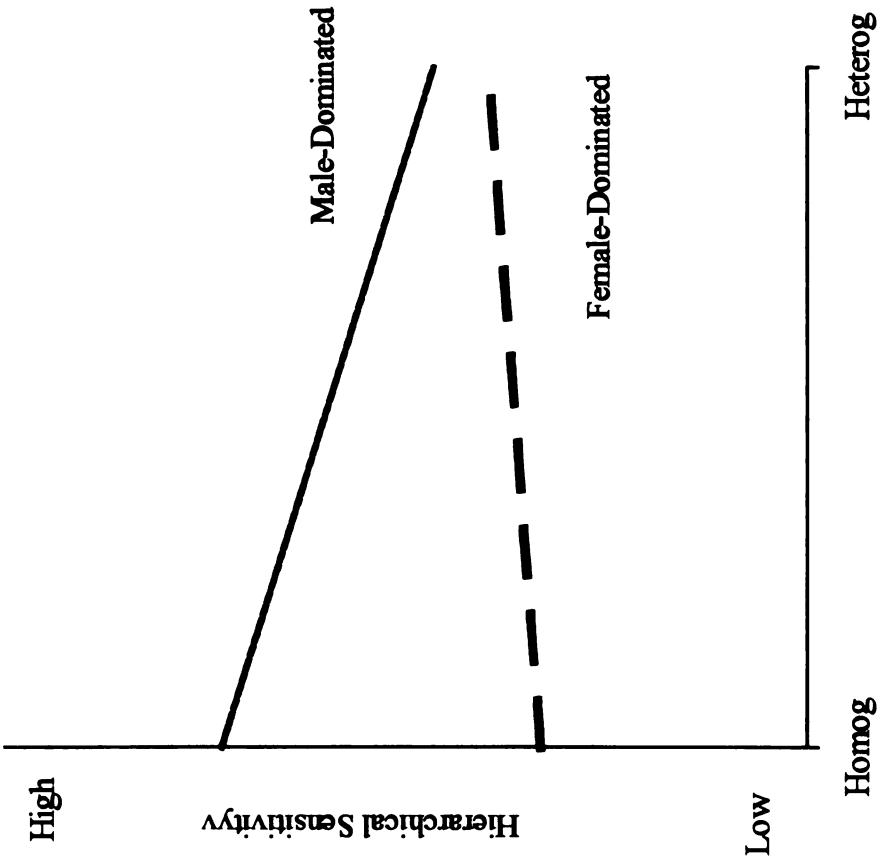


Figure 11. Interaction of dominance and homogeneity on hierarchical sensitivity.

lowest on the female task. Neither of the composition factors or the task sex-linkage had a significant effect on team decision accuracy (see Table 4).

The Multilevel Theory

Hypothesis 5, which predicted composition and task effects on team decision accuracy, was based on the assumption that the four decision making processes were related to performance. Each core variable was entered into the regression equation followed by their two-way interactions.[3] The interactions were included based on previous research that found some interactions among the core variables (e.g., staff validity x hierarchical sensitivity) to account for additional variance in decision accuracy. Result of the regression analysis showed that each of the decision making variables was significantly related to team decision accuracy and together with their interactions accounted for 52% of the variance in decision accuracy (see Table 5). A significant interaction effect was found for team informity and hierarchical sensitivity and was interpreted to indicate that teams were most accurate when they had both high team informity and hierarchical sensitivity (see Figure 12). Interestingly, these were also the two core variables most affected by sex composition and the task. The mediational role of the core constructs was not examined since neither sex composition or task sex-linkage had a significant effect on team decision accuracy.

Table 5
Regression of Team Decision Accuracy on the Core Decision Variables (N=87)

Step	Independent Variable	Total R^2	ΔR^2	β
1	Team Informity (TI)	.21**	.21**	-.39
2	Staff Validity (SV)	.43**	.22**	-.54
3	Hierarchical Sensitivity (HS)	.47**	.04*	-.68
4	TI x SV	.48**	.01	-.33
5	TI x HS	.51**	.03*	.52
6	SV x HS	.52**	.01	.49

* $p < .05$. ** $p < .01$.

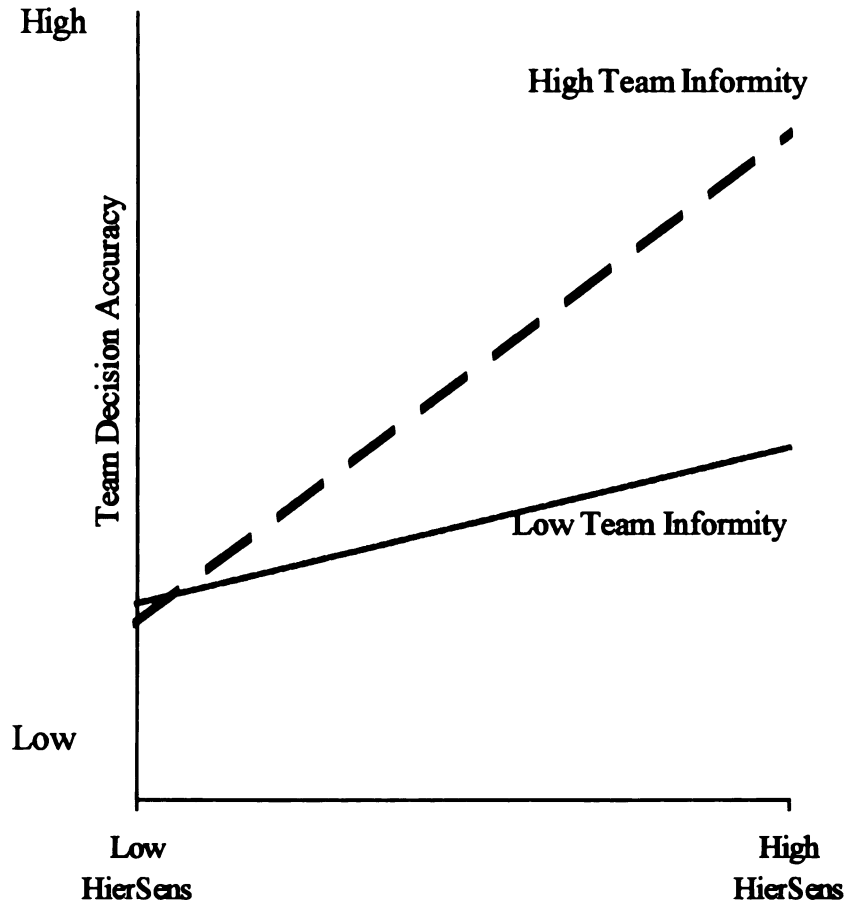


Figure 12. Interaction of team informity and hierarchical sensitivity on team decision accuracy.

DISCUSSION

The purpose of this study was to examine the effects of changing configurations of males and females on group processes and performance. Same-sex teams and teams with a single male or single female were compared on several variables identified as relevant to decision making effectiveness in teams characterized as hierarchical with distributed expertise. Numerous inconsistencies in the literature suggest that sex composition effects are complex and may depend on the influence of other variables. The sex-linkage of the task was examined as a potential moderator of the effects of sex composition based upon several studies that found different composition effects across tasks. In addition, changes in composition are arguably more visible in fields traditionally dominated by one sex.

The sex composition of a team affected all four decision making variables. The dominance factor had a consistent and significant effect on team informity, staff validity, and hierarchical sensitivity indicating that male-dominated teams (i.e., all-male and male-majority teams) were generally higher than female-dominated teams (i.e., all-female and female-majority teams) on all three variables.

The dominant sex of the team also interacted with team homogeneity to affect participation equality and hierarchical sensitivity. For participation equality, this interaction indicated that in same-sex teams, all-female teams participated more equally than all-male teams, but in mixed-sex teams the opposite occurred. That is, male-majority

teams participated more equally than female-majority teams. The interaction of dominance and homogeneity produced a different effect on hierarchical sensitivity in that the male advantage occurred primarily in same-sex teams. All-male teams had better hierarchical sensitivity than all-female teams, but there was little difference in the hierarchical sensitivities of male-majority and female-majority teams. This effect seemed to be attributable to the lower hierarchical sensitivity of male-majority compared to all-male teams.

The task sex-linkage moderated the effects of composition for the variables of participation equality and team informity. For participation equality, mixed-sex teams participated more equally than same-sex teams when working on the female task, but less equally when working on the male task. For team informity, there was a significant three-way interaction among the task, dominance, and homogeneity factors. On the female task, teams dominated by males had higher team informities than those dominated by females regardless of the team's homogeneity. On the male task, however, male-majority teams had substantially lower team informities compared with all-male teams, and female-majority teams had slightly higher team informities compared with all-female teams.

The task also had unexpected direct effects on participation equality and staff validity. The nature of these effects were such that team members generally participated more equally on the female than the male task, but they generally had higher staff validities on the male than the female task.

Although the task and composition affected the core decision processes, there were no significant effects on team decision making accuracy. Several possible reasons for this will be explored. First, a more detailed discussion of the composition and task

effects on each of the four decision making variables is provided, including attempts to identify some underlying causes of the observed effects.

Participation Equality

For participation equality, there was no general dominance effect as there was with the other three decision making variables. Instead, there were differences between male and female-dominated teams which varied depending on the team's homogeneity. All-female teams participated more equally than all-male teams, but there was more equal participation among male-majority than female-majority teams.

The observed difference between all-male and all-female teams was not predicted although it was not inconsistent with previous findings in the literature. Some researchers have found that male teams tend to exhibit more stable patterns of dominance than female teams (e.g., Aries, 1976). That is, certain members emerge as dominant and maintain that position throughout the team's existence. Female team members are more likely to share positions of dominance. The sharing should result in a more equal distribution of participation over the lifespan of a team. Based on existing knowledge, it is reasonable to find that all-female teams participated more equally than all-male teams.

The more puzzling finding is that this difference did not transfer to mixed-sex teams. Male-majority teams were observed to participate more equally than female-majority teams. The change in composition from all-female to female-majority reduced participation equality, but the change from an all-male to a male-majority composition led to more equal participation. This raises the question of how the inclusion of a single member of the opposite sex affected the distribution of participation among team members, and why did this effect differ for predominantly male and female teams.

Individual Participation Rates

The effect of sex composition on participation equality was further explored by examining the individual participation rates of team members within different compositions. Specifically, the participation rates of males and females were compared across compositions (see Figure 13). There was a significant sex difference in participation rates for same-sex teams with males participating at a higher rate than females. This sex difference did not consistently emerge across compositions. In mixed-sex teams, there was a significant interaction effect for sex and dominance which indicated that males participated more than females in female-majority teams but not in male-majority teams. One possible explanation for the higher participation of males in female-majority teams is that the single male may have assumed a dominant position and the majority females more submissive positions in the team. The differences in male and female participation rates for across compositions appears to explain the differences in participation equality observed at the team level. Male-majority teams experienced more equal participation than female-majority teams because males and females differed less in their participation rates.

Task Effect

In addition to the composition effects on participation equality, there were significant effects involving the sex-linkage of the task. There was a significant main effect for the task indicating that teams participated more equally on the female than the male task. This effect was larger in mixed-sex than same-sex teams as reflected by the significant interaction of homogeneity and task. Mixed-sex teams participated more equally on the female task but less equally on the male task than same-sex teams.

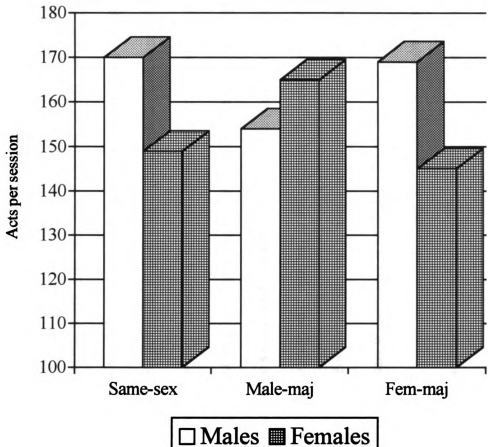


Figure 13. Individual participation rates for males and females by composition.

One possible explanation for this finding is that the discrepancy between male and female participation rates within mixed-sex teams was greater on the male than the female task. The mean participation rates for males and female working on the male task are 177 and 166 acts per session respectively, and for the female task 139 and 134 respectively. Although there appears to be a larger difference in participation rates between males and females on the male task, this effect was not significant. However, there was a significant task effect indicating that team members consistently participated at a higher rate on the male than the female task, and a significant effect for member sex which revealed that males generally participated more than females.

Since the male-female differential in participation rates did not appear to readily explain the observed interaction effect of the task and homogeneity, it was necessary to focus on understanding the influence of the task. The observed task effect on participation equality may be attributable to the lower participation rates of staff members when working on the female as compared to the male task. The question is why did the task have such an effect on individual members' behaviors. One suggestion is that the difference in task orientation often attributed to males and females may transfer to tasks which are differentially associated with the sexes. If participants behave in a manner consistent with the sex-linkage of the task, both males and females may appear more task-oriented on male than female tasks. Since the majority of participation in this study can be categorized as task-oriented, the higher participation rates on the male task may reflect a higher task-orientation associated with the male than the female task.

Another possible explanation is that the male task motivated members to participate more because it was more interesting than the female task. Whatever the

reason is for the lower participation levels of individuals working on the female task, it likely reduced the amount of variance in staff members' participation, which resulted in the more equal participation observed at the team level. Such an effect may be greater in mixed-sex teams because they have more potential to vary in their distribution of participation, which would provide a possible explanation for the observed interaction of the task and homogeneity.

Team Informity

Two significant effects were observed for team informity: a main effect for dominance and a three-way interaction of dominance, homogeneity, and the task. Potential explanations for the dominance effect are discussed, followed by an examination of the interaction effect.

Dominance Effect

Teams dominated by male members generally had higher team informity than those dominated by female members. Possible explanations for this effect may exist at different levels of analysis. At the team level, certain compositions may foster a more productive environment and increase the amount of information obtained by members. There may also be individual differences between males and females which leads teams dominated by male members to outperform those dominated by females.

In terms of team level explanations, researchers have found different compositions to vary in their task-orientation (Piliavin & Martin, 1978) and competitiveness (Aries, 1976). Aries found, for example, that all-male teams exhibited a sense of competitiveness which was not observed in other compositions. In the present study, teams dominated by male members may have been more competitive than those dominated by females,

resulting in greater effort to obtain task-relevant information. A competitive attitude was in fact observed in all-male teams in the form of verbal outbursts in reaction to successful outcomes (i.e., "hits"), and not so successful outcomes (i.e., "disasters"). This was in spite of the fact that members were instructed to communicate solely through typewritten messages. Unfortunately, no comparable expression to these verbal outbursts appeared in the typewritten messages, and, therefore, this observation could not be tested.

Although team level explanations seem reasonable, there remains the possibility that the dominance effect reflects an individual sex difference. If this is the case, differences should exist in the amount of information acquired by males and females regardless of the composition. An examination of the informity scores of individual team members[4] revealed a significant sex difference such that males were more informed than females (M = .68 and .48 respectively, $p > .01$). The question becomes why did males have higher informity scores than females?

It is widely believed that males are more task-oriented than females (Eagly, 1987). One possible explanation is that males focused more of their time on task-relevant activity and became more informed than females. There is research, however, that contradicts the higher task-orientation of males and suggests that the difference in task-orientation between males and females may depend on other factors (Johnson & Schulman, 1989; Mabry, 1989). Both the composition and task are factors that have been suggested in the literature. The influences of both variables are discussed in detail below, but one aspect of the task deserves mention here. The general task, regardless of its sex-linkage, was a computer simulation. It can be argued that males are generally more interested and familiar with computer games. Therefore, males may have been more adept at using the

computer to obtain information or may have simply enjoyed working on the task more than females. This could have contributed to their higher informities.

An individual sex difference may explain the dominance effect on team informity, but members could not attain high informity by acting independently. Some of the information had to be received from other team members. This suggests that a combination of individual and team level explanations may best characterize the results obtained here. For example, males may initially be more interested in the task than females, and by working with other males they become more motivated and involved in the task.

Interaction of Task, Dominance, and Homogeneity

The higher team informity of male-dominated teams did not hold across all conditions. For the male task, male-majority teams had lower informity scores than all-male and female-majority teams. In other words, the inclusion of a single female in a predominantly male team seemed to suppress the general male advantage indicated by the dominance effect.

Two aspects of this effect deserve explanation. First, why did male-majority teams experience a substantial decrement in team informity compared to all-male teams? Second, why did this only occur on the male version of the task? One potential explanation is that the single females in male-majority teams did not receive relevant information from other members and lowered the team's overall informity. The extent to which this occurred could be tested by examining the informity scores of individual team members within the different composition and task conditions.

Figure 14 shows the individual informities of male versus female members by task and composition. This data reveals that on the male task, males rather than females were negatively affected by the male-majority composition. Further, males working in male-majority teams were less informed than the those working in all-male teams. This effect did not occur on the female task. Instead, the individual informities of males were higher in the male-majority than in the all-male condition. Majority males were not negatively affected by working with a single female on the female task as they were on the male task. In addition, the single female members were more informed than females in any other condition (see Figure 14).

One possible explanation for the differences found for male-majority teams across the two tasks is that a single female working on a male task stands out as incongruent and draws more attention than a single female working on a female task. This is consistent with the distraction theory, referred to by Craig and Sherif (1986) as the "rooster effect," in which males shift their attention from the task to the female. In this study, the males may have directed their attention to the female member rather than obtaining important task-related information.

An alternative explanation is that the presence of a single female affected the motivation of team members. On the female task, the single female may be viewed as an asset, raising the performance expectations and motivations of the team. But on the male task she may be viewed as a liability, lowering members' expectations and motivations.

It is interesting to note that members of female-dominated teams also experienced different levels of informity as a function of the composition and task. In female-majority teams, both male and female members had low individual informities when working on the

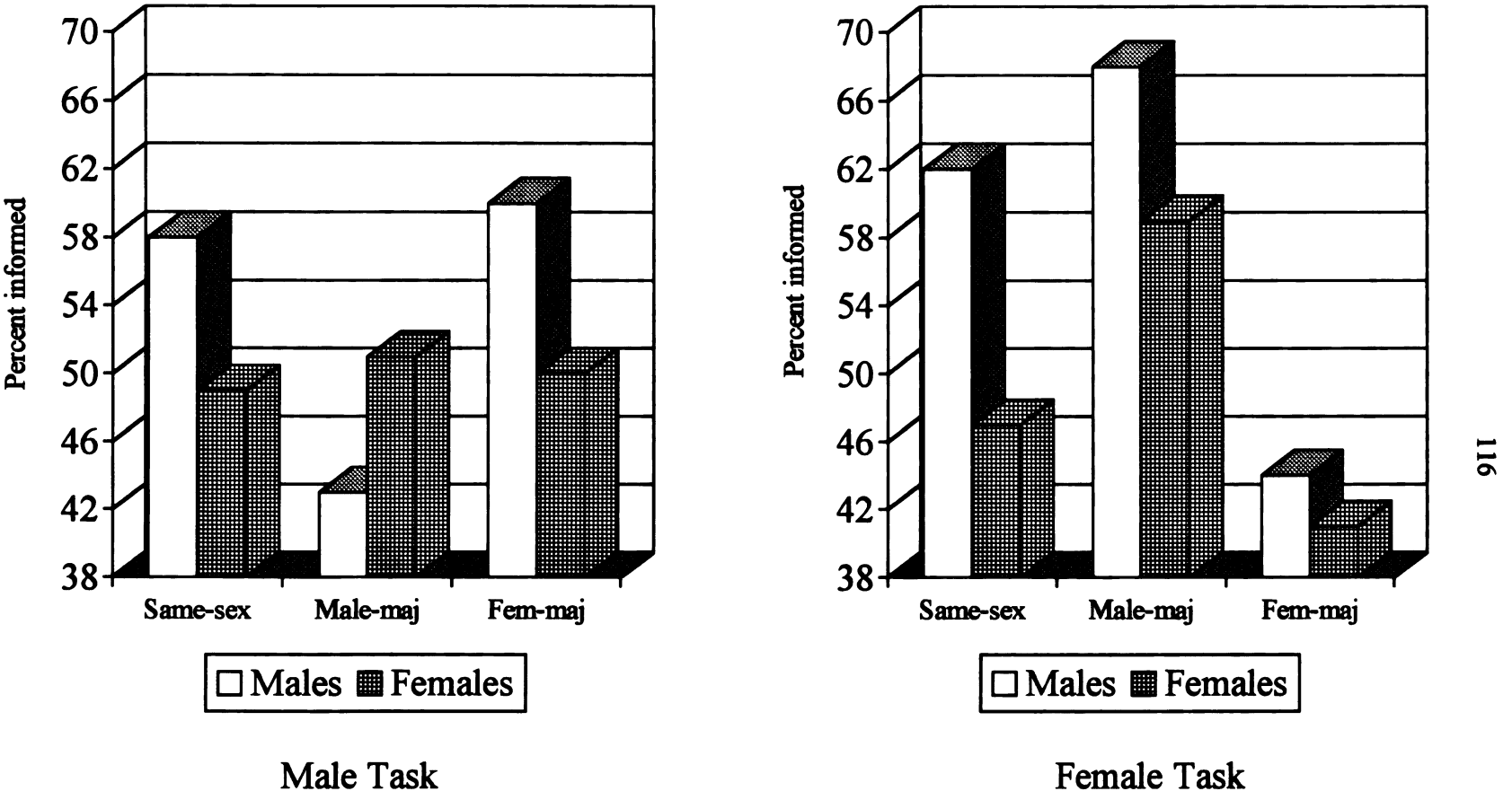


Figure 14. Individual informities of males and females by composition and task.

female task. On the male task, however, females had comparable informities to other compositions, but the single male members were more informed than in all-male or male-majority conditions (see Figure 14).

These findings suggest that male and female teams are similarly affected by changes in composition when it comes to informity. When the sex of the minority member is inconsistent with the task, staff members become less informed. But when that member's sex is consistent with the task, staff members appear to respond more positively. Further research is needed to identify whether these changes in behavior are attributable to attentional or motivational factors. These behavioral changes do help explain the interaction effect whereby male-majority teams experienced lower team informity than all-male teams on the male but not the female task.

Staff Validity

For staff validity, which measures how well team members' recommendations predict the correct team decision, there were no differences between same and mixed-sex compositions. Composition did affect staff validity in that teams dominated by male members had higher staff validities than those dominated by females. As with team informity, this dominance effect may be attributable to individual as well as team level sources. Although obtaining information was somewhat dependent on the actions of other team members, evaluating that information was a fairly independent activity given the task's structure. It is reasonable to expect that the difference found between male and female-dominated teams may reflect an underlying sex difference. In fact, the mean individual validities of males and females regardless of composition or task were .52 and .45 respectively ($p < .01$).

Individual Sex Differences

A reasonable explanation for the higher validities of males is that they were better able to process the information in the form it was presented. The task can be characterized as a multiple cue probability task in which members are required to interpret numerical values according to decision rules. Numerous researchers have proposed the existence of sex differences in specific cognitive abilities. For example, Hyde, Fennema, and Lamon (1990) suggest that males are better at problem solving than females. However, it is impossible to conclude that the differences observed in this task were due to a sex difference in cognitive ability without further research. A study of individuals working independently on the same decision making task found no significant difference between males and females (M = .67 and .68 respectively), thus questioning the accuracy of this explanation.

Another alternative explanation for the difference observed between the validities of males and females. Validity involved not only evaluating one's information, but also choosing a recommendation from seven decision alternatives. These decision alternatives ranged on a continuum from least to most aggressive action. The least aggressive decision reflected either ignoring the aircraft or releasing the newborn. The most aggressive action was to defend against the aircraft or to operate on the infant. A fairly well-established difference between males and females has been found for aggressiveness. That is, males are generally more aggressive and assertive than females (Maccoby & Jacklin, 1974). This difference may have emerged in the use of decision alternatives such that males made more aggressive decisions more often than females.

Unlike differences in ability, differences in the use of decision alternatives can be tested with the present data. The frequency with which males and females used each of the seven decision alternatives were compared (see Figure 15). Females were more likely than males to use alternatives 3 and 4 which reflect moderate courses of action (e.g., monitoring the infant's health or aircraft's threat). The more aggressive alternatives (5 through 7) were more frequently used by males.

These differences could have affected validities in two primary ways. First, the recommendations of females may have been less predictive of the correct decision simply because they were less willing to use the more aggressive decision alternatives. Second, the use of the moderate decision alternative can also be considered less risky since it reduces one's degree of inaccuracy (see Table 2). For example, in choosing alternative 4, the most alternatives one can be from the correct decision is three. If one selects alternative 6, it is possible to be five alternatives from the correct response. By choosing less risky decision alternatives females may have reduced their inaccuracy, but at the same time constricted the variance in their decisions and lowered their validities.

The data on use of decision alternatives provide evidence that males and females differed in a way that could have affected their validities. They do not, however, rule out the possibility of team level influences. Differences in riskiness or aggressiveness may be fostered by team environments, particular those dominated by one sex or the other. Bauer and Turner (1974) found that all-male teams were riskier in their decision making than all-female teams. Therefore, characteristics of the team may have contributed to the difference observed between males and females in their use of decision alternatives.

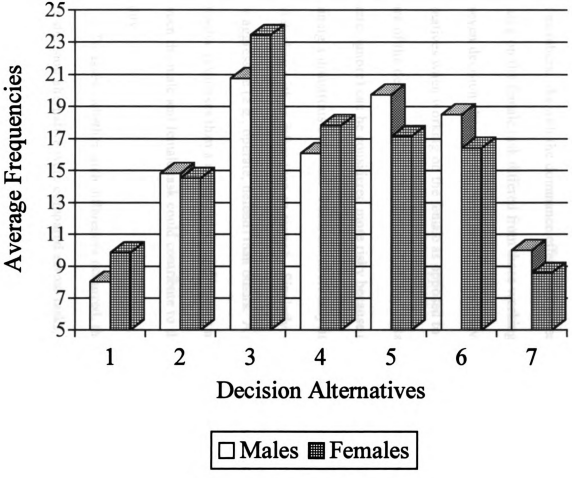


Figure 15. Frequencies in use of decision alternatives for males and females.

Task Effect

In addition to the dominance effect on staff validity, there was a direct task effect indicating that teams had lower staff validities on the female than the male task. This finding suggests an unexpected task difference that affected the recommendations made by staff members. As with the dominance effect, one potential explanation is that teams working on the female task differed from those working on the male task in their use of the seven decision alternatives. Staff members may have chosen less risky decision alternatives when working on the female as opposed to the male task simply due to the nature of the decision object. As discussed above, certain decision alternatives (e.g., operate, ignore) can be considered more risky because they increase the probability of obtaining a disastrous outcome. Team members may have been less willing to risk disaster when dealing with an infant than an aircraft. Similarly, some alternatives can be viewed as more aggressive (e.g., operate, defend) than others. A military task may simply elicit more aggressive responses than a nursing task. Differences in the use of decision alternatives between the male and female task could contribute to the observed task effect on staff validity.

To assess whether such differences occurred, the frequency of using each of the seven decision alternative were compared across tasks. As shown in Figure 16, members appeared to make more conservative recommendations about twice as often as risky ones, but there was no significant difference between the two tasks in the use of risky or aggressive decision alternatives. Therefore, task differences in staff validity do not appear to be attributable to differences in the use of decision alternatives by staff members.

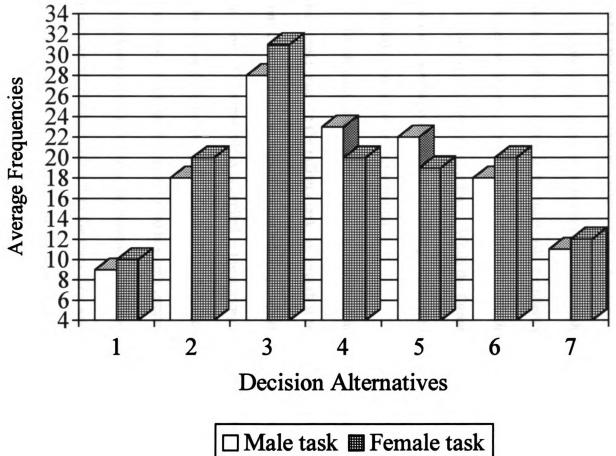


Figure 16. Frequencies in use of decision alternatives for the male and female tasks.

Since differences did not occur in the use of decision alternatives, the only other feasible explanation is that members were better able to make valid recommendations on the male than the female task. There is reason to suspect that the information on the male task was easier to evaluate and combine into a decision recommendation than information on the female task. Information in the male task may have been more intuitive than in the female task.[5] For example, in the male task, members were asked to combine speed, angle and direction into a judgment, and in the female task they were asked to combine heart rate, blood pressure and temperature. While the former closely resembles the way information is interpreted by actual military teams, the latter does not accurately depict the way nursing staffs process information.

In addition, the way information is combined may have impeded members working on the female task. In the military task, an aircraft is to be considered non-threatening if any one characteristic in a combination rule (e.g., speed, angle or direction) is non-threatening. The same rule was applied in the nursing task. However, an infant's health may be considered in danger if any one of the characteristics poses a threat. A nurse typically does not ignore an infant who has high temperature and blood pressure even with a normal heart rate. Therefore, the judgments staff members made may have reflected their own interpretations rather than the rules they were instructed to use.

This raises the question of whether there were differences in familiarity with the two tasks. Many of the computer and video games that students play involve some type of conflict, including military combat. One would be hard pressed, however, to find a nursing game in an arcade or on a home computer. The general familiarity with military games could explain the higher validity of members who worked on the male task in this

study. Their prior experiences may have led them to more easily interpret the military-related data than the information about the health of newborns.

There are a number of feasible explanations for the dominance and task effects on staff validity. Post hoc analyses suggested that the difference between male and female-dominated teams is likely attributable to differences in the decision alternative used by males and females. Unfortunately, the data does not similarly account for the difference between the male and female tasks. Prior experiences and expectations may be the most logical explanation for the task's effect on staff validity.

Hierarchical Sensitivity

The task had an effect on all three variables previously discussed, but the effects on hierarchical sensitivity were limited to the composition variables. There was a direct effect for dominance which revealed that teams dominated by male members generally had higher hierarchical sensitivities than those dominated by females. This effect was dependent on the team's homogeneity such that differences between male and female-dominated teams were greater in same than mixed-sex compositions. In other words, all-male and all-female teams differed more in terms of hierarchical sensitivity than male-majority and female-majority teams.

Male and Female Leaders

As with team informity and staff validity, understanding the dominance effect may call for individual level explanations. Hierarchical sensitivity primarily captures the activities of the team's leader, that is, how effectively he or she uses staff members' recommendations. It is possible that the dominance effect reflects a difference between

male and female leaders. This again raises the issue that a general sex difference may have influenced team level results.

There are any number of factors that could explain the differences in hierarchical sensitivity. Male and female leaders may differ in their ability to attend to task-relevant information or to identify which staff members are more reliable than others. They may also differ in their decision making strategies. For example, female leaders may average staff members' recommendations while male leaders use a weighting scheme. While there is no data that directly measures the use of task-relevant or irrelevant information, it is possible to assess, to some extent, the use of different decision strategies.

If female leaders did use more of an averaging approach than male leaders there should be less variability in the weights they assign to staff members' recommendations. An examination of this data reveals no significant difference in the standard deviation of weights assigned by male and female leaders to their staff members (M = .15 and .16 respectively). Both male and female leaders appear to vary in the weights assigned to staff members. The apparent difference between male and female leaders is not readily explained. The interaction of dominance and homogeneity discussed next may provide some insight.

The difference in hierarchical sensitivity between male and female-dominated teams was less pronounced in mixed-sex teams. Male-majority teams had lower hierarchical sensitivity than all-male teams, which reduced the difference between male and female-majority teams. A better understanding of this effect requires determining how the sensitivities of male leaders were affected by the inclusion of a single female member in the team.

Dyadic Sensitivity

One way to address the question of why male-majority teams had lower hierarchical sensitivity than all-male teams was to examine the appropriateness of the weights assigned by a leader to individual staff members, which are referred to as dyadic sensitivities. The dyadic sensitivities for male and female staff members were compared across different compositions (see Figure 17). It was expected that leaders of male-majority teams would underweigh the recommendations of the single female, thus lowering their dyadic sensitivity. As shown in Figure 17, leaders of male-majority teams actually weighed the male staff members less appropriately than the single female members. More importantly, leaders weighed male staff members less appropriately in male-majority than in all-male teams.

Although there was little difference in the hierarchical sensitivities of all-female and female-majority teams, an examination of the dyadic sensitivities reveals an interesting effect. Leaders weighed female staff members more appropriately in female-majority than in all-female teams. However, they weighed the single male members far less appropriately than the female members. These effects apparently canceled out one another so that little difference emerged in the hierarchical sensitivity of female-majority and all-female teams.

The dyadic sensitivity data suggests that both male and female leaders were influenced by the sex of their staff members. The composition appears to have had a more substantial and negative influence on the sensitivities of male leaders. As proposed earlier with regard to team informity, a single female member may serve as a distraction to the rest of the team. A team's composition may influence where its members focus their

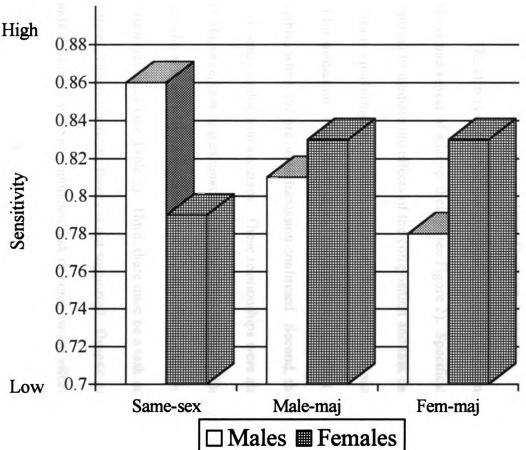


Figure 17. Dyadic sensitivities for males and females by composition.

attention and their ability to perform effectively. For example, all-male teams may be more task-focused than all-female or male-majority teams which assists the ability of leaders to effectively weigh staff members' recommendations. The difference between the hierarchical sensitivity of male and female-dominated teams may be attributable to both individual differences and team level influences. Identifying more specific explanations is a task for future research.

Team Decision Accuracy

The effects of the task and composition on the decision making variables only address one aspect of a larger theory (see Figure 2). Specifically, these variables were proposed to mediate the effects of the composition and task on the ultimate outcome of the team's performance, decision accuracy. Several conditions must be met in order to test for mediation. First, the task and composition must affect the core decision making variables which the previous discussion confirmed. Second, those variables must relate significantly to decision accuracy. These relationships were also confirmed by the data, with the exception of participation equality. That is, team informity, staff validity and hierarchical sensitivity each contributed to a significant portion of the variance in team decision accuracy (see Table 5). Third, there must be a task or composition effect to mediate. This is where the theory is not supported. Despite support for the first two conditions, there were no significant task or composition effects on decision accuracy. There was nothing to be mediated by the core decision making variables.

The lack of a task or composition effect on team decision accuracy is puzzling given the consistent dominance effect on the three core decision making variables. Although male-dominated teams appeared to have an advantage over female-dominated

teams in the decision making process, their final outcomes did not differ. There are several possible explanations for this discrepancy.

One possibility is that there was not enough statistical power to assess the significance of task or composition effects on decision accuracy. The percent variance accounted for by any of these factors or their interactions was no greater than 3%. Therefore, regardless of significance, there was no substantial relationship to be mediated by the core variables.

The next question is why did the composition effects on the core decision variables fail to transfer to an effect on decision accuracy? The most likely rationale is that female-dominated teams somehow compensated for their generally lower scores on team informity, staff validity and hierarchical sensitivity. It is possible that these variables failed to capture some process or processes that female-dominated teams were better at than male-dominated teams. For example, leaders of female teams may acted to offset the poor performance of their staff members.

Furthermore, other variables may influence decision accuracy without relating to the core variables. Previous research on hierarchical decision making teams has found some variables to have a direct effect on team decision accuracy after accounting for the core decision making variables (Hollenbeck et al., 1995). One variable that had a direct effect on decision accuracy was group cohesion. Thus, female-dominated teams may have positively influenced decision accuracy by being more cohesive than male-dominated teams. Other factors that female-dominated teams have been found to exhibit more than male-dominated teams include optimism and agreement (Kent & McGrath, 1969; Mabry, 1985). In addition, female-dominated teams in the present study participated more equally

than male-dominated teams. Participation equality, however, was not a significant predictor of decision accuracy. Although it is reasonable to expect that female-dominated teams may have outperformed male-dominated teams on variables like cohesion and agreement, it is unlikely that such variables would have a large enough influence on decision accuracy to offset the significant differences on the core decision making variables.

An alternative explanation for the comparable decision accuracy of male and female-dominated teams is that leaders of female teams somehow atoned for lower scores on the core variables in the process of making the final team decision. The results for hierarchical sensitivity indicated that female leaders weighed their staff members' recommendation less appropriately than male leaders. But they may have compensated for this by incorporating their own evaluation of the data into making the decision. The extent to which leaders weighed information in addition to staff members' recommendations was examined. This involved entering the nine attributes associated with the decision object into a regression equation following the three staff members' recommendations. There was no indication from this analysis that male or female leaders were influenced by information other than staff members' recommendations.

Since it appears unlikely that female-dominated teams could have easily compensated for lower team informity, staff validity and hierarchical sensitivity, it is possible that these teams used a different style of decision making which is not represented by the multilevel theory. In order to test the adequacy of the theory in explaining female team decision making, the relationship of the core variables to decision accuracy was tested separately for male and female teams.

As shown in Table 6, the core variables accounted for more variance in decision accuracy for female-dominated teams than for male-dominated teams (total R^2 = .61 and .53 respectively). However, a different pattern of relationships was found. In male-dominated teams, the best predictor of decision accuracy was team informity, while in female-dominated teams it was staff validity. For male teams, the key to decision accuracy was obtaining all the relevant information, but for female teams it was making good recommendations to the leader. In addition to this difference, hierarchical sensitivity was only a significant predictor in female-dominated teams, as was the interaction of team informity and hierarchical sensitivity.

Although these results do not answer the question of why male and female-dominated teams did not differ in decision accuracy, they do suggest that male and female teams arrive at their decisions through different processes. Further theory and research is needed to determine the potential differences between these processes.

Study Limitations

Although a number of interesting observations arose from this study, there remain many unanswered questions due, in part, to the limited contribution of the task sex-linkage and participation equality to the understanding of sex composition effects. Some potential problems with these variables are discussed next.

Task Sex-Linkage

With the exception of team informity, the sex-linkage of the task did not moderate the effects of composition as predicted. Differences were expected to primarily occur between male-majority and female-majority teams rather than between all-male and all-female, with the nature of these differences depending on the task sex-linkage. Instead,

Table 6
Regression of Team Decision Accuracy on the Core Decision Variables for Male and Female-Dominated Teams

Step	Independent Variable	Total R^2	ΔR^2	β
		Male-dominated teams (n = 40)		
1	Team Informity (TI)	.30**	.30**	-.32
2	Staff Validity (SV)	.46**	.16**	-.34
3	Hierarchical Sensitivity (HS)	.49**	.03	-.15
4	TI x SV	.51**	.02	-.79
5	TI x HS	.51**	.00	-.35
6	SV x HS	.53**	.02	.65
		Female-dominated teams (n = 47)		
1	Team Informity (TI)	.15**	.15**	-.61
2	Staff Validity (SV)	.44**	.29**	-.78
3	Hierarchical Sensitivity (HS)	.51**	.07*	-1.29
4	TI x SV	.52**	.01	-.35
5	TI x HS	.59**	.07*	.88
6	SV x HS	.61**	.02	.98

* $p < .05$. ** $p < .01$.

teams dominated by males had a general advantage over those dominated by females. One explanation for this effect is that the general structure of both tasks favored the decision making style of male teams. In other words, the female task may not have been as female-oriented as it was intended.

The nursing task was designed to be equivalent in structure and complexity to the military task in order to isolate the effects of stereotypes and avoid possible confounds of additional task differences. Unfortunately, the efforts that were made to ensure equivalency may have undermined the sex-linkage manipulation. The nursing task may have been de-feminized because it did not involve the characteristics typically associated with infant care (e.g., compassion, sensitivity). Even though the future practice of medicine may involve experts from remote locations who make decisions regarding patients over computer terminals, the form of medical care most people are familiar with involves hands-on treatment.

To avoid potential confounds, the tasks were piloted and modified to make sure that they were equal in difficulty. Although pilot testing did not reveal any significant differences, this was conducted using individuals. At the team level, the task was adapted to the hierarchical structure. Information was distributed according to staff members' expertise and the final decision was made by the leader. As suggested earlier, different processes may have been involved in female and male team decision making. When the task was adapted to the team level, the effort to develop a female-oriented task may have been compromised by a structure that was viewed as male-oriented. The trade-off in manipulating task sex-linkage is between creating equivalent, but perhaps superficial tasks, or developing realistic tasks which may differ in number of additional ways. The latter

creates potential confounds which can make it difficult to identify the exact cause of any observed effects.

In addition to generally failing to produce the intended effects, the task had some unexpected effects that suggest other problems with the sex-linkage manipulation. Teams participated more equally on the female task and had lower staff validities than on the male task. The difference in participation equality was attributed to the lower participation rates of members when working on the female task. It is not clear, however, why team members participated less on the female than the male task. The effect on staff validity appeared to indicate the tasks differed in difficulty. As suggested earlier, the nursing task may have been counter-intuitive and somewhat superficial to participants, making the task more difficult than the military task. Additionally, the military task may have been more interesting or familiar to participants given the wide availability of war-type games. This provides a reasonable explanation for both the lower participation and lower validities of participants who worked on the female as opposed to the male task.

Although there are potential limitations with the sex-linkage manipulation, there is evidence that the two tasks were viewed stereotypically. First, the task's influence on the individual informity of team members is consistent with the sex-linkage manipulation. Members of mixed-sex teams responded differently depending on the task. Their informities were higher when the single member's sex was consistent with the sex-linkage of the task and lower when it was inconsistent.

Second, the data on dyadic sensitivity provides support for the sex-linkage manipulation. Typically, the absolute difference between the weights assigned by the leader and the appropriate weight based on the correct decision is used to assess dyadic

sensitivity. However, one can also look at the direction of the weights to identify whether leaders underweigh or overweigh their staffs' recommendations (see Figure 18). These weights reveal that females were overweighed on the female task and underweighed on the male task. Similarly, males were underweighed on the female task, yet weighed fairly appropriately on the male task. These findings suggest that, at least from the leader's perspective, the task did influence members' perceptions. Females appeared to be viewed as more competent on the female task and males more competent on the male task. The sex-linkage manipulation may have had some of its intended effects on the perceptions of team members but not to the extent that was initially expected.

Participation Equality

The other variable that contributed little to the understanding of sex composition effects was the equality of members' participation. Participation equality was included along with the core decision making variables with the expectation that it would add to the prediction of decision accuracy. It was argued that since each member's contribution was considered important to effective team performance, a measure of participation equality would capture an additional team process. Although teams did vary in the equality of their participation, it was not a significant predictor of team decision making accuracy. An additional justification for including participation equality as a key variable was that it would promote team informity and hierarchical sensitivity. Unfortunately, participation equality also failed to relate to these variables. For the decision making task used in this study, participation equality does not appear to be a relevant variable. This does not rule out the possibility that it may be important to other types of decision making tasks such as consensus. For tasks in which participation equality is a critical determinant of effective

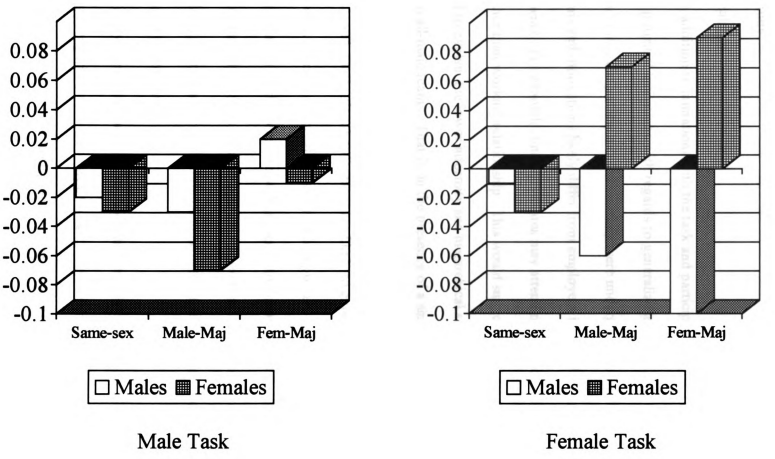


Figure 18. Direction of discrepancy between leaders' weights and appropriate weights by composition and task.

team performance, the composition effects may be different than those observed in the present study.

Generalizability

In addition to limitations with the task and participation equality variables, there are some potential limitations with regards to generalizing the findings here to other situations. First, the participants in this study were undergraduate students whose perceptions and motivations likely differ from employees in actual military or nursing environments. For example, undergraduates may attend more to cues indicative of a social rather than working relationship. This would support the distraction theory proposed to explain the lower informity and hierarchical sensitivity of male-majority relative to all-male teams. That is, in the presence of a single female, males focus their attention on her rather than the task.

Second, motivational differences are likely to exist between undergraduates and actual employees even when efforts are made to provide incentives for good performance. Participants in this study were randomly assigned to the male or female task, yet employees typically choose their occupation. Therefore, individuals in military and nursing fields, particularly non-traditional members, are likely to be more interested and motivated to perform well.

Finally, the participants in this study may have less well-defined stereotypes about particular occupations than those who work in such environments. Although certain majors may be characterized by disproportionate numbers of men or women, the undergraduates in this sample were fairly integrated in terms of sex. However, military units and nursing wards have been traditionally dominated by one sex which could result in

persistent stereotypes being developed about the type of persons suited for such occupations. For example, many members of traditionally all-male military academies maintain strong beliefs about the qualifications of females. This suggests that the sex-linkage manipulation may not elicit the same stereotypes in undergraduates as it would in actual employees.

The second generalizability issue involves the focus on hierarchical team decision making. Although many sex composition studies use decision making tasks and address groups with leaders, they typically do not examine the same variables or focus on the same level of analysis as the present study. Most of the previous research addresses consensus decision making, largely ignoring alternatives such a hierarchical decision making. Different factors are likely to influence the quality of decisions made through consensus as opposed to those made hierarchically. For example, in hierarchical decision making teams, it is not important that members agree in their judgments, but in consensus decision making, this is a critical determinant of effective team performance. This means that the effects of sex composition on variables in one case may not generalize to another. Therefore, conclusions regarding the effects of sex composition and the task sex-linkage in this study should not be generalized beyond hierarchical decision making contexts.

Recommendations for Future Research

As the previous discussion indicates, a number of questions remain regarding the effects of sex composition on team decision making. These questions can be categorized into three main areas. First, research is needed to better understand the underlying causes of the observed composition effects on the core decision making variables. Second, there is a need to explain why there was no effect on team decision accuracy. Third, the

potential influence of task characteristics on sex composition effects should continue to be explored. More specific issues to be address in each of these areas are discussed below.

For each of the decision making variables, potential explanations for sex composition effects were identified at both the individual and team level. These included individual sex differences (e.g., task-orientation) and differences as a function of the composition (e.g., competitiveness). Data were available to address some of these issues such as whether males were more aggressive in their decision making than females. The majority of feasible explanations, however, could not be readily tested. Therefore, numerous research questions can be generated from this study.

A basic question to be addressed is to what extent the observed effects are attributable to individual and team level factors. It was suggested, for example, that the higher informity of male-dominated teams may have been attributable to the higher task-orientation of individual males. This raises the question of whether the differences observed between compositions are simply reflections of individual differences between males and females. Another finding was that male leaders appeared to be more negatively affected by mixed-sex compositions than females leaders. Future research should explore how individuals might be differentially affected by the team's composition. Finally, the data seemed to suggest that male-majority teams were less motivated or task-focused than all-male teams. Do different compositions or tasks lead to different levels of motivation or interest on the part of team members?

The second direction for future research involves the question of why sex composition did not affect team decision accuracy. It was suggested that female-dominated teams compensated for their lower performance on the core decision making

variables by outperforming male-dominated teams on some other factor related to decision accuracy. It seems unlikely that a variable or combination of variables could offset the amount of variance in decision accuracy accounted for by the core variables. However, post hoc analyses suggested that female and male-dominated teams arrived at their decisions differently. A more in depth investigation of the process by which male and female teams make decisions is needed. This might include examining the way males and females process information, and whether female teams apply a different structure, like consensus, to the decision making task.

The third area in which further research is needed involves the influence of the task. Although there were potential limitations with the sex-linkage manipulation, there was evidence that team members responded differently to the two tasks. The informities of staff members appeared to be influenced by the task in a way consistent with its sex-linkage. The task effects on participation rates and individual validities, however, suggested additional differences between the tasks that may have overshadowed the sex-linkage effects. One direction for future research is to develop better manipulations of the sex-linkage construct. New manipulations should attempt to deal with problems of artificiality and potential differences in familiarity or interest with the task.

In addition to sex-linkage, this study suggests that the structure of a task may influence sex composition effects. Researchers have found that females prefer more participative styles of leadership and males more autocratic styles (e.g., Jago & Vroom, 1982). The hierarchical decision making structure in this study may have been perceived as a male-oriented style of decision making. Therefore, the general task structure may have interfered with the sex-linkage manipulation. Since decision making styles may be

differentially associated with the sexes, the structure of the task might provide another direction for studying the effects of sex composition. Research is needed that compares how different compositions perform using hierarchical versus consensus decision making structures.

These are some of the issues to be addressed by future research. There are more general questions which also need to be considered. For instance, how do teams composed of equal numbers of males and female compare to those studied here? What happens with larger team sizes? Are there differences between leaders who are members of the majority sex versus the minority? And, are differences likely to emerge between teams when working on a sex-neutral task. Answers to these questions will hopefully provide more insight into the potential effects of changing workforce demographics.

Conclusions

The main question addressed by this study was how teams composed of different representations of males and females perform on tasks traditionally associated with one sex or the other. In attempting to answer this question, a number of interesting observations were made regarding the effects of sex compositions on team decision making.

In general, teams dominated by male members outperformed those dominated by females on all three core variables related to team decision accuracy. However, teams with a male majority were often less effective than all-male teams. Staff members were weighed less appropriately in male-majority than in all-male teams, and they were less informed in male-majority teams when working on the male task. The behaviors of team members were clearly affected by the composition and task.

Despite the differences found for the core variables, there were no composition effects on team decision accuracy. Male and female-dominated teams appear to arrive at the same outcome through different processes. This implies that different task structures may be appropriate for different compositions or alternatively, that teams should be composed to best fit the structure of the task.

These results raise some important issues to be considered by researchers and practitioners. When conducting team studies, researchers should be aware of the potential effects different sex compositions may have on the results. Depending on the research question, it may be desirable to control for composition in the study design or data analysis. In terms of designing work teams, practitioners should be aware that certain compositions may have negative effects on the behaviors of team members, and that certain compositions may be better suited for a particular task than others.

As the workforce becomes increasingly diverse, and in particular, men and women continue to enter fields traditionally dominated by the opposite sex, additional efforts will be needed to develop a better understanding of the effects of changing compositions on team performance and the behaviors of team members. These efforts will hopefully ensure the successful transition of men and women into non-traditional roles.

FOOTNOTES

[1]The terms gender and sex reflect the common uses in the literature (e.g., gender diversity, sex composition). There is no intent here to distinguish between psychological and physiological characteristics. Teams were composed according to the self-reported sex of participants as either male or female.

[2]Throughout this manuscript, the terms group and team are used interchangeably to refer to a variety of collectives with a common objective. The term team, however, is primarily used in reference to the present study to be consistent with existing research and theory on hierarchical decision making.

[3]Since participation equality did not correlate significantly with team decision accuracy, it was not included in the regression with the other core decision making variables.

[4]Individual informity measures the percent of trials on which a staff member obtained all of the requisite information. For example, if a staff member only acquires two of the six pieces of information on every trial, his or her individual informity is 33%.

[5]Pretests were conducted using individuals to ensure that both tasks were comparable in terms of difficulty. The tasks were considered equivalent once there were no significant differences in individual performance across the two tasks.

APPENDICES

APPENDIX A

APPENDIX A

HANDBOOK FOR TEAM MEMBERS
NAVAL COMMAND AND CONTROL SIMULATION

Experiment #14

Team Effectiveness Research Laboratory
Michigan State University
East Lansing, MI
Spring 1995

INTRODUCTION

The year is 1996 and you are a part of a U.S. naval carrier group's command and control team stationed in the Middle East. A regional conflict between two nations in this area has recently broken out, and your mission is to protect seagoing commercial traffic in the area from accidental or intentional attacks. As history indicates, this is a highly sensitive task. For example, in 1987, failure by a command and control team to quickly and accurately identify a plane as threatening, allowed an Iraqi jet to accidentally fire two Exocet missiles into the Frigate U.S.S. Stark, killing 37 American serviceman and crippling the vessel. One year later, a command and control team error resulted in the U.S.S. Cruiser Vincennes accidentally shooting down an Iranian passenger plane killing 290 innocent civilians. Any repeat of mistakes of this kind will probably lead to a withdrawal of American forces from the area. Such a withdrawal would have disastrous economic and political ramifications that would spread well beyond this region.

THE TASK FORCE

Your naval carrier group is an array of ships, planes and other supporting units with the purpose of protecting approximately 196,000 square miles of ocean. In order to control such a large area, radar surveillance is necessary so that the carrier group is not surprised by the enemy. The carrier group is composed of four units who provide most of the radar coverage. These units are linked together by an electronic data network so that they can supply bits and pieces of critical information concerning possible enemy planes to each other. Essentially, these four units must communicate and coordinate what they see on their individual radars, so that the team can obtain an accurate overall assessment of the aircraft.

TEAM MISSION - Monitoring Air Space

The team of which you are a part, will play the roles of Commanding Officers of the four units which compose the carrier group's command and control team. Your mission is to monitor the airspace surrounding the carrier group, making sure that neutral ships are not attacked. **In performing this role, you must make certain that you do not allow loss of life resulting from accidental or intentional attacks on ships in the task force. At the same time, it is also of paramount importance that you do not inadvertently shoot down friendly military aircraft or any civilian aircraft.** Many passenger flights move in and out of the region, and friendly military aircraft from nations not involved in the conflict also patrol the area.

OVERVIEW OF ROLES

There are four roles in this simulation, one for each member of a four person team. The leader is the Commanding Officer (CO) of the Aircraft Carrier. The other team members are the commanding officers of the AWACS air reconnaissance plane, the Cruiser, and the CAD (Coastal Air Defense unit). The team's task is to decide what response the carrier group should make toward incoming aircraft targets. The AWACS, Cruiser, and CAD will make recommendations to the Carrier, who will then make the final decision for the team. Team members base their decisions on data they collect by measuring characteristics of targets that enter the carrier group's airspace using sophisticated radar and other electronic devices that members of the team are experts on interpreting. Aircraft that are being tracked are called targets. There are seven possible choices to make for each incoming target. These responses are graded in terms of their aggressiveness and there is one correct response for each aircraft. Each of these is described below, moving from least to most aggressive.

SEVEN POSSIBLE DECISIONS

1) **IGNORE:** This means that no further attention should be devoted to the target and instead focus should be directed on other possible targets in the area. Never ignore a target that might possibly attack. This would most assuredly lead to loss of lives.

2) **REVIEW:** This means attention can be shifted away from this target momentarily. After a short period of time this target should be returned to in order to update its status. A large number of targets can be in review status, however, this number is finite.

3) **MONITOR:** This means that the target should be continuously tracked. The systems that do this tracking are capable of monitoring fewer targets than can be reviewed, and thus monitoring diminishes overall patrol capacity.

4) **WARN:** This means that a message is sent to the target ordering it to turn away. Warning targets that should be ignored detracts from the importance of legitimate warnings. Warning targets that intend to attack is also bad, since the warning makes it easier for an attacker to locate the ship.

5) **READY:** This means to get into a defensive posture and to set defensive weapons on automatic. A ship in a readied position is rarely vulnerable to attack. This stance should not be taken to non-threatening targets since weapons set to automatic can fire mistakenly at innocent targets that fly too close to the carrier group. A ship in this position, however, cannot readily take offensive action toward other targets.

6) **LOCK-ON:** This synchronizes radar and attack weapons so that the weapons fix themselves on the target. A ship at Lock-On position can take offensive action at a moments notice. The capacity to track other targets is severely constrained once there is Lock-On to a single target, however. Thus, this should be reserved for targets that are almost certain to be threatening.

7) **DEFEND:** This is "weapons away" and means to attack the target with missiles or depth charges. A defend decision cannot be aborted once initiated and thus must only be used when enemy attack is imminent.

CHARACTERISTICS OF AIRBORNE TARGETS

Airborne targets can be measured on nine attributes. These are listed below along with the ranges of possible values for these attributes:

(1)	**Speed**	Faster targets are more threatening. **100 to 800 mph.**
(2)	**Altitude**	Lower targets are more threatening. **35,000 to 5,000 ft.**
(3)	**Size**	Smaller targets are more threatening. **65 to 10 mtr.**
(4)	**Angle**	Rapidly descending targets are more threatening. **+15 dgs** (rapid ascent) **to -15 dgs** (rapid descent).
(5)	**IFF**	IFF stands for "Identification Friend of Foe" and identifies whether an aircraft is civilian, para-military or military. **.2 MHz** (civilian) **to 1.8 MHz** (military).
(6)	**Direction**	Targets coming straight towards carrier are more threatening. **+30 dgs** (passing far to the left or right) **to 00 dgs** (coming straight in).
(7)	**Corridor Status**	A corridor is a 20 mile wide "safe lane" open to commercial air traffic, and is expressed in terms of miles away from the center of the corridor. **0 mi** (in the middle of it) **to 30 mi** (way out of it).
(8)	**Radar Type**	Targets with weapons radar are more threatening. **Class 1** (weather radar only) **to Class 9** (weapons radar).
(9)	**Range**	Aircraft that are closer to the carrier are more threating. **200 mi to 1 mi.**

DETERMINING THE LEVEL OF THREAT FOR A DECISION RULE

In general, the degree to which an incoming target is threatening depends on its standing on these nine attributes. These nine attributes combine into three simple rules which are used to determine the danger associated with any target. The commanding officers of the CAD, AWACS, and Cruiser are each responsible for combining these attributes into the rules. Each officer is responsible for their area of expertise plus an additional rule representing the expertise of another member. This ensures that all information will be sufficiently represented in the team. Each officer must make an evaluation of the aircraft based on these rules. The Carrier is responsible for combining the recommendations from the CAD, AWACS, and Cruiser into an overall team decision.

Location Rule (CAD & AWACS):

ALTITUDE, CORRIDOR STATUS, and RANGE go together to determine the location of the aircraft. Aircraft are threatening only if they are **low** (low value on altitude), **outside commercial traffic lanes** (high value on corridor status), and **close** (low value on range) to the carrier. If any one of these three values are non-threatening, then the aircraft is to be considered none-threatening in terms of the location rule.

Movement Rule (AWACS & CRUISER):

SPEED, ANGLE, AND DIRECTION go together to determine the movement of the aircraft. Aircraft are threatening only if they are going fast (high value on speed), descending (low value on angle), and coming straight in to the Carrier (low value on direction). If any one of these three values are non-threatening, then the aircraft is to be considered non-threatening in terms of the movement rule.

Category Rule (Cruiser & CAD):

SIZE, IFF, and RADAR TYPE go together to determine the category of aircraft. Aircraft are threatening only if they are **small** (low value on size), **military** (high value on IFF) and carrying **weapons radar** (high value on radar). If any one of these three values are non-threatening, then the aircraft is to be considered non-threatening in terms of the category rule.

COMBINING RECOMMENDATIONS TO DETERMINE TEAM DECISIONS

The three rules combine to determine the overall threat represented by the aircraft. For example, if the CAD recommends a DEFEND, and the AWACS recommends a DEFEND, and the Cruiser recommends a MONITOR -- the Carrier should probably choose LOCK-ON or DEFEND since two teammates recommend DEFEND and the other teammate is recommending an intermediate course of action.

Another example would be if the CAD recommends an IGNORE, and the AWACS recommends a MONITOR, and the Cruiser recommends an IGNORE -- the Carrier should probably choose IGNORE or REVIEW since two teammates are recommending an IGNORE and the other teammate is recommending an intermediate course of action.

Another example would be if the CAD recommends a DEFEND, and the AWACS recommends an WARN, and the Cruiser recommends an IGNORE -- since the three recommendations are spread out, the Carrier should probably pick an intermediate judgment such as MONITOR, WARN or READY.

OUTCOMES OF DECISIONS

Your decisions regarding each target are to be made based upon the information on the dimensions listed above. According to rules described in this section, there are five possible evaluative outcomes associated with the accuracy or your decisions (scoring is done automatically by the computer). The five possible outcomes include:

	OUTCOME	DEFINITION	EXAMPLE	SCORE
(1)	**HIT**	The decision was exactly correct	You said defend, correct answer was defend	+2
(2)	**NEAR MISS**	The decision was off by one level	You said defend, correct answer was lock-on	+1
(3)	**MISS**	The decision was off by two levels	You said defend, correct answer was ready	0
(4)	**INCIDENT**	The decision was off by three levels	You said defend, correct answer was warn	-1
(5)	**DISASTER**	The decision was off by more than three levels	You said defend, correct answer was either monitor, review, or ignore	-2

CARRIER – INSTRUCTIONS FOR AIRCRAFT TARGETS

As the Carrier, you are the team's leader and the person who must make the team's final decision. Each of your teammates (CAD, AWACS, and Cruiser) is responsible for sending you a recommendation based on their assigned rules. Each rule requires three pieces of information. Each of your teammates is able to directly measure one or two of the attributes that make up a rule; the remaining information is measured by another member of the team. You are able to measure some of these attributes (**Angle, Corridor Status and Radar**) in order to provide team members with information that they may be missing.

The following tables illustrate: 1) the decision rules each team member is responsible for; 2) the attributes which make up each decision rule; 3) the attributes the member can measure directly; and 4) the attributes they need to make an informed recommendation. Since this information will not be posted at your station, you will need to try to memorize what information each position has and what each needs. This is important because your role is to help your teammates get the information they need to make accurate recommendations. Remember, you are going to base your decision on your teammates recommendations -- you cannot be accurate unless they are.

CAD is responsible for the **LOCATION and MOTION RULES**

LOCATION RULE:	**CAD IS ABLE TO MEASURE:**	**CAD NEEDS:**
ALTITUDE	ALTITUDE	
RANGE		**RANGE**
CORRIDOR STATUS	CORRIDOR STATUS	
MOTION RULE:		
SPEED		**SPEED**
DIRECTION	DIRECTION	
ANGLE		**ANGLE**

AWACS is responsible for the **MOTION and CATEGORY RULES**

MOTION RULE:	**AWACS IS ABLE TO MEASURE:**	**AWACS NEEDS:**
SPEED	SPEED	
DIRECTION		**DIRECTION**
ANGLE	ANGLE	
CATEGORY RULE:		
SIZE		**SIZE**
IFF	IFF	
RADAR		**RADAR**

CRUISER is responsible for the **CATEGORY and LOCATION RULES**

CATEGORY RULE:	**CRUISER IS ABLE TO MEASURE:**	**CRUISER NEEDS:**
SIZE	SIZE	
IFF		**IFF**
RADAR	RADAR	
LOCATION RULE:		
ALTITUDE		**ALTITUDE**
RANGE	RANGE	
CORRIDOR STATUS		**CORRIDOR STATUS**

CAD – INSTRUCTIONS FOR AIRCRAFT TARGETS

YOUR SPECIFIC ROLE

As the CAD, your role is to assess the aircraft targets on several attributes related to two decision rules (LOCATION and MOTION) and then make a recommendation to the Carrier regarding the stance that the team should take toward the target. You can directly measure one or two of the attributes that make up each rule. Information on all three of the attributes in each rule is necessary in order to make an accurate assessment of the target's level of threat. Other members of the team have access to the attributes you are missing. Your unique knowledge concerns how to interpret and combine the attributes to assess the LOCATION and MOTION of the target. If any attribute in a rule is non-threatening, the target is non-threatening on that rule even if the other two attributes are in the high threatening range.

The range of values and degree of threat associated with each attribute are shown below. You will need to try to memorize the end points of the value ranges on each scale in order to identify when the aircraft goes from non-threatening to somewhat threatening and to very-threatening. This information will not be posted at your work station -- you need to have these values committed to memory.

The **bolded** values are critical values, because they determine when the aircraft moves from one status (non-threatening to somewhat threatening; or somewhat threatening to very threatening). **Remember – if an aircraft is non-threatening on any one value that makes up a rule it is non-threatening overall on that rule, regardless of the values for the other two attributes.**

ATTRIBUTES FOR THE LOCATION RULE:

Altitude (thou. ft)	35k---------- No threat	**25k**----------**15k** Some threat	----------5k High threat
Range (mi)	200---------- No threat	**100**----------**50** Some threat	----------1 High threat
Corridor Status (mi)	0---------- No threat	**10**----------**20** Some threat	----------30 High Threat

ATTRIBUTES FOR THE MOTION RULE:

Speed (mph)	100---------- No threat	**300**----------**550** Some threat	----------800 High threat
Direction (dgs)	30---------- No threat	**20**----------**10** Some threat	----------0 High threat
Angle (dgs)	+15---------- No threat	**+6**---------- **-6** Some threat	---------- -15 High Threat

AWACS – INSTRUCTIONS FOR AIRCRAFT TARGETS

YOUR SPECIFIC ROLE

As the AWACS, your role is to assess the aircraft targets on several attributes related to two decision rules (MOTION and CATEGORY) and then make a recommendation to the Carrier regarding the stance that the team should take toward the target. You can directly measure one or two of the attributes that make up each rule. Information on all three of the attributes in each rule is necessary in order to make an accurate assessment of the target's level of threat. Other members of the team have access to the attributes you are missing. Your unique knowledge concerns how to interpret and combine the attributes to assess the MOTION and CATEGORY of the target. If any attribute in a rule is non-threatening, the target is non-threatening on that rule even if the other two attributes are in the high threatening range.

The range of values and degree of threat associated with each attribute are shown below. You will need to try to memorize the end points of the value ranges on each scale in order to identify when the aircraft goes from non-threatening to somewhat threatening and to very-threatening. This information will not be posted at your work station -- you need to have these values committed to memory.

The **bolded** values are critical values, because they determine when the aircraft moves from one status (non-threatening to somewhat threatening; or somewhat threatening to very threatening). **Remember -- if an aircraft is non-threatening on any one value that makes up a rule it is non-threatening overall on that rule, regardless of the values for the other two attributes.**

ATTRIBUTES FOR THE MOTION RULE:

Speed (mph)	100---------- No threat	**300**----------**550** Some threat	----------800 High threat
Direction (dgs)	30---------- No threat	**20**----------**10** Some threat	----------0 High threat
Angle (dgs)	+15---------- No threat	**+6**---------- **-6** Some threat	---------- -15 High Threat

ATTRIBUTES FOR THE CATEGORY RULE:

Size (mtrs)	65---------- No threat	**40**----------**20** Some threat	----------10 High threat
IFF (MHz)	.2---------- No threat	**.7**----------**1.2** Some threat	----------1.8 High threat
Radar (class)	1---------- No threat	**3**----------**7** Some threat	----------9 High Threat

CRUISER – INSTRUCTIONS FOR AIRCRAFT TARGETS

YOUR SPECIFIC ROLE

As the Cruiser, your role is to assess the aircraft targets on several attributes related to two decision rules (CATEGORY and LOCATION) and then make a recommendation to the Carrier regarding the stance that the team should take toward the target. You can directly measure one or two of the attributes that make up each rule. Information on all three of the attributes in each rule is necessary in order to make an accurate assessment of the target's level of threat. Other members of the team have access to the attributes you are missing. Your unique knowledge concerns how to interpret and combine the attributes to assess the CATEGORY and LOCATION of the target. If any attribute in a rule is non-threatening, the target is non-threatening on that rule even if the other two attributes are in the high threatening range.

The range of values and degree of threat associated with each attribute are shown below. You will need to try to memorize the end points of the value ranges on each scale in order to identify when the aircraft goes from non-threatening to somewhat threatening and to very-threatening. This information will not be posted at your work station -- you need to have these values committed to memory.

The **bolded** values are critical values, because they determine when the aircraft moves from one status (non-threatening to somewhat threatening; or somewhat threatening to very threatening). **Remember – if an aircraft is non-threatening on any one value that makes up a rule it is non-threatening overall on that rule, regardless of the values for the other two attributes.**

ATTRIBUTES FOR THE CATEGORY RULE:

Size (mtrs)	65---------- No threat	**40**----------**20** Some threat	----------10 High threat
IFF (MHz)	.2---------- No threat	**.7**----------**1.2** Some threat	----------1.8 High threat
Radar (class)	1---------- No threat	**3**----------**7** Some threat	----------9 High Threat

ATTRIBUTES FOR THE LOCATION RULE:

Altitude (thou. ft)	35k---------- No threat	**25k**----------**15k** Some threat	----------5k High threat
Range (mi)	200---------- No threat	**100**----------**50** Some threat	----------1 High threat
Corridor Status (mi)	0---------- No threat	**10**----------**20** Some threat	----------30 High Threat

APPENDIX B

APPENDIX B

HANDBOOK FOR TEAM MEMBERS
NEONATAL NURSING SIMULATION

Experiment #14

Team Effectiveness Research Laboratory
Michigan State University
East Lansing, MI
Spring 1995

INTRODUCTION

The year is 1996 and you are a part of a neonatal nursing team called to a city in the southeastern U.S. which has recently experienced an epidemic of premature births. Researchers are diligently trying to isolate the potential environmental causes of this problem. In the meantime, University Hospital is confronted with an abnormally high rate of low-birth-weight (LBW) infants which usually experience a variety of life threatening health problems. Caring for high-risk newborns is an extremely sensitive issue. As of 1995, the U.S. infant mortality rate exceeds that of many other nations. For both moral and economic reasons, it is important that the current epidemic be handled effectively to reduce the infant mortality rate.

THE TASK FORCE

Your nursing team involves several specialists along with other support staff whose purpose is to care for high risk infants. The most technologically advanced measuring and monitoring equipment is available to you to assess the health of these newborns. Information about each infant's health is entered into a computer data base to which your team has access. Your team is composed of three specialists and a supervisor. Together, the four of you must communicate and coordinate the information obtained from the data base to make an overall assessment of each infant.

TEAM MISSION - Monitoring High-Risk Infants

The team of which you are a part, will play the role of the four members of a neonatal nursing team. Your task is to monitor high-risk infants that enter the intensive care ward of University Hospital, and make decisions regarding their treatment. **In performing this role, you must make certain that you do not allow loss of life resulting from the premature release of infants from the hospital. At the same time, it is also important that you do not operate on infants who do not require surgery since this is an extremely risky procedure.** Many infants will move in and out of the ward under your care -- you want to ensure that all newborns receive the appropriate care they require.

OVERVIEW OF ROLES

There are four roles in this simulation, one for each member of a four person team. The leader is the Nursing Supervisor (NS) of the Neonatal Ward. The other team members include the Heart Specialist (HS), the Lung Specialist (LS), and the Metabolic Specialist (MS). The team's task is to decide what response the nursing team should make toward infants in the neonatal ward. The Heart, Lung and Metabolic Specialists will make recommendations to the Nursing Supervisor, who will then make the final decision for the team. Team members base their decisions on data they collect by measuring characteristics of newborns that enter the neonatal ward. These measures are obtained from sophisticated equipment; the nurses are experts in intrepreting this information. There are seven possible choices to make for each infant to be evaluated. These responses are graded in terms of their severity and there is one correct response for each infant. Each of these is described below, moving from least to most severe.

SEVEN POSSIBLE DECISIONS

1) **RELEASE:** This means allow the newborn to be released from the hospital. Attention should be directed toward other infants in the ward. Never release an infant that might require surgery. A newborn that is released prematurely can be placed in a life-threatening situation.

2) **DOWNGRADE:** This means move the newborn out of intensive care. However, continue to check on the infant and update its status.

3) **MONITOR:** This means you will continue to monitor all signs for health threats. This is an appropriate response when there is some threat to the newborn's health, but the infant is not yet in serious danger. Monitoring numerous infants diminishes the team's overall capacity to evaluate infants.

4) **INCUBATE:** This means to place the infant in a regulated environment to ensure no external factors (e.g., temperature) threaten the newborn's health. There are limited numbers of incubators in the neonatal ward, so the decision to incubate must be reserved for those who need such care.

5) **THERAPY:** This means try using various physical manipulations to reduce high risk symptoms. Therapy is not particularly useful for extreme health problems, and can lead to further deterioration in the newborn's health. However, it is better to avoid medication and surgery if the health problems can be corrected through therapy.

6) **MEDICATE:** This involves ingesting the newborn with medications in the hope of correcting the problem without surgery. Medicating the infant does not ensure that surgery will be avoided; many drugs can have harmful side effects that may necessitate an operation. Therefore, medication should only be used if there are almost certain threats to the infant's health.

7) **OPERATE:** This means performing surgery to correct to infant's health problems. Surgery is extremely risky and should only be used when the infant's condition is clearly life-threatening.

CHARACTERISTICS OF INFANTS

Infants can be measured on nine health attributes. These are listed below along with the ranges of possible values for these attributes:

(1)	**Breathing**	Faster respirations are more threatening. **20 to 80 rpm.**
(2)	**Heart Rate**	Faster heart rates are more threatening. **40 to 130 bpm.**
(3)	**Glucose**	Lower glucose levels are more threatening. **100 to 10 mg%.**
(4)	**pH Balance**	Lower pH balances are more threatening. **7.8 to 7.0 pH.**
(5)	**Calcium**	Lower calcium levels are more threatening. **10 to 4 mg/dl.**
(6)	**Mean Air Pressure (MAP)**	Higher MAP is more threatening. **5 to 15 cmH2O.**
(7)	**Temperature**	Higher temperatures are more threatening. **97 to 103 dgs.**
(8)	**Magnesium**	Lower magnesium levels are more threatening. **2.5 to 0 mEq.**
(9)	**Blood Pressure**	Higher blood pressure is more threatening. **20 to 95 mmHg.**

DETERMINING THE LEVEL OF THREAT FOR A DECISION RULE

In general, the degree to which an infant's health is threatening depends on its standing on these nine attributes. These nine attributes combine into three simple rules which are used to determine the danger associated with any newborn. The nurse specialists of the heart, lungs, and metabolism are each responsible for combining these attributes into these rules. Each nurse is responsible for their area of expertise plus an additional rule representing the expertise of another member. This ensures that all information will be sufficiently represented in the team. Each nurse must make an evaluation of the newborn's condition based on these rules. The nursing Supervisor is responsible for combining the recommendations from the nursing specialists into an overall team decision.

Cardiovascular Rule (HS & MS):

HEART RATE, BLOOD PRESSURE, and TEMPERATURE go together to determine the cardiovascular condition of the infant. Infants are under high threat if their **heart rate** is **fast**, **blood pressure** is **high** and **temperature** is **high**. If any one of these three values falls in the non-threatening range, then the infant is to be considered non-threatening in terms of the cardiovascular rule.

Respiratory Rule (LS & HS):

BREATHING, MAP, and pH BALANCE go together to determine the repiratory condition of the infant. Infants are under high threat only if their **respirations** are **fast**, their **MAP** is **high**, and their **pH balance** is **low**. If any one of these three values falls in the non-threatening range, then the infant is to be considered non-threatening in terms of the respiratory rule.

Homeostasis Rule (MS & LS):

GLUCOSE, CALCIUM, AND MAGNESIUM go together to determine the homoestatic condition of the infant. Infants are under high threat only if their **glucose** is **low**, **calcium** level is **low**, and **magnesium** level is **low**. If any one of these three values falls in the non-threatening range, then the infant is to be considered non-threatening in terms of the homeostasis rule.

COMBINING RECOMMENDATIONS TO DETERMINE TEAM DECISIONS

The three rules combine to determine the overall threat of the infant's health. For example, if the HS recommends to OPERATE, and the LS recommends to OPERATE, and the MS recommends to MONITOR -- the Supervisor should probably choose MEDICATE or OPERATE since two teammates recommend OPERATE and the other teammate is recommending an intermediate course of action.

Another example would be if the HS recommends a RELEASE, and the LS recommends a MONITOR, and the MS recommends a RELEASE -- the Supervisor should probably choose RELEASE or DOWNGRADE since two teammates are recommending a RELEASE and the other teammate is recommending an intermediate course of action.

Another example would be if the HS recommends to OPERATE, and the LS recommends a INCUBATE, and the MS recommends a RELEASE -- since the three recommendations are spread out, the Supervisor should probably pick an intermediate judgment such as MONITOR, INCUBATE or THERAPY.

OUTCOMES OF DECISIONS

Your decisions regarding each infant are to be made based upon the information on the dimensions listed above. According to rules described in this section, there are five possible evaluative outcomes associated with the accuracy or your decisions (scoring is done automatically by the computer). The five possible outcomes include:

	OUTCOME	DEFINITION	EXAMPLE	SCORE
(1)	**HIT**	The decision was exactly correct	You said operate, correct answer was operate	+2
(2)	**NEAR MISS**	The decision was off by one level	You said operate, correct answer was medicate	+1
(3)	**MISS**	The decision was off by two levels	You said operate, correct answer was therapy	0
(4)	**INCIDENT**	The decision was off by three levels	You said operate, correct answer was incubate	-1
(5)	**DISASTER**	The decision was off by more than three levels	You said operate, correct answer was either monitor, downgrade, or release	-2

NURSE SUPERVISOR – INSTRUCTIONS FOR NEONATAL TASK

As the Nurse Supervisor, you are the team's leader and the person who must make the team's final decision. Each of your teammates (HS, LS and MS) is responsible for sending you a recommendation based on their assigned rules. Each rule requires three pieces of information. Each of your teammates is able to directly measure one or two of the attributes that make up a rule; the remaining information is measured by another member of the team. You are able to measure some of these attributes (**Temperature, pH Balance and Magnesium**) in order to provide team members with information that they may be missing.

The following tables illustrate: 1) the decision rules each team member is responsible for; 2) the attributes which make up each decision rule; 3) the attributes the member can measure directly; and 4) the attributes they need to make an informed recommendation. Since this information will not be posted at your station, you will need to try to memorize what information each position has and what each needs. This is important because your role is to help your teammates get the information they need to make accurate recommendations. Remember, you are going to base your decision on your teammates recommendations -- you cannot be accurate unless they are.

HS is responsible for the **CARDIOVASCULAR and RESPIRATORY RULES**

CARDIOVASCULAR RULE:	**HS IS ABLE TO MEASURE:**	**HS NEEDS:**
HEART RATE	HEART RATE	
BLOOD PRESSURE		**BLOOD PRESSURE**
TEMPERATURE	TEMPERATURE	
RESPIRATORY RULE:		
BREATHING		**BREATHING**
MAP	MAP	
pH BALANCE		**pH BALANCE**

LS is responsible for the **RESPIRATORY and HOMEOSTASIS RULES**

RESPIRATORY RULE:	**LS IS ABLE TO MEASURE:**	**LS NEEDS:**
BREATHING	BREATHING	
MAP		**MAP**
pH BALANCE	pH BALANCE	
HOMEOSTASIS RULE:		
GLUCOSE		**GLUCOSE**
CALCIUM	CALCIUM	
MAGNESIUM		**MAGNESIUM**

MS is responsible for the **HOMEOSTASIS and CARDIOVASCULAR RULES**

HOMEOSTASIS RULE:	**MS IS ABLE TO MEASURE:**	**MS NEEDS:**
GLUCOSE	GLUCOSE	
CALCIUM		**CALCIUM**
MAGNESIUM	MAGNESIUM	
CARDIOVASCULAR RULE:		
HEART RATE		**HEART RATE**
BLOOD PRESSURE	BLOOD PRESSURE	
TEMPERATURE		**TEMPERATURE**

HEART SPECIALIST (HS)– INSTRUCTIONS FOR NEONATAL TASK

YOUR SPECIFIC ROLE

As the HS, your role is to assess the infant's health on several attributes related to two decision rules (CARDIOVASCULAR and RESPIRATORY) and then make a recommendation to the Supervisor (NS) regarding the stance that the team should take toward the infant. You can directly measure one or two of the attributes that make up each rule. Information on all three of the attributes in each rule is necessary in order to make an accurate assessment of the infant's level of health threat. Other members of the team have access to the attributes you are missing. Your unique knowledge concerns how to interpret and combine the attributes to assess the CARDIOVASCULAR and RESPIRATORY state of the infant. If any attribute in a rule is non-threatening, the infant's health is non-threatening on that rule even if the other two attributes are in the high threatening range.

The range of values and degree of threat associated with each attribute are shown below. You will need to try to memorize the end points of the value ranges on each scale in order to identify when the infant's health goes from non-threatening to somewhat threatening and to very-threatening. This information will not be posted at your work station -- you need to have these values committed to memory.

The **bolded** values are critical values, because they determine when the infant's health moves from one status (non-threatening to somewhat threatening; or somewhat threatening to very threatening). **Remember – if an infant's health is non-threatening on any one value that makes up a rule it is non-threatening overall on that rule, regardless of the values for the other two attributes.**

ATTRIBUTES FOR THE CARDIOVASCULAR RULE:

Heart Rate (bpm)	40---------- No threat	**70**----------**100** Some threat	----------130 High threat
Blood Pressure (mmHg)	20---------- No threat	**45**----------**70** Some threat	----------95 High threat
Temperature (dgs)	97---------- No threat	**99**----------**101** Some threat	----------103 High Threat

ATTRIBUTES FOR THE RESPIRATORY RULE:

Breathing (rpm)	20---------- No threat	**40**----------**60** Some threat	----------80 High threat
MAP (cmH2O)	5---------- No threat	**8**----------**12** Some threat	----------15 High threat
pH Balance (pH)	7.8---------- No threat	**7.5**----------**7.3** Some threat	----------7.0 High Threat

LUNG SPECIALIST (LS) – INSTRUCTIONS FOR NEONATAL TASK

YOUR SPECIFIC ROLE

As the LS, your role is to assess the infant's health on several attributes related to two decision rules (RESPIRATORY AND HOMEOSTASIS) and then make a recommendation to the Supervisor (NS) regarding the stance that the team should take toward the infant. You can directly measure one or two of the attributes that make up each rule. Information on all three of the attributes in each rule is necessary in order to make an accurate assessment of the infant's level of health threat. Other members of the team have access to the attributes you are missing. Your unique knowledge concerns how to interpret and combine the attributes to assess the RESPIRATORY and HOMEOSTATIC state of the infant. If any attribute in a rule is non-threatening, the infant's health is non-threatening on that rule even if the other two attributes are in the high threatening range.

The range of values and degree of threat associated with each attribute are shown below. You will need to try to memorize the end points of the value ranges on each scale in order to identify when the infant's health goes from non-threatening to somewhat threatening and to very-threatening. This information will not be posted at your work station -- you need to have these values committed to memory.

The **bolded** values are critical values, because they determine when the infant's health moves from one status (non-threatening to somewhat threatening; or somewhat threatening to very threatening). **Remember -- if an infant's health is non-threatening on any one value that makes up a rule it is non-threatening overall on that rule, regardless of the values for the other two attributes.**

ATTRIBUTES FOR THE RESPIRATORY RULE:

Breathing (rpm)	20---------- No threat	**40**----------**60** Some threat	----------80 High threat
MAP (cmH2O)	5---------- No threat	**8**----------**12** Some threat	----------15 High threat
pH Balance (pH)	7.8---------- No threat	**7.5**----------**7.3** Some threat	----------7.0 High Threat

ATTRIBUTES FOR THE HOMEOSTASIS RULE:

Glucose (mg%)	100---------- No threat	**70**----------**40** Some threat	----------10 High threat
Calcium (mg/dl)	10---------- No threat	**8**----------**6** Some threat	----------4 High threat
Magnesium (mEq)	2.5---------- No threat	**1.5**----------**.5** Some threat	----------0 High Threat

METABOLIC SPECIALIST (MS) -- INSTRUCTIONS FOR NEONATAL TASK

YOUR SPECIFIC ROLE

As the MS, your role is to assess the infant's health on several attributes related to two decision rules (HOMEOSTASIS and CARDIOVASCULAR) and then make a recommendation to the Supervisor (NS) regarding the stance that the team should take toward the infant. You can directly measure one or two of the attributes that make up each rule. Information on all three of the attributes in each rule is necessary in order to make an accurate assessment of the infant's level of health threat. Other members of the team have access to the attributes you are missing. Your unique knowledge concerns how to interpret and combine the attributes to assess the HOMEOSTATIC and CARDIOVASCULAR state of the infant. If any attribute in a rule is non-threatening, the infant's health is non-threatening on that rule even if the other two attributes are in the high threatening range.

The range of values and degree of threat associated with each attribute are shown below. You will need to try to memorize the end points of the value ranges on each scale in order to identify when the infant's health goes from non-threatening to somewhat threatening and to very-threatening. This information will not be posted at your work station -- you need to have these values committed to memory.

The **bolded** values are critical values, because they determine when the infant's health moves from one status (non-threatening to somewhat threatening; or somewhat threatening to very threatening). **Remember -- if an infant's health is non-threatening on any one value that makes up a rule it is non-threatening overall on that rule, regardless of the values for the other two attributes.**

ATTRIBUTES FOR THE HOMEOSTASIS RULE:

Glucose (mg%)	100---------- No threat	**70**----------**40** Some threat	----------10 High threat
Calcium (mg/dl)	10---------- No threat	**8**----------**6** Some threat	----------4 High threat
Magnesium (mEq)	2.5---------- No threat	**1.5**----------**.5** Some threat	----------0 High Threat

ATTRIBUTES FOR THE CARDIOVASCULAR RULE:

Heart Rate (bpm)	40---------- No threat	**70**----------**100** Some threat	----------130 High threat
Blood Pressure (mmHg)	20---------- No threat	**45**----------**70** Some threat	----------95 High threat
Temperature (dgs)	97---------- No threat	**99**----------**101** Some threat	----------103 High Threat

APPENDIX C

APPENDIX C

TEAM INTERACTIVE TRAINING SCRIPT

(CNC/NEO Task)

Tell subjects: **"The interactive training involves primarily the first game of the simulation which is 10 minutes long. You will then have two additional trials to practice on. Please follow along closely and do not get ahead of me so that we can cover all the material."** Make sure everyone has their keyboard and mouse nearby. Then bring up the first trial by pressing the spacebar on the Carrier. Make sure everyone is on the blue icon screen and the correct task.

1 Point out the **icons, game #, time clock,** and **menu bar**.

2 First, explain that they will use their mouse to access the menu bar. "To measure attributes, drag the mouse and click on the **Measure** menu. Notice the 3 attributes you can measure are in this menu. To measure an attributes just point to the desired attribute and click on it. A **gray box** will appear on the lower left corner of your screen showing the attribute value. This will disappear in 3 seconds -- don't worry, you can review the information later. Now measure a second attribute."

3 "After you have measured two attributes, open the measure menu again and click on the **Measure Summary** option. This is a summary box that displays the attributes you have measured. It will stay open for only a few seconds. You can also access this summary box by hitting the **F2** key on your keyboard."

4 "Next, we will cover the **Query** option. You will notice that you can only measure a few attributes. Other people in the team have the additional information you need. Therefore, you may want to ask for this information, which you can do using **Query**. Click on the **Query** option, but do not proceed any further yet! In the Query menu you will see all the attributes. When you click on one of these attributes, you will get a box asking you who you want to Query, in other words, who you want to ask for the information just selected. You need to make a choice quickly by clicking on a station. For this practice trial I will tell you who to send a Query.

Carrier should Query the CAD / NurseSpvr should Query the HeartSpec
CAD should Query the AWACS / HeartSpec should Query LungSpec
AWACS should Query the Cruiser / LungSpec should Query MetabSpec
Cruiser should Query the Carrier / MetabSpec should Query NurseSpvr

Now select an attribute and send a query to the above mentioned stations by clicking on the appropriate station in the gray box."

5 "The **Qry** abbreviation should show up in the lower left corner of each screen. To get the query you will use the **Receive** menu. Click on the **Receive** menu and click on the **Q** to read the Query. Make sure you pay attention to who sent the query and what they asked for -- once the box disappears it cannot be recalled.

6 "Now you will send something to the person who queried you. To do this you will use the **Transmit** option. Open the **Transmit** menu. Notice that the only attribtes shown in this menu are the attributes you have measured. You cannot send your teammates attributes you cannot measure or haven't measured yet. What I want you to do is select an attribute and send it to the same person who queried you. If you don't have the information requested, for now send something you do have. If you don't remember who queried you, here's who you transmit to:

Carrier to Cruiser / NurseSpvr to MetabSpec
CAD to Carrier / HeartSpec to NurseSpvr
AWACS to CAD / LungSpec to HeartSpec
Cruiser to AWACS / MetabSpec to LungSpec

7 "Notice the **Trn** abbreviation in the lower left part of the screen. There can be three types of messages displayed here. **QRY** indicates a Query or that someone is asking you for information, **TRN** indicates a Transmit or that someone is sending you information, and **MSG** indicates a Text Message which we'll go over in a few minutes. The key is to use **Receive** anytime you see a message in the lower left corner of the screen. Now go to the Receive menu and get the Transmit sent to you. After you received the transmit, you can press the **F2** key again and see that this transmitted information is now in you summary box."

8 "While no talking is allowed during the simulation, you can send typewritten messages to one another using the **Text** option under the **Transmit** menu. Before you select this option, I want to tell you who to send a text message to:

Carrier / NurseSpvr send a text message to the CAD / HeartSpec
CAD / HeartSpec send a text message to the AWACS / LungSpec
AWACS / LungSpec send a text message to the Cruiser / MetabSpec
Cruiser / MetabSpec send a text message to the Carrier / NurseSpvr

Now select text, then the station you want to send a message to. When you get to the box with the long black strip, you can type in a short message (e.g., Hello) and then send the message by pressing **Enter**.

9 "At this point everyone should have an **Msg** abbreviation in the lower left corner of your screen. Again, you receive this message by selecting the **Receive** menu. When you receive the message you have the option of **Log** or **Don't Log**. Log is the default and means that the message will be saved to a summary file. To see this summary file, click on **Measure** and the choose **LOG File**. This is a summary box of all the

messages you save. You can also access the **LOG File** by hitting the **F3** key on your keyboard. The messages you save will remain in the summary box for the entire simulation unless you delete them. To delete simply highlight the desired message using the **arrow keys** on your keyboard and hit the **Delete** key.

10 "You can also send a text message to yourself. You may want to do so to remind yourself of something for later in the simulation. To do this simply select **Transmit** then **Text** and to the far right select **Log File**. Then just type a message to yourself and hit enter. You do not have to receive this message -- it will automatically go to your summary box. To see this message along with those others have sent you, just hit the **F3** key.

11 "So far you've learned how to **Measure** an attribute, how to request information from someone else using **Query**, how to send specific information using **Transmit**, how to send and log **Text Messages**, and how to **Receive** queries, transmits and messages. The last thing to cover is how to make **Judgments**.

12 "With 30 seconds left, the clock starts beeping indicating a judgment should be sent by outlying stations (CAD, AWAC, Cruiser / HeartSpec, LungSpec, MetabSpec). **This judgment must reach the Carrier / NurseSpvr with enough time left to make a team decision**. Everyone except the Carrier / NurseSpvr should open the **Judgment** menu." (Explain to the Carrier / NurseSpvr that if the he or she has the menu bar highlighted or a box open, he/she will not receive incoming judgments.) For these practice trials I will tell you what judgment to make.

"To make a judgment, you will click on the decision you believe to be correct and then hit OK to Verify. If you accidently select the wrong decision, you can click on **Cancel** and resubmit your judgment. Once the judgment is sent, you cannot change it even if there is time left on the clock. You can submit your judgment at any time during the trial, but if you fail to send in a judgment by the time the clock runs out your decision will be registered as a **No Call** which equals an **Ignore / Release**. Right now everyone except the Carrier / NurseSpvr should choose an **Ignore / Release**.

13 "Now its time for the Carrier / NurseSpvr to make its **Judgment**. Notice that when an icon turns red it means that station has made a decision and the decision is indicated in the middle of the icon. These recommendations from the CAD / HeartSpec, AWACS / LungSpec and Cruiser / MetabSpec are what the Carrier / NurseSpvr based the team decision on, so make sure your judgments get to the Carrier / NurseSpvr in plenty of time before he/she has to make the final decision. The Carrier / NurseSpvr should now make an **Ignore / Release** decision.

14 Once the Carrier / NurseSpvr has made the decision the next screen will be the **feedback** screen. There are different types of information on this screen including: the **team decision (Ignore / Release)**, the **correct decision (Ignore / Release)**, the **outcome** which was a **Hit** meaning you made the right decision. The **individual station judgments** along the left side of the screen are the recommendations you made

to the Carrier / NurseSpvr and should all be Ignores / Releases. The performance history on the right tells you the **number of trials** and **outcomes**. The **performance score** at the bottom is based on 2 points for a "Hit", 1 for "Near Miss", 0 for "Miss", -1 for "Incident", and -2 for "Disaster". Depending on the outcomes, the background color will vary, for instance green means Hit, and black means Disaster.

15 **At this time I want to make three very important points.**
(1) With 30 seconds it is very important that non-Carrier / non-Supervisor stations make their judgments quickly so as to leave time for the Carrier / NurseSpvr to make the team decision.
(2) When the time is running down and a judgment was already made, the non-Carrier / non-Supervisor stations need to have their menu bar clear and be out of any boxes in order to proceed to feedback and the next trial. To make sure everything's clear you can simply hit the **ESC** key. If you notice negative time on the clock or are still in feedback when others have proceeded to the next game, you need to contact a researcher immediately.
(3) When you are in a box, the clock will appear frozen, but it is actually counting down. Be aware!
(4) There is no talking during the experiment. All communications must take place through the computer.

16 "The next trial will automatically appear on your screens. Go ahead and practice on the next two trials. Notice that there is less time for this trial. After the practice trials, the amount of time you have to make decision will vary so you will need to pay attention to the clock." (Let them make their own decisions.) "I will answer any questions during this time, but after that you will not be allowed to talk. You will be monitored through an intercom and everything you type is recorded by the computer." (During these two trials, make sure everyone understands how to use the computer and that there are no misunderstandings.)

17 At the end of trial #3 hit **Ctrl-F9** on the Carrier's / NurseSpvr's machine and answer any final questions. Refer back to the protocol, item #7.

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