THE RELATIONSHIP BETWEEN TEAM SEX COMPOSITION AND TEAM PERFORMANCE IN THE CONTEXT OF TRAINING COMPLEX, PSYCHOMOTOR, TEAM–BASED TASKS

A Thesis

by

STEVEN JARRETT

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

December 2010

Major Subject: Psychology

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Approved by:

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ABSTRACT

The Relationship Between Team Sex Composition and Team Performance in the Context of Training Complex, Psychomotor, Team–based Tasks. (December 2010)

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The objective of this study was to investigate the role of team sex composition in team training performance and team processes in the context of a complex, psychomotor, information–processing task. With the growing number of women in the workplace, the role of, and implications for, team sex composition is an important research question because there are performance domains, such as psychomotor tasks, where replicable sex differences have been documented. We used 92 four–person teams to investigate the relationship between team sex composition, team declarative knowledge, team–efficacy, team communication, team cohesion, and team performance on a complex, psychomotor, information–processing task.

The results indicate that team sex composition was significantly related to team performance and team declarative knowledge. Furthermore, team performance and team declarative knowledge showed significant mean differences across the levels of team sex composition, such that teams with a larger proportion of males had higher scores on each of the variables. As hypothesized, team communication showed an opposite effect where teams with higher proportions of females reported larger amounts of communication, but

none of the team sex composition pairwise comparisons were significantly different. The posited relationship between team cohesion and team homogeneity was not supported. Finally, there was no evidence for any of the process variables moderating the relationship between team sex composition and team performance.

Team sex composition may be an important variable in training situations where past sex differences have been demonstrated on the performance task of interest. The findings suggest the need to consider instructional design strategies that may mitigate the negative effects of team sex composition on team performance. Future research is needed to determine the extent to which findings from this single study generalize to other psychomotor task domains and how all–female teams will perform under similar circumstances.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER I

INTRODUCTION

Given the complexity of modern workplace tasks, coupled with increasingly sophisticated technology, information processing demands, and the internationalization of the workplace, a majority of organizations use teams to meet their workplace demands (Devine, Clayton, Philips, Dunford, & Melner, 1999). Consequently, researchers and practitioners are interested in identifying factors that influence team processes and performance including team design (e.g., Hackman, 1987; Kozlowski & Bell, 2003; Stewart, 2006), team training (e.g., Kraiger, 2003; Salas et al., 2008), and team composition (e.g., Bell, 2007; Kozlowski & Ilgen, 2006).

Team composition is the configuration of team members' attributes (Moreland & Levine, 1992) and is thought to influence both team processes and outcomes (Kozlowski & Bell, 2003). Team composition can be framed in terms of the input–process–output model (Guzzo & Shea, 1992; Hackman, 1987), such that team composition is a critical input variable. Given that the increasing diversity of the workforce will likely influence the composition of teams in organizations, a greater understanding of how this diversity influences team processes and outcomes is essential. Specifically, with a greater number of females employed in the workforce than ever before (U.S. Bureau of Labor Statistics, 2008), research on how input variables such as sex composition impact the relationship with training process and outcome variables could be quite informative.

This thesis follows the style of *Journal of Applied Psychology*.

Several team composition variables have received considerable attention in the extant literature, including personality traits, values, and abilities (Bell, 2007). However, there is relatively little empirical research regarding the relationships between team sex composition and training outcomes (McGrath, Arrow, & Berdahl, 2000). Thus, team sex composition warrants empirical research based on its potential influence on team process variables (e.g., team communication) and subsequently, team training outcomes (e.g., team performance).

Concomitant with the increased prevalence of teams in organizations, is an interest in developing and implementing effective training interventions to increase team performance. The extent to which individual training principles generalize to team training is not well understood (Arthur, Bell, & Edwards, 2007). Furthermore, interest in team training has generated new streams of training research including cross–training (Salas, Nichols, & Driskell, 2007), virtual team training (Olsen–Buchanan, Rechner, Sanchez, & Schmidtke, 2007; Rosen, Furst, & Blackburn, 2006), and active interlocked modeling (Shebilske, Regian, Arthur, & Jordan, 1992). Meta–analytic evidence indicates team training positively influences team outcomes across a wide range of training methods ($\rho = .39$, $k = 40$, $N = 1{,}024$; Salas et al., 2008).

Since 1974, the female civilian labor force has increased by 74% (U.S. Bureau of Labor Statistics, 2003). Similar trends are present in the military. For instance, in the U.S. Air Force women now represent 16.6% of the active duty personnel (U. S. Department of Defense, 2007). Furthermore, women are no longer restricted to traditionally female–oriented professions and are becoming more prominent in high status positions (Barnett, 2004). Over the next decade experts predict a 10% rise in overall employment and similar growth in predominantly team–based fields for woman (e.g., advertising; U.S. Bureau of Labor Statistics, 2008). This trend may lead to more women joining or being placed on teams that were previously homogeneously male.

Furthermore, females are currently vastly underrepresented in the science, technology, and mathematic fields. One possible explanation for this underrepresentation is males' proclivity for mental rotation which may allow them to excel in math and science fields (Ceci & Williams, 2007). There are several theories for why these sex differences in mental rotation may be present, including biological differences in the necessary skill sets, sociological differences in how males and females are raised, or some combination of the two (Ceci & Williams, 2007). Previous research has provided mixed support for all three theories; however the research has been unable to develop meaningful interventions to increase the representation of females in male–dominated fields. Tsui and Gutek (1999) posit that society should not only want females in these fields, but there is a social need for females to become active members in the male–dominated fields. That is, women can potentially influence male–dominated fields through diversity in the individual differences and social interactions within a mixed–sex team. Thus, in order to increase the amount of women entering science, technology, and mathematic occupations, it is necessary to better understand the processes and hindrances that reduce the likelihood of their entrance into these fields.

Given these trends, it is important to investigate the role of team sex composition in team training processes and performance. Previous research indicates that the effect of team sex composition on team processes and performance varies as a function of the task content (Bowers, Pharmer, & Salas, 2000). For the purpose of the current study, a complex information–processing task that required high levels of psychomotor ability was used. Complex information–processing tasks require short– and long–term memory load, high workload, dynamic attention allocation, decision making, prioritization, and resource management (Ericsson & Charness, 1994; Ericsson, Krampe, & Tesch–Roemer, 1993; Schneider, 1985). The current task is also considered a psychomotor task, such that it requires quick and accurate motor responses (Ackerman, 1987).

The present study's focus on a complex psychomotor, information–processing task is relevant for two reasons. First, these types of tasks are representative of a variety of tasks performed in the military (Johnson & Kobrick, 1997) and industrial sectors (Schwerha, Wiker, & Jaraiedi, 2007). Second, the skills and abilities that underlie the performance of these tasks display sex differences (Hyde, 2005). Said another way, it is not unreasonable to posit that the effects of team sex composition on training performance would be larger for tasks that require skills and abilities that display sex differences compared to tasks that require skills and abilities that do not display sex differences. Thus, because employees are likely to be performing complex psychomotor, information–processing tasks in the context of mixed–sex teams, an empirical assessment of the relationship between team sex composition and team training performance on psychomotor tasks is an important contribution to the extant literature.

Sex Differences

The study of sex differences has a long and controversial past in the history of psychology. Specifically, research on sex differences can be traced back to functionalism when Helen Bradford Thompson first empirically investigated the domain in 1903 (Benjamin, 2009). Although previous researchers attributed observed sex differences to biological differences between males and females, contemporary research argues that sex differences are a function of both genetic and social factors (Levine, Vasilyeva, Lourenco, Newcombe, & Huttenlocher, 2005). A substantial amount of previous research has investigated individual difference variables that display differences between the sexes. Although there are many individual differences that males and females may differ on, two variables that have received considerable attention in the extant literature and are relevant to the present study are spatial and verbal abilities.

Spatial Ability

Spatial ability refers to a group of individual difference variables that include mental rotation and spatial perception. Mental rotation is the ability to rotate two– or three–dimensional objects in one's imagination. Spatial perception is the ability to determine spatial orientation (Linn & Petersen, 1986). In a meta–analysis of sex differences on spatial ability, Voyer, Voyer, and Bryden (1995) found differences favoring males for mental rotation (d = 0.56, k = 78) and spatial perception (d = 0.44, k = 92). However, the magnitude of the differences for spatial abilities varied as a function of the specific research design used. In addition, there is evidence that spatial ability can be improved through training (Cherney, 2008; Newcombe, 2007; Terlecki, Newcombe,

& Little, 2007) or accommodations (e.g., using large displays; Tan, Czerwinksi, & Robertson, 2006).

Although sex differences in static spatial ability (mental rotation and spatial perception) are well established, there is emerging research examining sex differences in dynamic and environmental spatial abilities. Dynamic spatial abilities refer to “the ability to reason about moving stimuli” (Halpern & Collaer, 2005, p. 136). That is, dynamic spatial abilities represent one’s ability to perceive and extrapolate motion, estimate arrival times, and trajectories (Contreras, Rubio, Peña, Colom, & Santacreu, 2007). The preponderance of studies has found that males tend to outperform females on dynamic spatial ability tests as well (e.g., Contreras, Colom, Shih, Alava, & Santacreu, 2001; Contreras et al., 2007; Law, Pellegrino, & Hunt, 1993; Saccuzzo, Craig, Johnson, & Larson, 1996; Schiff & Oldak, 1990).

Environmental spatial abilities refer to the ability to maneuver in and remember one’s position in a specific environment. Environmental spatial ability tasks include “recognition of scenes from a learned environment, retracing routes taken, sketching a map of the environment, route distance estimates, and pointing to nonvisible landmarks in the environment” (Hegarty, Richardson, Montello, Lovelace, & Subbiah, 2002, p. 426). Like dynamic spatial ability, empirical evidence suggests that males tend to outperform females on environmental spatial ability tasks too (Cutmore, Hine, Maberly, Langford, & Grant, 2000; Prestopnik & Roskos–Ewoldson, 2000; Sholl, Acacio, Makar, & Leon, 2000). For example, Cutmore et al. (2000) reported that males outperformed females in a task that required navigating in a 3–D virtual environment. These performance differences were due in part to the ability of males to better acquire route information from landmarks in the virtual environment (Cutmore et al., 2000). This cluster of spatial ability skills are considered necessary for high levels of performance on complex psychomotor, information–processing tasks.

Verbal Ability

Verbal ability is a cluster of individual difference variables that, to some extent, have shown sex differences favoring females (Halpern, 2000; Kimura, 2000). Specifically, several researchers have concluded on the basis of narrative reviews that females are superior to males in verbal ability (Denno, 1982; Halpern, 1986; Lewin, Wolger, & Herlitz, 2001; Maccoby & Jacklin, 1974). The narrative reviews identify consistent findings for verbal ability differences favoring females in writing (d = 0.5–0.6), and language usage (d = 0.4–0.5; Halpern et al., 2007). These conclusions have been echoed in meta–analytic results which show females to be superior to males for a subset of verbal ability constructs such as general verbal ability (d = 0.20, k = 25), solving anagrams (d = 0.22, k = 22), and quality of speech production (d = 0.33, k = 12; Hyde & Linn, 1988). Hyde and Linn (1988) note that the effect sizes are smaller than previously thought and although we concur, we disagree with their conclusion that the effect sizes are so small that they can be considered negligible. That is, because of the consistency of the sex differences identified in primary and meta–analytic research over time as well as across several cultures (Ogle et al., 2003), it is not uninformative to investigate the effect of these differences on training–related outcomes where these differences may play an important role.

Team Sex Composition

The resultant critical question is whether sex differences in spatial, psychomotor, and verbal ability translate into team training performance differences. The role of team composition in team performance is a function of the knowledge, skills, and abilities (KSAs) required to perform the task (Bowers et al., 2000; Wood, 1987). However, the preponderance of research investigating the effect of team sex composition on team performance has been in the context of problem solving or decision–making tasks (e.g., Fenwick & Neal, 2001; Harskamp, Ding, & Suhre, 2008; Orlitzky & Benjamin, 2003). This is a potential limitation because there has been no investigation of the relationship between team sex composition and team performance on tasks that have documented sex differences. In addition, the previous studies used tasks that are considered either disjunctive or compensatory (Steiner, 1966; 1972). Specifically, Steiner proposed four task types (i.e., additive, disjunctive, conjunctive, and compensatory), and posited that the influence of each individual's contributions would differentially affect team performance depending on the task type. For example, a disjunctive task is one in which the contributions of the team's most competent member determines the team's performance. Thus, team sex composition seems to be a non–issue for disjunctive tasks as performance on these tasks is, at least conceptually, determined by one member of the team.

However, the current study requires participants to perform an interdependent psychomotor task, a task type in which previous research has shown males to have higher performance than females. For example, researchers found that males showed higher performance than females on a video–game task and these effects persisted even when the males and females were matched on their video–game experience (Brown, Hall, Holtzer, Brown, & Brown, 1997). That is, the theory that males play more video games and thus, are better at psychomotor tasks does not fully explain performance differences and there may be some differences in ability based on sex.

Given the performance differences between males and females on psychomotor tasks, it was posited that the different ability levels of the males and females would manifest themselves at the team–level of performance. Theoretically, every team member's ability should influence performance in tasks requiring high levels of interdependence, such that a team's performance is the average of all team members' ability to perform the task. In Steiners (1972) typology, a task in which team–level performance is based on the average of the team members' ability is considered a compensatory task. Thus, based on the results of previous studies using psychomotor tasks (e.g., video games) and the well–documented sex differences favoring men on spatial ability and psychomotor ability, it was hypothesized that:

Hypothesis 1: Teams with a higher proportion of males will outperform teams with a lower proportion of males.

Team Processes and Performance

The importance of understanding the processes by which team composition influences team performance is reflected in several theoretical models of team performance (Guzzo & Shea, 1992; Hackman, 1987). Team processes may serve as an explanatory mechanism for the proposed effects between team sex composition and team performance. Thus, we investigate the role of four potential moderating processes, namely team declarative knowledge, team–efficacy, team communication, and team cohesion.

Teamwork vs. Taskwork Processes

The team performance literature distinguishes between two dimensions of team behavior, teamwork skills and taskwork or technical skills. Specifically, teamwork skills are considered global KSAs necessary for individuals to perform interdependently towards a common goal. In addition, teamwork skills are also considered to be behaviors that are required for cooperative functioning. Teamwork skills are distinct from taskwork or technical skills in that taskwork skills are task/job specific (Kozlowski & Bell, 2003). Previous research in this field has identified the predictive ability of taskwork skills using tools such as declarative knowledge tests (Banks & Millwood, 2007) and land navigation skills for military personnel (Goodwin, 1999) to predict future performance.

The relationship between team performance and teamwork skills including interpersonal relations, communication, and decision–making has also been previously established in the literature (Cannon–Bowers & Salas, 1997). Independent of the taskwork skills necessary to perform in a specific domain, developing teamwork skills may positively influence and be a necessary condition for superior team performance (Ellis, Bell, Ployhart, Hollenbeck, & Ilgen, 2005; Salas, Bowers, & Rhodenizer, 1998). For example, Ellis et al. (2005) found that teamwork–specific training was able to improve both cognitive and skill–based outcomes in a command–and–control task. In addition, Rapp and Mathieu (2007) found that teams that were given a teamwork training session performed significantly better in a market simulation task than teams that were only given information on the technical knowledge necessary to perform the task.

These findings indicate that to maximize team performance, members must not only understand the task domain, but also how to effectively interact as a team in order to fulfill a task's requirements. Although teamwork skills are considered an important facet of team performance, it would seem teamwork is a necessary but not sufficient condition for high performing teams. This is not to underplay the importance of teamwork skills, but instead to highlight the significance of taskwork skills for effective performance in a task/job domain. The current study investigates the importance of both teamwork (communication, cohesion, and team–efficacy) and taskwork (declarative knowledge) team processes.

Team Declarative Knowledge

Declarative knowledge is the factual and conceptual information that is necessary to perform a specified task (Banks & Millward, 2007), and is a prerequisite for higher order knowledge or skill development (Ackerman, 1987; Anderson, 1982). Furthermore, declarative knowledge predicts performance for both individuals (r = .48, k = 10; Hunter & Hunter, 1984; Hunter & Schmidt, 1996) and teams (r = .29, k = 24; Devine & Phillips, 2001). For instance, teams with higher mean declarative knowledge scores outperformed teams with lower mean declarative knowledge scores on a simulated business decision–making task (Devine, 1999).

In the context of training on the current study's complex psychomotor, information–processing task, males may have higher levels of declarative knowledge as they tend to have greater interest and motivation to perform these types of tasks. Specifically, males tend to seek out and engage in more high school sports, thus assisting in developing necessary psychomotor and visual skills (Vihjalmsson & Kristjansdottir, 2003). In addition, males tend to play video games more frequently than females, further developing their skills to perform well in tasks of this sort. For instance, in a national survey Gentile (2009) reported that boys played video games more often than girls (d = 0.98), and for longer periods of time (d = 0.57). Furthermore, boys were more likely to have mature–rated video games, which may represent more boys playing first–person shooter games (prototypical example of a complex psychomotor, information–processing task). In sum, males may be more interested and motivated to perform within the context of complex psychomotor, information–processing tasks. Therefore, it is not unreasonable to posit that these differences would be reflected in declarative knowledge scores. Thus, we tested the following hypotheses.

Hypothesis 2a: Team declarative knowledge will be positively related to team performance.

Hypothesis 2b: Teams with a higher proportion of males will display higher levels of declarative knowledge compared to teams with a lower proportion of males.

Hypothesis 2c: Team declarative knowledge will moderate the relationship between team sex composition and team *performance, such that there will be a stronger positive relationship between team performance and team sex composition at high levels of team declarative knowledge.*

Team–efficacy

Team–efficacy refers to a team's "shared belief in its conjoint capabilities to organize and execute the courses of action required to produce given levels of attainments" (Bandura, 1997, p. 477). Although the relationship between team–efficacy and team performance has been well–documented (e.g., Arthur et al., 2007; Gully, Incalcaterra, Joshi, & Beaubien, 2002; Lindsley, Brass, & Thomas, 1995; Porter, 2005), the antecedents of team–efficacy are not as well understood as the antecedents of self–efficacy. The primary antecedents of self–efficacy consist of enactive mastery (experience), vicarious experience, verbal persuasion, and physiological states (Bandura, 1997). For teams, initial evidence suggests these same antecedents contribute to team–efficacy as well (Prussia & Kinicki, 1996). Furthermore, perceptions of other teammates' ability or experience is likely to influence team–efficacy (Edens, 2001), coupled with the perceptions of the team's ability to coordinate their efforts (Bandura, 2000). Thus, team–efficacy is not simply the aggregate of self–efficacy within a team; rather there is an interactive component (Bandura, 1997). Specifically, Bandura posited that self– and team–efficacy diverge as task interdependence increases. Meta–analytic evidence supports this proposition, as team–efficacy demonstrated incremental validity over self–efficacy in predicting performance at high levels but not low levels of task interdependency (Gully et al., 2002).

Concerning sex differences, males tend to have higher spatial ability self–efficacy compared to females (Baenninger & Newcombe, 1995). Social role theory (Eagly, 1987) posits that gender expectations influence the way males and females behave, such that, when individuals perform tasks that are more congruent with their social norms, they will exert more effort in performing the task. Furthermore, Bandura (1986) found that a team's level of efficacy is positively related to the level of effort that members are willing to put forth. Thus, the stereotypical expectation that males will outperform females on complex psychomotor, information–processing tasks may influence team–efficacy. Based on these findings we tested the following hypotheses:

Hypothesis 3a: Team–efficacy will be positively related to team performance.

Hypothesis 3b: Teams with a higher proportion of males will have higher levels of team–efficacy compared to teams with a lower proportion of males.

Hypothesis 3c: Team–efficacy will moderate the relationship between team sex composition and team performance such that there will be a stronger positive relationship between team performance and team sex composition at high levels of team–efficacy.

Team Communication

Team communication refers to team members' skill at exchanging information and utilizing information sharing techniques (Stevens & Campion, 1994).

Communication is conceptualized as a generic teamwork competency that is required in all interdependent team–based tasks and jobs. The main function of communication is to provide a mechanism by which team members can coordinate their actions (Cannon–Bowers, Salas, Tannenbaum, & Mathieu, 1995; Ellis et al., 2005; Marks, Zaccaro, & Mathieu, 2000). Historically, teams that overtly communicate more frequently outperform teams that overtly communicate less frequently (e.g., Bowers, Jentsch, Salas, & Braun, 1998; Cannon–Bowers & Salas, 1997).

In reference to sex differences, meta–analytic research provides evidence for a sex difference in the amount of verbal production ($d = 0.33$; Hyde & Linn, 1988), such that, females produce more verbal communication than males. Given the observed sex differences in verbal production (Ceci, Williams, & Barnett, 2009; Hyde & Linn, 1988) it is not unreasonable to expect that teams with a high proportion of females will communicate more frequently compared to teams with a lower proportion of females. Thus,

Hypothesis 4a: Teams with a higher proportion of females will have higher levels of team communication compared to teams with a smaller proportion of females.

As previously noted, higher levels of communication are typically associated with higher levels of performance on team tasks (e.g., Bowers et al., 1998; Cannon–Bowers & Salas, 1997). However, given the high psychomotor demands of the task used in the present study, the prototypical communication/performance relationship was expected to be attenuated such that communication is expected to display an effect only after some requisite level of psychomotor ability. Thus, team communication is expected to play a necessary but not sufficient role because of the high psychomotor demands of the task. So, for teams with a higher proportion of males, who theoretically have the requisite psychomotor skills to perform the task, team communication is expected to display a stronger relationship with team performance. In summary, although teams with a higher proportion of females are posited to have higher communication scores, it is hypothesized that given the nature of the task, there will be larger performance gains from communication for teams with a higher proportion of males.

Hypothesis 4b: Team sex composition will moderate the relationship between team communication and team performance, such that teams with a higher proportion of males who report higher team communication levels will have higher levels of team performance than teams with lower proportions of males, and teams with lower levels of communication.

Team Cohesion

Team cohesion is classically defined as “the resultant forces that are acting on the members to stay in a group” (Festinger, 1950, p. 274). Barrick, Stewart, Neubert, and Mount (1998) describe team cohesion as “synergistic interactions between team members, including positive communication, conflict resolution, and effective workload sharing” (p. 382). Team cohesion is considered to be an important teamwork process variable because of its positive relationship with team performance. Meta–analytic evidence shows a moderate relationship between cohesion and team performance (d = 0.30, k = 19) in terms of behavioral outcomes (Beal, Cohen, Burke, & Mclendon, 2003).

However, the relationship is weaker when team performance is operationalized in terms of objective outcomes (d = 0.17, k = 47; Beal et al., 2003).

The preponderance of the extant literature generally suggests an inverse relationship between team sex composition and team cohesion such that, as teams become more heterogeneous their team cohesion decreases (Allmendinger & Hackman, 1995). For example, South, Bonjean, Markham, and Corder (1983) found that as the percentage of females increased in previously predominant male intact work teams, the level of social support across group members decreased. In addition, in jobs considered to be blue collar, sex heterogeneity was positively related to the level of emotional conflict in work teams (Pelled, 1996). An investigation of task–oriented teams found that more heterogeneous sex–based teams resulted in lower levels of cohesion (Shapcott, Carron, Burke, Bradshaw, & Estabrooks, 2006). Similar results have been found in the relational demography literature, which investigates how demographic characteristics affect employee perceptions. For example, Riordan and Shore (1997) found that race/ethnic similarity led to more favorable perceptions of an individual's workgroup.

Given the previous findings, we would expect a positive relationship between performance and cohesion and a team's level of cohesion to be inversely related to the sex heterogeneity of the team. Unlike the previous hypotheses, it is not proposed that cohesion will be directly related to the number of males. Instead, cohesion is thought to be related to the level of sex homogeneity of the team. Specifically, the all–male teams will demonstrate the highest level of cohesion followed by the 3–male and 1–male teams and finally the 2–male teams. For a representation of all study hypotheses see Figure 1.

Hypothesis 5a: Team cohesion will be positively related to team performance.

Hypothesis 5b: The level of team cohesion will be negatively related to the sex heterogeneity of the team.

Hypothesis 5c:Team cohesion will moderate the relationship between team sex composition and team performance, such that there will be a stronger positive relationship between team performance and team sex composition at high levels of team cohesion.

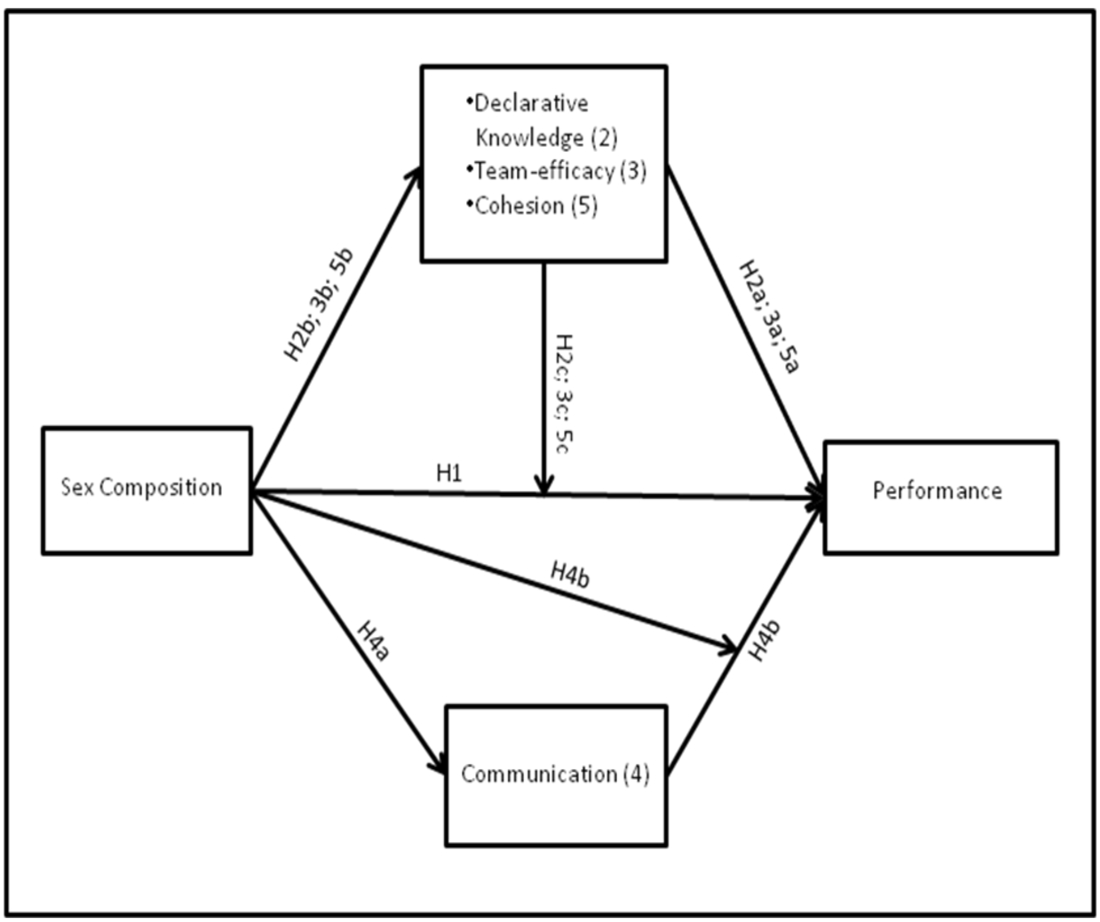

Figure 1. Representation of relationships between the study variables. Number in parentheses indicates corresponding hypotheses.

CHAPTER II

METHOD

Participants

The participants in this study were introductory psychology students at Texas A&M University, who participated in return for partial course credit. Participants were also eligible to receive a monetary reward of $80, $40, or $20 for the teams that attained the three highest average performance scores, respectively. The current data consists of two waves of data collection using the same performance task. The sample was 368 individuals (41.8% female) who participated in 92 4–person teams. Of the 92 teams, 14 (15.22%) were 4–male teams, 21 (22.83%) were 3–male teams, 38 (41.30%) were 2–male teams, and 19 (20.65%) were 1–male teams. There were no all–female teams (the possible implications of this are discussed in the discussion section). Table 1 presents the frequency of teams in the two data collection waves which are discussed in the Procedure section. The participants' mean age was 18.97 years (*SD* = 0.69).

Table 1
Team Sex Composition Frequency Distribution by Study

Team Sex Composition	Wave 1	Wave 1 %	Wave 2	Wave 2 %	Total	Total %
4–Male	9	9.79	5	5.43	14	15.22
3–Male	16	17.40	5	5.43	21	22.83
2–Male	29	31.52	9	9.78	38	41.30
1–Male	16	17.39	3	3.26	19	20.65
Total	70	76.10	22	23.90	92	100

Note. 3–Male refers to a team composition of 3 males and 1 female. Likewise 2–Male refers to 2 males and 2 females, and so on.

Measures

Performance Task —Steel Beasts Pro PE ver. 2.370 (eSim Games, 2007)

Performance was assessed using *Steel Beasts Pro PE,* which is a cognitively complex, PC–based battle tank simulation that allows multiple players to jointly complete a mission on a simulated battlefield. The simulator used highly accurate replicas of U.S. and Russian tanks to simulate an armored warfare environment. The two–tank team performed the task by means of 4–networked computers, with each participant operating the simulator from his/her own computer. Each tank was operated by two participants, with one participant serving as the gunner and the other serving as the commander/driver. Multiple first–person perspective views and a map screen were available to each participant.

Steel Beasts Pro PE Missions. Five missions (Missions A–E) were created to assess the performance of the team members. Each mission required a team to travel to a destination marked on their map and to destroy all 10 enemy tanks on route to their destination. Each mission included a map that marked areas labeled "possible enemy positions." Missions A–C presented participants with seemingly unique missions by varying the placement of the enemy tanks, the areas marked as possible enemy positions, and the teams' destination. Missions D and E were similar to Missions B and C except that the areas marked as possible enemy positions in Missions D and E were twice as large as those in Missions A–C. The larger areas required a greater proficiency in navigating, searching, identifying, and destroying enemy tanks.

Each mission began with a 2–minute briefing session during which teams were encouraged to formulate a strategy to complete the mission. After the briefing, teams were allowed 15 minutes to complete each mission. A mission was terminated when (a) the team had completed the mission objectives (i.e., destroyed all 10 enemy tanks and moved both tanks to the specified location), (b) all of the participants' tanks were destroyed, or (c) when the 15–minute time limit had expired.

Performance scores were obtained at the team–level (i.e., two–tank platoon). Participants earned points for the number of enemy tanks destroyed (10 points per tank) and they lost points for the number of friendly tanks destroyed by fratricide (–20 per fratricide with maximum of 1). Analysis of team performance was based on the mean of the 6 mission performance scores, which could range from –20 to 100. The method used to determine the performance scores was explained to participants during the training. Performance scores were also available for participants to review at the conclusion of every team mission.

Team Declarative Knowledge

Declarative knowledge was assessed using a 30–item, 3–alternative multiple–choice test. The test was developed using the measure used by Arthur, Edwards, Bell, and Bennett (2002) as a guide. Individual declarative knowledge scores were the number of items answered correctly. The correlation between the second and third administrations from first wave (n = 70) resulted in a test–retest reliability of .90 at the team–level. Team scores were calculated by taking the mean of the four team members' declarative knowledge scores after the final performance mission.

Team–efficacy

Arthur et al.'s (2007) team–efficacy measure was modified to reflect the performance task and used to assess team–efficacy. Team–efficacy was measured after the final test session. The measure consisted of six task specific items with a team referent. For example, "I think **my platoon** can meet the challenges of Steel Beasts." Participants rated their 4–person team on a five–point Likert scale (1 = strongly agree; 5 = strongly disagree). Team–efficacy scores were calculated using the mean for all four team members for the post–mission performance administration of team–efficacy. The coefficient alpha for the team–efficacy measure (individual–level) was .92.

Team Communication

Team communication was measured using a 4–item team process scale by Barry and Stewart (1997). Items were reworded to represent the Steel Beasts task and provided information as to the amount of communication between team members. The scale consisted of items such as "My platoon members and I listened to each others' inputs." Using a five–point Likert scale (1 = to a very little extent; 5 = to a very great extent), participants rated their 4–person team. Team communication was calculated using the mean of the item responses for all team members. The coefficient alpha for the communication measure (individual–level) was .72.

Team Cohesion

Team cohesion was measured using a 6–item scale designed by Morgan, Glickman, Woodward, Blaiwes, and Salas (1986). The content of the items were changed to match the performance task. A sample item was, "My *platoon* and I enjoyed interacting with each other." Ratings were made on a 5–point Likert scale (1 = to a very little extent; 5 = to a very great extent) and the measure was scored by obtaining the mean of all team members' responses. The coefficient alpha for the team cohesion measure (individual–level) was .87.

Procedure

The study took five hours and was divided into three phases. During the first phase of the study, participants were familiarized with the protocol, completed the informed consent form, and the baseline Steel Beasts declarative knowledge measure. After completing the measures, participants were then randomly assigned to a specific role within the team, either the gunner or commander/driver position of the performance task, as well as a specific tank. Sex composition was not manipulated a priori in an attempt to provide a natural sex distribution amongst teams.

During the second phase of the study, participants began their individual simulation training. Participants completed the tutorials on four individual computers and monitors using the keyboard and a right handed joystick to navigate through the tutorials/missions. The joystick controlled the participants' viewpoint and was used to judge distances and fire at enemy targets. Each computer had a headset that allowed participants to listen individually to the tutorials and later in team missions communicate with other team members. Trainees were given 45 minutes to read and complete all of the tutorials. For the first tutorial, the researcher read the tutorial to the participants as they followed along in their tutorial handbooks. After completing the first tutorial, participants then completed the remaining tutorials at their own pace. Each tutorial began with participants reading the tutorial content from a tutorial handbook. Once participants understood the content and objectives of the tutorial, they then completed a tutorial–based mission that provided hands–on practice of the tutorial content. Subsequent tutorials continued following the same procedure. Participants who completed their tutorials before the 45–minute time limit were allowed to repeat any of the tutorials if they wanted to.

Upon completing the tutorials, participants then began the third and final phase of the protocol, the team–training phase. To begin this phase of the protocol, participants were shown how to use the headset and voice activated microphones. Participants were asked to demonstrate their ability to use the headsets and microphones, after which they began their first team mission.

Each team mission began with a planning period. Participants were allowed 2 minutes to review the mission briefing and map, formulate a strategy, and discuss the strategy with their teammates during the planning period. Teams were allowed to begin the mission prior to the 2–minute time limit if all team members were ready to do so and agreed to it. Otherwise, the team mission began after 2 minutes had expired. Teams were allowed 15 minutes to complete each team mission. The simulator displayed the mission runtime. Once a team completed a mission or the mission was terminated, teams continued with the subsequent mission until study completion. Team mission briefing (2 minutes) and team mission (15 minutes) time limits were deemed to be sufficient on the basis of pilot testing.

As previously noted, the study data were collected in two waves, such that there were changes to the tutorials, performance missions, and the administration of measures (see Figure 2) made between the first wave (70 teams, 76.1% of total sample) and the second wave of data collection (22 teams, 23.9% of total sample). In Wave 1,

Wave 1

Session	Event
0	Consent Declarative Knowledge Video Game Experience Demographics Position Assignments Tutorials
1	Briefing/Planning Test (M1a)
2	Briefing/Planning Test (M2a) Team–efficacy
3	Briefing/Planning Test (M3a) Declarative Knowledge
4	Briefing/Planning Test (M2b) Team–efficacy
5	Briefing/Planning Test (M3b)
6	Briefing/Planning Test (M1a) Team–efficacy Declarative Knowledge Team Communication Team Cohesion

Wave 2

Session	Event
0	Consent Declarative Knowledge Video Game Experience Demographics Position Assignments Tutorials/Team Tutorial
1	Briefing/Planning Test (M1a) Team–efficacy
2	Briefing/Planning Test (M2a)
3	Briefing/Planning Test (M3a)
4	Briefing/Planning Test (M2b)
5	Briefing/Planning Test (M3b)
6	Briefing/Planning Test (M1a) Team–efficacy Declarative Knowledge Team Communication Team Cohesion

Figure 2. Data collection protocol for the first and second data collection waves.

participants completed 10 tutorials whereas in Wave 2, participants completed only nine tutorials. Two tutorials were dropped because the skills demonstrated in the tutorials were not necessary for mission performance and a team tutorial was added for a total of nine tutorials in Wave 2.

The missions used in the second wave were the same as those used in the first wave with some modifications. Specifically, the enemy firing ranges were reduced with the goal of decreasing the difficulty and consequently increasing the amount of time the teams interacted with the simulator. In addition, the ordering of the missions was changed based on evidence from the first wave to ensure that the missions were progressively more difficult.

To determine whether it was appropriate to collapse the data from the two waves, six analysis of variance (ANOVA) tests were run to examine the relationship between team sex composition, the outcome and process variables (i.e., team performance, team declarative knowledge, team–efficacy, team communication, and team cohesion), and the data collection waves (i.e., Wave 1 and Wave 2). None of the outcome by wave interactions were significant and each demonstrated a small effect size, $\eta^2 = 0.02, 0.01, 0.03, 0.01$, and 0.06 for team performance, team declarative knowledge, team–efficacy, team communication, and team cohesion, respectively. These results suggest that the differences between Wave 1 and Wave 2 did not unduly impact the relationships examined in the current study. As such, it was deemed appropriate to collapse the two data collection waves. So, all subsequent analyses are based of the entire data set (i.e., Waves 1 and 2).

CHAPTER III

RESULTS

Sex Composition and Performance

Table 2 presents the descriptive statistics and intercorrelations among all the study variables. Table 3 provides the means and standard deviations for declarative knowledge, team–efficacy, communication, cohesion, and performance for each configuration of team sex composition. The correlation between team sex composition and performance was statistically significant ($r = .35$, $p < .05$).

Table 2
Descriptive Statistics and Intercorrelations for Study Variables

Variable	*N*	Mean	*SD*	1.	2.	3.	4.	5.
1. Team sex composition	92	2.33	0.97	—				
2. Team declarative knowledge	92	17.67	1.78	.34*	—			
3. Team–efficacy	92	3.29	0.52	.15	.36*	—		
4. Team communication	90	4.16	0.38	–.17	.10	.36*	—	
5. Team cohesion	90	3.85	0.52	–.05	.13	.43*	.81*	—
6. Team performance	92	14.29	9.65	.35*	.32*	.31*	.28*	.32*

Note. Team sex composition indicates the number of males on a 4–person team, such that 4 = all–male team and 1 = 1 male and 3 females. Performance is operationalized as the number of kills minus fratricides (10 points for kills, –20 for fratricides, range = –20 – 100). Two teams did not provide complete data for team communication and cohesion. * $p < .05$ (one–tailed).

Hypothesis 1 stated that teams with a higher proportion of males would outperform teams with fewer males. A 1–way ANOVA was ran to examine this hypothesis. The results indicated a significant main effect for team sex composition on team performance $F\ (3, 88) = 6.05$, $p < .05$, $\eta^2 = 0.17$. Furthermore, planned comparisons using Tukey's multiple comparison procedure indicated that 4–male teams outperformed 3–, 2–, and 1– male teams (see Table 4). The remaining comparisons resulted in a general pattern of results that were in the hypothesized direction (with the exception of the 1–male/2–male comparison) and although none of them reached statistical significance, the pattern seems to provide mixed support for Hypothesis 1.

Table 3

Variable Means and Standard Deviations by Team Sex Composition

Variable	1–Male			2–Male			3–Male			4–Male		
	Mean	*SD*	*N*	Mean	*SD*	*N*	Mean	*SD*	*N*	Mean	*SD*	*N*
Team declarative knowledge	17.06	1.30	19	17.30	1.80	38	18.08	1.90	21	18.88	1.47	14
Team–efficacy	3.32	0.52	19	3.15	0.57	38	3.33	0.41	21	3.62	0.38	14
Team communication	4.31	0.35	18	4.10	0.40	37	4.26	0.31	21	3.97	0.41	14
Team cohesion	4.06	0.42	18	3.69	0.56	37	3.93	0.45	21	3.84	0.52	14
Team performance	12.28	10.30	19	11.82	7.30	38	14.52	9.21	21	23.33	10.60	14

Note. 4–Male = all–male teams; 3–Male = 3 males/1 female; 2–Male = 2 males/2 females; 1–Male = 1 male/3 females. Declarative knowledge scores can range from 0 – 30 and performance scores can range from –20 – 100.

Table 4

Pairwise Team Performance Differences by Team Sex Composition

Comparison	*d*
1–Male vs 2–Male	–0.05
1–Male vs 3–Male	0.23
1–Male vs 4–Male	1.06*
2–Male vs 3–Male	0.34
2–Male vs 4–Male	1.39*
3–Male vs 4–Male	0.90*

*Note. d*s were computed by subtracting the first condition from the second such that a positive *d* indicates the participants in the second condition had higher performance. * $p < .05$ (one–tailed).

Team Declarative Knowledge

The second set of hypotheses pertained to the relationships between team declarative knowledge, team sex composition, and team performance. It was posited that team declarative knowledge would be positively related to team sex composition and team performance. In addition, team declarative knowledge was hypothesized to moderate the relationship between team sex composition and team performance. The correlation between declarative knowledge and performance was statistically significant ($r = .32$, $p < .05$), thus Hypothesis 2a was supported. Furthermore, teams with a higher proportion of males had higher declarative knowledge scores than teams with a lower proportion of males ($r = .34$, $p < .05$).

The results of a 1–way ANOVA indicated significant mean differences between groups F (3, 88) = 4.30, $p < .05$, $\eta^2 = 0.13$. The results of the planned comparisons indicated that 4–male teams had higher declarative knowledge scores than 1–male teams ($d = 1.22$, $p < .05$) and 2–male teams ($d = 0.88$, $p < .05$). Similar to team performance, although none of the other pairwise comparisons (e.g., 3–male vs 2–male) were statistically significant, they did show a consistent pattern of the results in the hypothesized direction (see Table 5). Thus, there was mixed support for Hypothesis 2b.

Hypothesis 2c stated that team declarative knowledge would moderate the relationship between team sex composition and performance. For all of the subsequent moderation analyses the variables were centered at the mean to reduce multicollinearity in the moderated ANOVA. The results showed significant main effects for both team sex composition and team declarative knowledge but the sex composition by declarative

Table 5
Pairwise Team Declarative Knowledge Differences by Team Sex Composition

Comparison	*d*
1–Male vs 2–Male	0.11
1–Male vs 3–Male	0.79
1–Male vs 4–Male	1.22 *
2–Male vs 3–Male	0.55
2–Male vs 4–Male	0.88 *
3–Male vs 4–Male	0.34

*Note. d*s were computed by subtracting the first condition from the second condition. * $p < .05$ (one–tailed).

knowledge interaction term was not statistically significant $F= (1, 88) = 1.73, p > .05, \eta^2 = .02$ (see Table 6). These results suggest that the effect of declarative knowledge on the relationship between team sex composition and performance was not significant. Thus, Hypothesis 2c was not supported.

Table 6
ANOVA Results for Study Variables Moderating the Relationship Between Sex Composition and Performance

Variables	*F*	η^2
Team declarative knowledge[A]		
Sex composition	12.92*	.12
Declarative knowledge	4.79*	.05
Sex composition × declarative knowledge	1.73	.02
Team–efficacy[A]		
Sex composition	18.49*	.12
Team–efficacy	45.61*	.24
Sex composition × team–efficacy	1.94	.01
Team communication[B]		
Sex composition	12.34*	.11
Communication	13.09*	.12
Sex composition × communication	0.51	.04
Team cohesion[B]		
Sex composition	12.53*	.11
Cohesion	13.18*	.12
Sex composition × cohesion	1.94	.02

Note. [A] $N = 92$ and [B] $N = 90$. All variables were centered at the mean. *$p < .05$.

Team–efficacy

The third set of hypotheses considered the relationship between team–efficacy, team sex composition, and team performance. The correlation between team–efficacy and performance was statistically significant ($r = .31$, $p < .05$). Thus, Hypothesis 3a was supported. The relationship between team–efficacy and team sex composition was not significant ($r = .15$, $p < .05$). The results of a 1–way ANOVA testing differences in team–efficacy for each level sex composition indicated there was not a significant main effect for sex composition $F\ (3, 88) = 2.01$, $p > .05$, $\eta^2 = 0.06$. Furthermore none of the pairwise comparisons identified significant differences between the levels of sex composition (see Table 7). Thus, Hypothesis 3b was not supported.

Table 7
Pairwise Team–efficacy Differences by Team Sex Composition

Comparison	*d*
1–Male vs 2–Male	–0.21
1–Male vs 3–Male	–0.12
1–Male vs 4–Male	0.54
2–Male vs 3–Male	0.10
2–Male vs 4–Male	0.84
3–Male vs 4–Male	0.77

*Note. d*s were computed by subtracting the first condition from the second such that a positive *d* indicates the participants in the second condition had higher team efficacy than that of the first condition.
* $p < .05$ (one–tailed).

To test Hypothesis 3c, which posited that the relationship between team sex composition and performance would be moderated by team–efficacy, we tested the interaction term of team–efficacy and sex composition. The results indicated that the interaction term was not significantly related to team performance (F (1, 88) = 1.94, $p >$ .05, $\eta^2 = 0.01$; see Table 6). Therefore, Hypothesis 3c was not supported.

Team Communication

Team communication was posited to have a negative relationship with team sex composition, such that teams with a higher proportion of males would show lower levels of communication. Team sex composition was also hypothesized to moderate the relationship between team communication and team performance. Although communication did show an inverse relationship with the number of males on the team, the relationship was not significant (r = –.17, p > .05).

The 1–way ANOVA identified a significant difference between the groups F (3, 86) = 3.10, p < .05, $\eta^2 = 0.10$, such that the mean amount of communication was lower for teams with a higher proportion of males. Further investigation using Tukey's multiple comparison procedure indicated that the only significant difference between the groups was that between 4–male and 1–male teams (d = –0.90, p < .05). Similar to team performance and declarative knowledge, the other pairwise comparisons for communication were generally in the hypothesized direction with the exception of the 3–male/2–male comparison (see Table 8). Thus, there was mixed support for Hypothesis 4a.

To investigate Hypothesis 4b—which posited a stronger positive relationship between team communication and performance amongst teams with a higher proportion of males—team sex composition was tested as a moderator of the relationship between team communication and team performance. The interaction was not significant, F (1, 86) = 0.51, p >.05, η^2= .00 (see Table 6). Hence, there was no support for communication as a moderator.

Table 8
Pairwise Team Communication Differences by Team Sex Composition

Comparison	*d*
1–Male vs 2–Male	–0.55
1–Male vs 3–Male	–0.15
1–Male vs 4–Male	–0.90*
2–Male vs 3–Male	0.43
2–Male vs 4–Male	–0.32
3–Male vs 4–Male	–0.82

*Note. d*s were computed by subtracting the first condition from the second such that a positive *d* indicates the participants in the second condition had higher communication than that of the first condition. * p < .05 (one–tailed).

However, because communication was positively related to performance (r = .28) but negatively related to team sex composition (r = –.17), we sought to reconcile this pattern of results by further exploring the hypothesized moderation effect by using an extreme groups approach. Specifically, the analyses were rerun using only the 4–male (n = 14) and 1–male (n = 18) teams F (3, 31) = 8.38, p <.05, η^2= 0.47. Not surprisingly, because of the small sample sizes and associated levels of low power (.54), the interaction term was again not significant, F (1, 31) = 2.93, p >.05, η^2= 0.06. Nevertheless, a plot of the means (see Figure 3), using a median split for communication indicated a pattern of results that was consistent with the hypothesized effect.

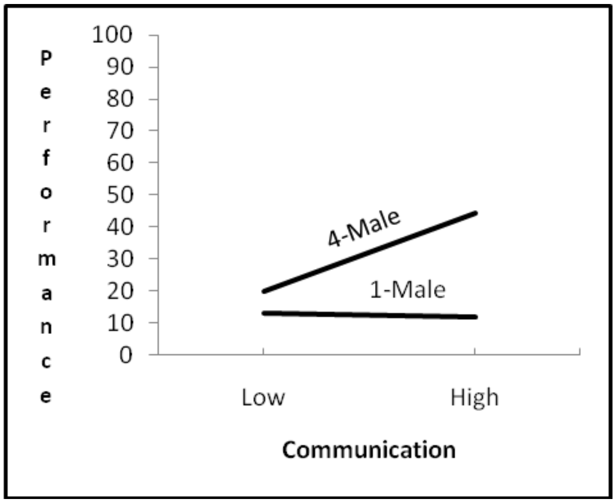

Figure 3. Plot of the interaction term for sex composition × communication on performance.

Team Cohesion

Team cohesion was hypothesized to be positively related to team performance. In addition, it was also hypothesized that team cohesion would be positively related to the team's level of sex homogeneity and moderate the relationship between team sex composition and team performance. Team cohesion showed a significant relationship to team performance (r = .32, p < .05), thus providing support for Hypothesis 5a.

To further investigate the effect of sex composition on team cohesion, a 1–way ANOVA was performed and found no statistically significant differences across the different team sex composition configurations, F (3, 86) = 2.37, p > .05, η^2= 0.07. To determine if any of the pairwise comparisons were significantly different, we once again performed a Tukey's multiple comparison procedure. Similar to the ANOVA findings, there were no statistical differences between any of the pairwise comparisons (see Table 9). Hence, there was no support for Hypothesis 5b.

Table 9
Pairwise Team Cohesion Differences by Team Sex Composition

Comparison	*d*
1–Male vs 2–Male	0.75
1–Male vs 3–Male	0.30
1–Male vs 4–Male	0.47
2–Male vs 3–Male	–0.47
2–Male vs 4–Male	–0.28
3–Male vs 4–Male	0.19

*Note. d*s were computed by subtracting the first condition from the second such that a positive *d* indicates the participants in the second condition had higher cohesion than that of the first condition.

A test of the effect the team sex composition × team cohesion interaction term was not statistically significant, $F\ (1, 86) = 1.94$, $p > .05$, $\eta^2 = 0.02$. Thus, contrary to Hypothesis 5c, there was no evidence to support team cohesion as a moderator of the relationship between team sex composition and team performance.

CHAPTER IV

CONCLUSIONS

The extant literature on demographic team composition variables (e.g., race and sex) has focused predominantly on performance in the context of problem solving and decision–making tasks (e.g., Fenwick & Neal, 2001; Orlitzky & Benjamin, 2003). However, sex–based diversity has grown in all areas of industry, such that mixed–sex teams are called upon to perform a multitude of team–based tasks. Therefore, the present study advances the field by investigating the effects of team sex composition using a psychomotor task—a task domain that has shown consistent sex differences between males and females. Specifically, the objective of the current study was to examine the relationships between team sex composition, team performance, team declarative knowledge, team–efficacy, team communication, and team cohesion.

The Effect of Team Sex Composition on Training Processes and Outcomes

The first conclusion that can be drawn from the current findings is that the number of males on a team is positively related to the team's task performance. The results indicated that all–male teams outperformed 3–, 2–, and 1–male teams. However, there were no statistically significant differences between 3–, 2–, and 1–male teams. Furthermore, team declarative knowledge was positively related to team sex composition and team performance. Similar to team performance, the results for team declarative knowledge indicated a significant difference between all–male teams and 2– and 1–male teams. Of the remaining variables (i.e., team–efficacy, team communication, and team cohesion), only team communication scores were significantly different across the levels of team sex composition; the amount of communication was negatively related to the number of males on a 4–person team.

The team performance findings mirror the results found in the literature investigating individual sex differences on psychomotor tasks (Bowers et al., 1997). Thus, in the context of psychomotor tasks, low–performing team members may negatively impact task performance even in teams that are comprised of predominantly high–ability members. These results are consistent with Steiner's (1972) conceptualization of a compensatory task, such that performance is the average of all members' ability to perform the task. Specifically, it seems that one low–performing team member can significantly impact the level of performance for that team. Furthermore, the results indicate that one–female team member had a similar effect on performance as a team that is predominantly female (1 male and 3 females), given the lack of mean differences between these levels of sex composition (i.e., 1–male vs. 2–male vs. 3–male).

The nature of the task used in the present study may partially explain the lack of significant mean differences for performance amongst the teams with female participants (i.e., 1–, 2–, and 3–male teams). Specifically, the absence of performance differences may be due to the difficulty of the task leading to a low mean–level of performance scores and a restricted amount of variance. That is, the variance across performance scores was relatively small, making it more difficult to identify differences between the groups. That being said, we consider these performance differences to be meaningful based on the consistent pattern of effects across the training variables.

Independent of team–level performance, low–performing teammates may affect each team members' ability to learn a complex task in a team–training environment. That is, previous research indicates that an individual's training partners can influence individual performance in the context of complex tasks (Bowler, Woehr, Rentsch, & Bowler, 2009; Day et al., 2005). For example, Day et al. (2005) found that when a high–ability team member was paired with another high–ability individual, both training partners had significantly higher individual performance scores than high–ability individuals who were paired with low–ability individuals. Similar performance results were found when a team member was paired with an aggressive partner, such that teams with an aggressive team member displayed lower individual performance scores (Bowler et al., 2009). Thus, it would seem that the effect of team sex composition on task knowledge and performance could potentially span beyond the team–level to the individual team members. Unfortunately, due to the lack of individual–level data, we were unable to directly test this effect in our study.

Mixed–sex teams not only presented lower performance scores, but these teams demonstrated less knowledge of the training task. Thus, given the positive relationship between knowledge and performance, it would seem that lower scores on the team declarative knowledge could subsequently lead to performance differences based on team sex composition (Hunter & Schmidt, 1996). However, given the temporal structure of the current data, we were unable to directly investigate team declarative knowledge as a mediator. In addition, there was no evidence for team declarative knowledge moderating the relationship between team sex composition and team performance.

Although there was no evidence of team declarative knowledge as a mediator or moderator, given the importance of declarative knowledge in the context of training scenarios and the relationship with team performance, the mean differences across the levels of team sex composition is an important finding for organizations that use team training protocols.

Given the well–documented findings for the relationship between team–efficacy and team performance (e.g., Arthur et al., 2007) it was not surprising that those results were replicated in this study. However, contrary to our expectations, there were no mean differences on team–efficacy based on team sex composition. Bandura (1986) found evidence for a positive relationship between team–efficacy and the level effort exerted in a given task. Given a positive relationship between team–efficacy and level of effort, one would acknowledge that the knowledge and performance differences found here are most likely a function of the knowledge and ability of the team members and not their motivation to perform. This supports the claim that the psychomotor demands of the current task are such that, without the requisite knowledge and skills, teams will be unable to perform at a high level. Thus, it would seem that to improve team performance, training should focus on the knowledge and skills necessary to perform the task and less so on the team's attitudes or perceptions towards performing the task.

Kraiger (2003) discusses two team–related behavioral domains that are positively related to performance, specifically teamwork and taskwork skills. In addition, previous studies have indicated that the number of female team members was positively related to the amount of team communication, a teamwork variable that displays a positive relationship with team performance (Ellis et al., 2005). Similar to Ellis et al. (2005), communication was significantly related to team performance in our study. However, even though the amount of communication was higher for teams with a greater proportion of females, these differences were not related to higher mean levels of performance for teams with a higher proportion of females. This provides preliminary evidence for the hypothesis that teams must obtain a minimal level of task knowledge and skills to garner the positive effects of teamwork skills.

Furthermore, although the results indicated that the team sex composition × team communication interaction was not significant, there was some evidence for sex composition as a potential moderator. Analyses using the two extreme groups (i.e., 4–male and 1–male teams) demonstrated a pattern of results that was consistent with the notion that there would be larger performance gains from communication for those teams who possess the necessary psychomotor ability. However, the pattern of results was not consistent across the other levels of team sex composition (e.g., 3–male and 2–male teams. Another possible explanation for sex composition not moderating the communication — performance relationship could be a misspecification of the relationship. Specifically, a more appropriate conceptualization may be that of moderated mediation, such that communication mediates the relationship between ability and performance, but it is differentially related at different levels of sex composition. By using a moderated mediation framework it would allow for a test of the generalizability of the ability → communication → performance relationship across the levels of sex composition.

Finally, the current study's operationalization of communication as the *amount* of verbal communication between team members may be a potential factor for why team sex composition did not moderate the relationship between communication and performance. Other operationalizations of communication, such as the focus of communication, may better explain some of the variance in team performance. Furthermore, whereas sex composition did not moderate the relationship between team communication and team performance in the current task, higher amounts of communication associated with female team members may be an effective means of increasing team performance in tasks that are not predominantly driven by psychomotor skills.

Implications

This study suggests the need to consider instructional design strategies that may mitigate the negative effects of team sex composition on team knowledge and performance. In the current training protocol, the number of males on a four–person team was positively related to the team's declarative knowledge and performance scores. Hence, it is important to investigate other instructional design features to determine if they can be equally as effective for both males and females. Such design features include varying the spacing of the practice interval (Arthur et al., in press), increasing the training period or training to mastery, and training on the whole task instead of using part training.

Furthermore, one could provide training on the necessary knowledge and skills relevant to the specific task. Providing training on the specific spatial ability skills necessary to perform the task could improve females' performance (Cherney, 2008; Newcombe, 2007; Terlecki, Newcombe, & Little, 2007) and reduce the gap between teams that differ in terms of their sex composition. These different training strategies and interventions may allow mixed–sex teams to achieve performance levels similar to those obtained from all–male teams.

An additional implication is the potential for team sex composition to influence performance outcomes of work teams. Understanding how team sex composition will affect teams is important for organizational personnel who place employees into teams. Given the inconsistent findings for team sex composition as a function of the task (Bowers et al., 2000) and outcome (Beal et al., 2003), it is important to understand the boundary conditions under which team sex composition operates. Thus, it may be necessary to match team sex composition with the task and outcomes of interest.

Limitations and Directions for Future Research

One potential limitation of the current study is the use college students performing in teams with a limited life span. The threats to ecological validity associated with the use of college students in laboratory settings have been well–documented. Furthermore, the results of the current study may not generalize to training interventions where females are given the opportunity to train on their spatial and psychomotor skills. However, when mixed–sex teams are trained in the context of a complex psychomotor, information–processing task, the training intervention may need to either (a) provide initial training on psychomotor skills and/or spatial ability, or (b) increase the length of the training to allow low–ability trainees to develop the required skills. The extended session or increased practice interval may lead to smaller mean performance differences by sex composition as has been demonstrated in previous research. For example, previous studies have found that increased training and exposure to spatial ability tasks can reduce the role of sex differences (Cherney, 2008; Newcombe, 2007; Terlecki et al., 2007).

Another potential limitation is the absence of all–female teams. The presence of all–female teams would have permitted an informative extreme contrast of all–male to all–female teams. Specifically, it is not difficult to envision qualitatively different team processes occurring in all–female teams. For instance, the higher performance scores for all–male teams could have been a function of their homogeneity and less so the absence of a female team member. However, there is little reason to believe that all–female teams would display a different pattern of performance from that which we see here, given the effects of mixed–sex teams.

Given the several limitations that were discussed previously, it would seem that there are several study characteristics that could be altered to provide a more robust experimentation of the study variables. The first change would be to collect the entire dataset under one protocol, thereby reducing the likelihood that the protocol may unduly impact the results. In addition, the use of all-female teams would allow researchers to determine if the effects are specific to mixed-sex teams or are indicative of low-ability team members. Related to this, as opposed to relying on sex as a surrogate for spatial and psychomotor ability, it would be advantageous to directly measure these individual differences and thus allow for a better understanding of how mixed–teams influence performance. Furthermore, reducing the difficulty of the task may allow for greater variance in performance and increase the likelihood of identifying differences between the groups. However, it is important to note that reducing the difficulty could alter the task type, thus it would be necessary to pilot the new missions to ensure that the task does not change from a complex to simple task. Finally, future research should increase the spacing interval between training and mission performance. This would increase learning and provide a more ecologically valid representation of the training and performance environment.

The current study extends the extant sex composition literature by examining performance implications on a complex psychomotor, information–processing task. Furthermore, these findings highlight the importance of investigating the role of team sex composition using different task–types. Additional research investigating the effect of low–ability team members on the other team members' individual performance is also warranted.

Future research is also needed to further investigate the conclusions drawn from this study's findings. For instance, is there some minimal level of task knowledge and skills necessary for teamwork variables to be able to affect performance? Similarly, additional research should be conducted to determine the underlying processes by which mixed–sex teams can increase their cohesion. The current findings indicated that a team's level of heterogeneity was positively related to team cohesion; this ran contrary to findings in previous team sex composition research (Riordan & Shore, 1997; Shapcott et al., 2006). In addition, future sex composition research should investigate other possible moderators such as the focus of team communication and motivation to perform the task. However, this is only one study which uses a different performance task than usually associated with this type of research, thus replication of these findings is needed to assess their robustness.

Finally, investigations examining the extent to which distributed (as opposed to co–located) training protocols mitigate or exacerbate the team sex composition effects are warranted. Specifically, travel time and costs are a large burden on organizations that attempt to train individuals in a co–located fashion. Furthermore, there is some evidence that the increased anonymity associated with computer–mediated communication can increase performance and feelings of justice within mixed–sex teams (Triana, 2009). As such, determining if distributed training protocols are as effective, if not more, than co–located protocols in the context of mixed–sex teams is an important area of research.

Summary

Given the increasing diversity of the workforce, particularly in terms of more females in the workforce, it is important to understand the boundary conditions under which current training design characteristics are effective for training diverse work teams. The current study investigated the effect of team sex composition in 4–person teams on training outcome and process variables in the context of a complex psychomotor, information–processing task. As expected, the number of males on a 4–person team was positively related to the teams' declarative knowledge and performance scores. Team communication seemed to be positively related to the number of females on the team, which is consistent with previous research investigating sex differences in verbal communication. However, team sex composition did not show a consistent pattern of relationships with the teams' level of team–efficacy and cohesion. These findings highlight the importance of identifying different training design characteristics that can mitigate the observed differences between predominantly male and predominantly female action teams.

REFERENCES

Ackerman, P. L. (1987). Individual differences in skill learning: An integration of psychometric and information processing perspectives. *Psychological Bulletin, 102,* 3–27.

Allmendinger, J., & Hackman, J. R. (1995). The more, the better? A four–nation study of the inclusion of women in symphony orchestras. *Social Forces, 74,* 423–460.

Anderson, J. R. (1982). Acquisition of a cognitive skill. *Psychological Review, 89*, 369–406.

Arthur, W. Jr., Bell, S. T., & Edwards, B. D. (2007). A longitudinal examination of the comparative criterion–related validity of additive and referent–shift consensus operationalizations of team–efficacy. *Organizational Research Methods, 10,* 35–58.

Arthur, W. Jr., Day, E. A., Villado, A. J., Boatman, P. R., Kowollik, V., Bennett, W. Jr., & Bhupatkar, A. (in press). The effects of distributed practice on immediate post–training, and long–term performance on a complex command–and–control task. *Human Performance.*

Arthur, W. Jr., Edwards, B. D., Bell, S. T., & Bennett, W. Jr. (2002). *Identifying Factors That Influence the Cognitive Readiness and Performance of Teams: The Development and Evaluation of a High Fidelity Synthetic Team Task Performance Environment (STTPE) Lab*. Grant/contract No. F41624–97–C–5000, L–3 Mesa, AZ, Communications Corporation, Link Simulation and Training Division.

Baenninger, M., & Newcombe, N. (1995). Environmental input to the development of sex–related differences in spatial and mathematic ability. *Learning and Individual Differences, 7,* 363–379.

Bandura, A. (1986). *Social Foundations of Thought and Action.* Englewood Cliffs, NJ: Prentice–Hall.

Bandura, A. (1997). *Self–efficacy: The Exercise of Control*. New York: Freeman.

Bandura, A. (2000). Exercise of human agency through collective efficacy. *Current Directions in Psychological Science, 9,* 75–78.

Banks, A. P., & Millward, L. J. (2007). Differentiating knowledge in teams: The effect of shared declarative and procedural knowledge on team performance. *Group Dynamics: Theory, Research, and Practice, 11,* 95–106.

Barnett, R. C. (2004). Women and work: Where are we, where did we come from, and where are we going? *Journal of Social Issues, 4,* 667–674.

Barrick, M. R., Stewart, G. L., Neubert, M. J., & Mount, M. K. (1998). Relating member ability and personality to work–team processes and team effectiveness. *Journal of Applied Psychology*, *83*, 377–391.

Barry, B., & Stewart, G. L. (1997). Composition, process, and performance in self–managed groups: The role of personality. *Journal of Applied Psychology, 82*, 62–78.

Beal, D. J., Cohen, R. R., Burke, M. J., & McLendon, C. L. (2003). Cohesion and performance in groups: A meta–analytic clarification of construct relations. *Journal of Applied Psychology, 88,* 989–1004.

Bell, S. T. (2007). Deep–level composition variables as predictors of team performance: A meta–analysis. *Journal of Applied Psychology, 92*, 595–615.

Benjamin, L. T., Jr. (2009). *A History of Psychology: Original Sources and Contemporary Research.* Malden, MA: Blackwell Publishing.

Bowers, C. A., Jentsch, F., Salas, E., & Braun, C. C. (1998). Analyzing communication sequences for team training needs assessment. *Human Factors, 40,* 672–679.

Bowers, C. A., Pharmer, J. A., & Salas, E. (2000). When members homogeneity is needed in work teams: A meta–analysis. *Small Groups Research, 31,* 305–327.

Bowler, M. C., Woehr, D. J., Rentsch, J. R., & Bowler, J. L. (2009). The impact of aggressive individuals on team training. *Personality and Individual Differences, 49,* 88–94.

Brown, R. M., Hall, L. R., Holtzer, R., Brown, S. L., & Brown, N. L. (1997). Gender and video game performance. *Sex Roles, 36,* 793–812.

Cannon–Bowers, J. A., & Salas, E. (1997). Teamwork competencies: The interaction of team member knowledge, skills, and attitudes. In H. F. O'Neil (Eds.), *Workforce Readiness: Competencies and Assessment* (pp. 45–62). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Cannon–Bowers, J. A., Salas, E., Tannenbaum, S. I., & Mathieu, J. E. (1995). Toward theoretically based principles of training effectiveness: A model and initial empirical investigation. *Military Psychology, 7,* 141–164.

Ceci, S. J., &Williams, W. M.(2007). *Why Aren't More Women in Science?* Washington, D.C.: American Psychology Association.

Ceci, S. J., Williams, W. M., & Barnett, S. M. (2009). Women's underrepresentation in science: Sociocultural and biological considerations. *Psychological Bulletin, 135,* 218– 261.

Cherney, I. D. (2008). Mom, let me play more video games: They improve my mental rotation skills. *Sex Roles, 59,* 776–786.

Contreras, M. J., Colom, R., Shih, P. C., Alava, M. J., & Santacreu, J. (2001). Dynamic spatial performance: Sex and educational differences. *Personality & Individual Differences*, *30*, 117–126.

Contreras, M. J., Rubio, V. J., Peña, D., Colom, R., & Santacreu, J. (2007). Sex differences in dynamic spatial ability: The unsolved question of performance factors. *Memory & Cognition, 35,* 297–303.

Cutmore, T. R. H., Hine, T. J., Maberly, K. J., Langford, N. M., & Hawgood, G. (2000). Cognitive and gender factors influencing navigation in virtual environments. *International Journal of Human–Computer Studies, 53,* 223–249.

Day, E. A., Arthur, W. Jr., Bell, S. T., Edwards, B. D., Bennett, W. Jr., Mendoza, J. L., et al. (2005). Ability–based pairing strategies in the team–based training of a complex skill: Does the intelligence of your training partner matter? *Intelligence, 33,* 39–65.

Denno, D. (1982). Sex differences in cognition: A review and critique of the longitudinal evidence. *Adolescence, 17,* 779–788.

Devine, D. (1999). Effects of cognitive ability, task knowledge, information sharing, and conflict on group decision–making effectiveness. *Small Group Research, 30*, 608–634.

Devine, D. J., Clayton, L. D., Philips, J. L., Dunford, B. B., & Melner, S. B. (1999). Teams in organizations prevalence, characteristics, and effectiveness. *Small Groups Research, 30,* 678–711.

Devine, D. J., & Phillips, J. L. (2001). Do smarter teams do better: A meta–analysis of cognitive ability and team performance. *Small Group Research*, *32*, 507–532.

Eagly, A. H. (1987). Reporting sex differences. *American Psychologist, 7,* 756–757.

Edens, D. (2001). Means efficacy: External sources of general and specific subjective efficacy. In M. Erez, U. Kleinbeck, & H. Thierry (Eds.), *Work Motivation in the Context of a Globalizing Economy* (pp. 65–77). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Ellis, A. P. J., Bell, B. S., Ployhart, R. E., Hollenbeck, J. R., & Ilgen, D. R. (2005). An evaluation of generic teamwork skills training with action teams: Effects on cognitive and skill–based outcomes. *Personnel Psychology, 58,* 641–672.

Ericsson, K. A., & Charness, N. (1994). Expert performance: It's structure and acquisition. *American Psychologist, 49,* 725–747.

Ericsson, K. A., Krampe, R. T., & Tesch–Roemer, C. (1993). The role of deliberate practice in the acquisition of expert performance. *Psychological Review, 100,* 363–406.

eSim Games. (2007). *Steel Beasts Pro PE ver. 2.370* [Computer software]. Mountain View, CA: Author.

Fenwick, G. D., & Neal, D. J. (2001). Effect of gender composition on group performance. *Gender and Work Organization, 8,* 205–225.

Festinger, L. (1950). Informal social communication. *Psychological Review*, *57*, 271–284.

Gentile, D. (2009). Pathological video–game use among youth ages 8 to 18: A national study. *Psychological Science, 20,* 594–602.

Goodwin, G. F. (1999). *Predicting performance in U. S. Army Special Forces Teams: Staffing and Composition Issues*. Unpublished dissertation. The Pennsylvania State University, State College, PA.

Gully, S. M., Incalcaterra, K. A., Joshi, A., & Beaubien, J. M. (2002). A meta–analysis of team–efficacy, potency, and performance: Interdependence and level of analysis as moderators of observed relationships. *Journal of Applied Psychology, 87,* 819–832.

Guzzo, R. A., & Shea, G. P. (1992). Group performance and intergroup relations in organizations. In M. D. Dunnette & L. H. Hough (Eds.). *Handbook of Industrial and Organizational Psychology* (pp. 269–313). Palo Alto, CA: Consulting Psychologists Press.

Hackman, J. R. (1987). The design of work teams. In J. Lorsch (Ed.), *Handbook of Organizational Behavior* (pp. 315–342). Englewood Cliffs, NJ: Prentice Hall.

Halpern, D. F. (1986). A different answer to the question, “Do sex–related differences in spatial abilities exist?” *American Psychologist, 41,* 1014–1015.

Halpern, D. F. (2000). *Sex Differences in Cognitive Abilities.* Hillsdale, NJ: Erlbaum.

Halpern, D. F., Benbow, C. P., Geary, D. C., Gur, R. C., Hyde, J. S., & Gernsbacher, M. A. (2007). The science of sex differences in science and mathematics. *Psychological Science in the Public Interest, 8,* 1–51.

Halpern, D. F., & Collaer, M. (2005). Sex differences in visuospatial abilities: More than meets the eye. In P. Shah & A. Miyake (Eds.), *Higher–level Visuospatial Thinking and Cognition.* Cambridge, MA: Cambridge University Press.

Harskamp, E., Ding, N., & Suhre, C. (2008). Group composition and its effect on female and male problem solving in science education. *Educational Research, 50,* 307–318.

Hegarty, M., Richardson, A. E., Montello, D. R., Lovelace, K., & Subbiah, I. (2002). Development of a self–report measure of environmental spatial ability. *Intelligence, 30,* 425–447.

Hunter, J. E., & Hunter, R. F. (1984). Validity and utility of alternative predictors of job performance. *Psychological Bulletin, 96,* 72–98.

Hunter, J. E., & Schmidt, F. L. (1996). Intelligence and job performance: Economic and social implications. *Psychology, Public Policy, and Law, 2,* 447–472.

Hyde, J. S. (2005). The gender similarity hypothesis. *American Psychologist, 60,* 581–592.

Hyde, J. S., & Linn, M. C. (1988). Gender differences in verbal ability: A meta–analysis. *Psychological Bulletin, 104,* 53–69.

Johnson, R. F., & Kobrick, J. L. (1997). Effects of wearing chemical protective clothing on rifle marksmanship and on sensory and psychomotor tasks. *Military*

Psychology, 9, 301–314.

Kimura, D. (2000). *Sex and cognition*. Cambridge, MA: MIT Press.

Kozlowski, S. W. J., & Bell, B. S. (2003). Work groups and teams in organizations. In W. C. Borman, D. R. Ilgen, & R. J. Klimoski (Eds.), *Handbook of Psychology: Industrial and Organizational Psychology* (*Vol. 12.* pp. 333–375). London: Wiley.

Kozlowski, S. W. J., & Ilgen, D. R. (2006). Enhancing the effectiveness of work groups and teams. *Psychological Science in the Public Interest, 7,* 77–124.

Kraiger, K. (2003). Perspectives on training and development. In W. C. Borman, D. R. Ilgen, & R. J. Klimoski (Eds.), *Handbook of Psychology: Industrial and Organizational Psychology* (Vol. 12, pp. 171–192). New York: Wiley.

Law, D. J., Pellegrino, J. W., & Hunt, E. B. (1993). Comparing the tortoise and the hare: Gender differences and experience in dynamic spatial reasoning tasks. *Psychological Science*, *4*, 35–40.

Levine, S. C., Vasilyeva, M., Lourenco, S. F., Newcombe, N. S., & Huttenlocher, J. (2005). Socioeconomic status modifies the sex difference in spatial skills. *Psychological Science, 16,* 841–845.

Lewin, C., Wolger, G., & Herlitz, A. (2001). Sex differences favoring women in verbal but not in visuospatial episodic memory. *Neuropsychology, 15,* 165–173.

Lindsley, D. H., Brass, D. J., & Thomas J. B. (1995). Efficacy–performance spirals: A multi–level perspective. *Academy of Management Review, 20,* 645–678.

Linn, M. C., & Peterson, A. C. (1986). Gender differences in spatial ability: Implications for mathematics and science performance. In J. Hyde & M. C. Linn (Eds.), *The psychology of gender: Advance through meta–analysis.* Baltimore: John Hopkins University Press.

Maccoby, E. E., & Jacklin, C. N. (1974). *The psychology of sex differences.* Stanford, CA: Stanford University Press.

Marks, M. A., Zaccaro, S. J., & Mathieu, J. E. (2000). Performance implications of leader briefing and team–interaction training for team adaptation to novel environments. *Journal of Applied Psychology, 85,* 971–986.

McGrath, J. E., Arrow, H., & Berdahl, J. L. (2000). The study of groups: Past, present, and future. *Personality and Social Psychology Review, 4,* 95–105.

Moreland, R. L., & Levine, J. M. (1992). The composition of small groups. In E. Lawler, B. Markovsky, C. Ridgeway, & H. Walker (Eds.), *Advances in group processes* (Vol. 9, pp. 237–280). Greenwich, CT: JAI Press.

Morgan, B. B., Jr., Glickman, A. S., Woodward, E. A., Blaiwes, A. S., & Salas, E. (1986). *Measurement of team behaviors in a Navy training environment* (Tech. Report TR–86–014).

Newcombe, N. S. (2007). Taking science seriously: Straight thinking about spatial sex differences. In S. J. Ceci, & W. M. Williams (Eds.), *Why Aren't There More Women in Science: Top Researchers Debate the Evidence* (pp. 69–77). Washington, DC: American Psychological Association.

Ogle, L., Sen, A., Pahlke, E., Jocelyn, L., Kostberg, D., Roey, S., et al. (2003). *International Comparisons in Fourth–Grade Reading Literacy: Findings from* *the Progress in International Literacy Study (PIRLS) of 2001*. Washington, DC: U.S. Government Printing Office.

Olsen–Buchanan, J. B., Rechner, P. L., Sanchez, R. J., & Schmidtke, J. M. (2007). Utilizing virtual teams in management principles course. *Education & Training, 49,* 408–423.

Orlitzky, M., & Benjamin, J. D. (2003). The effects of sex composition on small–group performance in a business school competition. *Academy of Management Learning & Education, 2,* 128–138.

Pelled L. H. (1996). Relational demography and perceptions of group conflict and performance: A field investigation. *International Journal of Conflict Management, 7,* 230–246.

Porter, C. O. L H., (2005). Goal orientation: Effects on backing up behavior, performance, efficacy, and commitment in teams. *Journal of Applied Psychology, 90,* 811–818.

Prestopnik, J. L., & Roskos–Ewoldson, B. (2000). The relations among wayfinding strategy use, sense of direction, sex, familiarity, and wayfinding ability. *Journal of Environmental Psychology, 20,* 177–191.

Prussia, G. E., & Kinicki, A. J. (1996). A motivational investigation of group effectiveness using social–cognitive theory. *Journal of Applied Psychology, 81,* 187–198.

Rapp, T. L., & Mathieu, J. E. (2007). Evaluating an individually self–administered generic teamwork skills training program across time and levels. *Small Groups*

Research, 38, 532–555.

Riordan, C. M., & Shore, L. M. (1997). Demographic diversity and employee attitudes: An empirical examination of relational demography within work units. *Journal of Applied Psychology, 82,* 342–358.

Rosen, B., Furst, S., & Blackburn, R. (2006). Training for virtual teams: An investigation of current practices and future needs. *Human Resource Management, 45,* 229–247.

Saccuzzo, D. P., Craig, A. S., Johnson, N. E., & Larson, G. E. (1996). Gender differences in dynamic spatial abilities. *Personality and Individual Differences*, *21*, 599–607.

Salas, E., Bowers, C. A., & Rhodenizer, L. (1998). It is not how much you have but how you use it: Toward a rational use of simulation to support aviation training. *The International Journal of Aviation Psychology, 8,* 197–208.

Salas, E., DiazGranados, D., Kein, C., Burke, C. S., Stagi, K. C. et al. (2008). Does team training improve team performance? A meta–analysis. *Human Factors, 50,* 903–933.

Salas, E., Nichols, D. R., & Driskell, J. E. (2007). Testing three team-training strategies in intact teams: A meta–analysis. *Small Group Research, 38*, 471–488.

Schiff, W., & Oldak, R. (1990). Accuracy of judging time to arrival: Effects of modality, trajectory and gender. *Journal of Experimental Psychology: Human Perception and Performance*, *16*, 303–316.

Schneider, W. (1985). Training high–performance skills: Fallacies and guidelines.

Human Factors, 27, 285–300.

Schwerha, D. J., Wiker, S. F., & Jaraiedi, M. (2007). Effect of distracters, age, and level of education upon psychomotor task learning. *International Journal of Industrial Ergonomics, 37,* 801–809.

Shapcott, K. M., Carron, A. V., Burke, S. M., Bradshaw, M. H., & Estabrooks, P. A. (2006). Member diversity and cohesion and performance in walking groups. *Small Groups Research, 37,* 701–720.

Shebilske, W. L., Regian, J. W., Arthur, W. Jr., & Jordan, J. A. (1992). A dyadic protocol for training complex skills. *Human Factors, 34,* 369–374.

Sholl, M. J., Acacio, J. C., Makar, R. O., & Leon, C. (2000). The relation of sex and sense of direction to spatial orientation in an unfamiliar environment. *Journal of Environmental Psychology, 20*, 17–28.

South S. J., Bonjean, C. M., Markham, W. T., & Corder, M. (1983). Female labor–force participation and the organizational experience of male workers. *Sociological Quarterly, 24,* 367–380.

Steiner, I. D. (1966). Models for interring relationships between group size and potential group productivity. *Behavioral Science*, 11, 273–283.

Steiner, I. D. (1972). *Group process and productivity*. New York: Academic Press.

Stevens, M. J., & Campion, M. A. (1994). The knowledge, skill, and ability requirements for teamwork: Implications for human resource management. *Journal of Management, 37,* 503–530.

Stewart, G. L. (2006). A meta–analytic review of relationship between team design features and team performance. *Journal of Management, 32,* 29–55.

Tan, D. S., Czerwinski, M. P., & Robertson, G. C. (2006). Large displays enhance optical flow cues and narrow the gender gap in 3–D virtual navigation. *Human Factors, 48,* 318–333.

Terlecki, M. S., Newcombe, N. S., & Little, M. (2007). Durable and generalized effects of spatial experience on mental rotation: Gender differences in growth patterns. *Applied Cognitive Psychology, 22,* 996-1013.

Triana, M.C. (2009). *Are virtual teams more just? An investigation of how reducing social categorization can increase female participation in male–dominated teams.* (Unpublished Dissertation). Texas A&M University.

Tsui, A. S., & Gutek, B. A. (1999). *Demographic Differences in Organizations.* Latham, MD: Lexington Books

Vilhjalmsson, R. & Kristjansdottir, G. (2003). Gender differences in physical activity in older children and adolescents: The central role of organized sport. *Social Science and Medicine, 56,* 363–374.

Voyer, D., Voyer, S., & Bryden, M. P. (1995). Magnitude of sex differences in spatial abilities: A meta–analysis and review. *Psychological Bulletin, 117,* 250–270.

U.S. Bureau of Labor Statistics. (2003). *Employment Characteristics of Families in 2003*.Retrieved August 8th , 2009, from http://www.bls.gov/cps/wlf–databook.htm

U.S. Bureau of Labor Statistics. (2008). *Occupational Employment and Job Opening Data and Worker Characteristics*. Retrieved July 8th , 2010, from http://www.bls.gov/emp/ep_table_106.htm

U.S. Department of Defense. (2007). *Military Manpower, Annual Information.* Washington DC: Congressional Information Service.

Wood, W. (1987). Meta–analytic review of sex differences in group performance. *Psychological Bulletin, 102,* 53–71.

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