JAILZA SILVA CADER PAULY
Types of KSAs and Levels of Task Interdependence: Their Effects on Internal Processes and Outcomes of Teams performing a Production Task
(Under the Direction of LILLIAN T. EBY)

This study examined the effects of team composition based on task- and team-related knowledge, skills, and abilities (KSAs) on internal processes and outcomes of production teams. After being screened for task- and team-related KSAs, 44 groups of four individuals were formed. Team composition was systematically manipulated into combinations of high and low task- and team-related KSAs. Teams performed the Circuit Board Assembly Task © under two conditions of task interdependence. Hypotheses were tested with repeated measures analysis of variance or analysis of covariance at the group-level of analysis. Levels of task interdependence were related to two group internal processes (i.e., communication and task conflict) and one type of group outcome (i.e., quantity of output). In addition, specific task-related KSAs at the group-level were associated with quantity of output. Findings are discussed from theoretical and empirical perspectives along with the presentation of suggestions for future team composition research. Implications for theory and practice are also presented.

INDEX WORDS: Personnel Selection, Teams, Task Interdependence, Team- and Task-related KSAs, Team Composition, Production Tasks

TYPES OF KSAS AND LEVELS OF TASK INTERDEPENDENCE: THEIR EFFECTS ON INTERNAL PROCESSES AND OUTCOMES OF TEAMS PERFORMING A PRODUCTION TASK

by

JAILZA SILVA CADER PAULY

Bacharel em Psicologia, Universidade Federal da Bahia, Brasil, 1992

M.S., The University of Tennessee at Chattanooga, 1995

A Dissertation Submitted to the Graduate Faculty of The University of Georgia in Partial Fulfillment of the Requirements for the Degree

DOCTOR OF PHILOSOPHY

ATHENS, GEORGIA

2001

TYPES OF KSAS AND LEVELS OF TASK INTERDEPENDENCE: THEIR EFFECTS ON INTERNAL PROCESSES AND OUTCOMES OF TEAMS PERFORMING A PRODUCTION TASK

by

JAILZA SILVA CADER PAULY

Approved:

Major Professor: Lillian Eby

Committee: Charles Lance
Robert Mahan
Kecia Thomas
Garnett Stokes

Electronic Version Approved:

Gordhan L. Patel
Dean of the Graduate School
The University of Georgia
December 2001

DEDICATION

To Markus, with all my love and gratitude for your constant support and presence, especially during the many months in which we had the Atlantic between us.

ACKNOWLEDGMENTS

This work would not have been possible if it were not for the support, guidance, prayers, and words of encouragement from my professors, colleagues, friends, and family. They contributed to making this dissertation a reality in many different ways and their special touch is present throughout this document. To all of them, I can only say "muito obrigada, de coração". Nevertheless, I would like to leave here a record of names (whenever possible) as a demonstration of my gratitude to the ones who had a very direct impact on this project.

For your kind assistance through supervision, sound professional advice and understanding, I thank my advisor, Dr. Lillian Eby, and my committee members, Drs. Chuck Lance, Rob Mahan, Garnett Stokes, and Kecia Thomas.

For your help with video ratings, instruments, data collection, room scheduling, programming, photos, transporting of materials, and so many other ways, I thank Dr. Adam Meade, Allyson Mann, Amelia Maia, Dr. Andy Solomon, Angie Lockwood, Barbara Dial, Bill Gentry, Dr. Bridget Boyle, Cacilda Cader, Carrie Noble, Dr. Douglas Johnson, Eric Gerber, Eric Popp, Dr. Gail Wise, Dr. Gary Lautenshlager, Janet Fowler, Jennifer Commisiong, Kathy Shoemaker, Kalisha Hudgies, Kecia Bingham, Mandy Gray, Marcus Butts, Dr. Martin Levy, Mary Alice Crowe-Taylor, Melissa McMahan, Dr. Michael Stevens, Pilar Quintana, Dr. Ragin Hause, Research Pool Participants, Sales personnel at School Box and Home Depot, Sarah Stanley, Scott Mondore, Sharon James, Dr. Tim Irwin, and Tracy Lambert. I have been very fortunate to have your company as I worked on this project.

Financial support for this dissertation was provided in part by CNPq, an agency of the Brazilian Government dedicated to scientific and technological development.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

In recent years much has been said about the use of teams[1] and about the reasons why their utilization can benefit organizations (e.g., Cohen & Bailey, 1997; Ilgen, Major, Hollenbeck, & Sego, 1990; Tannembaum, Salas, & Cannon-Bowers, 1996). Gordon (1992) reported that 8 out of 10 organizations with 100 employees or more in the United States had assigned people to work in groups identified as teams. At least 80 percent of organizations using teams at that time claimed that they had improved quality, customer service, productivity, profits, and morale. In 1996, Gittleman, Horrigan, and Joyce reported findings on the extent to which organizations had adopted work practices that characterize flexible organizations. Based on a national representative sample, they reported that 32% of all establishments with 50 or more employees used work teams and the primary activity of those organizations was manufacturing. Currently, cross-functional teams is one of the most widely used approaches for manufacturing improvement (Flores, O'Leary-Kelly, & Vokurk, 1998) and the popularity of work teams in various industries continues to increase (Lawler, 1999).

Despite widespread utilization of teams, researchers have not yet fully addressed some basic human resources management (HRM) systems that directly impact teams, nor the implications that processes within these systems may bring for teams and organizational outcomes. One example of such a process is the selection and staffing of team members. Reviewing personnel selection literature from approximately mid- 1993 to 1996, Borman, Hanson and Hedge (1997) stated that there had been great progress toward understanding work groups and work group effectiveness, but only some preliminary attempts to apply that understanding to selection and staffing issues. Four years later, examining personnel selection research from 1995 to 1999, Hough and Oswald (2000) made a similar assertion: although "…much has been learned about factors affecting team performance and effectiveness …more work remains for personnel selection" (p. 648).

There have been calls for team based human resource systems (Cannon-Bowers & Salas, 1997; Stevens & Campion, 1994) and research on group formation and its implications on subsequent performance and processes (Owens, Mannix, & Neale, 1998). It has also been suggested that taxonomies of "team differences"(i.e., the group-level equivalent of individual differences) are needed to advance team selection research (Hough & Oswald, 2000) and that cross-level relationships should be included in personnel selection practices (Schneider, Smith, & Sipe, 2000). However, while these proposals are not answered, logical strategies based on small group and personnel selection research are being adopted as a means to provisionally solve the challenge of selecting team members and staffing teams (Klimoski & Zukin, 1999).

Task-related knowledge, skills, and abilities (KSAs) (e.g., technical skills) have long been employed in the selection of employees for individual jobs. KSAs have been the corner stone of selection processes, being used to determine selection criteria and the content of selection measures. Recent theoretical developments suggest that team-related KSAs (e.g., communication skills, conflict management) are potential requirements for team work and should also be assessed when candidates are being chosen to work in team environments (Cannon-Bowers & Salas, 1997; Cannon-Bower, Tannenbaum, Salas, & Volpe, 1994; Stevens & Campion, 1994; Owens et al., 1998). Although these theoretical advances are important during times in which little research is available on how to best build teams (Klimoski & Zukin, 1999), few studies have empirically addressed questions related to the use of task and team KSAs for team composition (e.g., Kichuck, 1996; Mohammed, Mathieu, & Barlett, 2000). In addition, Hough and Oswald (2000) have

---

[1] The terms "teams" and "groups" will be used interchangeably to refer to a collection of three or more individuals working on a complex and interdependent task that is linked to some important group outcome

called attention to the fact that specific team circumstances need to be considered when addressing team member selection issues. That is because individual characteristics interact with team attributes such as the type of task or the degree of specialization of team members' roles, influencing performance and effectiveness.

Taking this observation into account, two basic questions related to the use of task- and team-related KSAs for the selection of team members have not yet been answered. The first question relates to the nature of the relationship between these two types of KSAs in teams performing production tasks. Specifically, are performance differences predicted by task- and team-related KSAs the result of additive or non-additive relationships? The second question is whether task interdependence moderates the relationship between KSA types and teams' internal processes and outcomes. In other words, are task-related KSAs and team-related KSAs differentially important under different conditions of task interdependence?

This study examines the effects of team composition, based on team- and task-related KSAs, on the internal processes and outcomes of teams working on a production task under two levels of interdependence. The present study contributes to the team composition and to the team selection and staffing literatures in several ways. First, this research attempts to provide empirical evidence about the nature of the relationship between task- and team-related KSAs and the impact of such relationship on group processes and outcomes. Understanding how task- and team-related KSAs function together can provide guidance about how to best combine people for effective team performance. In addition, task-related KSAs other than cognitive ability and personality variables are examined, which answers a call for consideration of a wider range of composition variables in team research (Jackson, May, & Whitney, 1995; Mohammed et al., 2000).

The study also addresses Hough and Oswald's (2000) request for including team circumstances in studies related to team member selection by examining the impact of

---

(Sundstrom, DeMeuse, & Futrell, 1990).

levels of task interdependence on team composition. Although task interdependence has been considered a defining characteristic of teams (Hackman, 1987; Guzzo & Shea, 1992), empirical investigations into the role of task interdependence on team composition, and consequent impact for selection practices, has not been extensive. Furthermore, while previous research has addressed the effects of single individual-level inputs on team effectiveness, this investigation focuses exclusively at the group-level of analysis. The impact of group-level inputs and their effects on group level processes and outcomes is examined through manipulations of team composition based on task- and team-related KSAs. In addition, because research with production teams has been scant despite their widespread use in manufacturing settings (Fuxman, 1998, 1999), this study examines the effects of team composition on teams performing a production task.

CHAPTER 2

REVIEW OF THE LITERATURE

While task-related KSAs (e.g., technical skills) have long been used to select employees, recent theoretical developments suggest that team-related KSAs (e.g., communication skills and conflict management) should also be assessed when candidates are being chosen to work in team environments (Cannon-Bowers & Salas, 1997; Cannon-Bower, et al., 1994; Stevens & Campion, 1994; Owens et al., 1998). Team settings place great interpersonal demands on team members adding potential requirements for effective performance. Specifically, when working in teams, in addition to being capable of performing the job, individuals should also be able to engage in effective interactions with their peers (Steven & Campion, 1994). However, empirical investigations have not yet been undertaken to address two important questions related to the role of task- and team-related KSAs in team composition. The first question relates to the nature of the relationship between these two types of KSAs. The second question asks whether task interdependence moderates the relationship between KSA types and teams' internal processes and outcomes. To address these questions, the present study examines the effects of team composition based on team- and task-related KSAs on the processes and outcomes of teams working on a production task with two levels of interdependence.

Before introducing the proposed study, it is necessary that an appropriate context be provided for the study's research propositions. Hence, a heuristic framework is presented. Following this, the role of task interdependence on team composition is discussed and justifications for investigating production teams are presented. Then, two types of KSAs are distinguished and relevant theoretical and empirical works related to KSAs and teams are examined. This review is followed by an outline of the present study. The main research questions are detailed, variables of interest are discussed, and specific propositions are advanced after the presentation of theoretical or empirical rationale for the questions posed.

Organizing Framework

The input-process-output (IPO) framework has been the predominant theoretical reference in the study of teams (Gladstein, 1984; Guzzo & Shea, 1992; Hackman, 1987; McGrath, 1964). The IPO model (Figure 1) postulates that input factors affect group outputs through the interactions of group members (Hackman, 1987; McGrath, 1964).

Individual-level factors Group-level factors Environmental-level factors	→	Group interactions	→	Performance outcomes Other outcomes
INPUT		PROCESSES		OUTCOMES

Figure 1. Input-Process-Output Model (Adapted from McGrath, 1964)

Inputs have been grouped into three categories: individual-level factors (e.g., team member characteristics), group-level factors (e.g., structure), and environmental-level factors (e.g., task characteristics). Group interactions (i.e., processes) refer to the interchanges that take place among group members such as communication, supportiveness, and conflict. Group outputs are related to performance outcomes (e.g., performance quantity) and other outcomes such as member satisfaction.

While the IPO model has been extensively used, it has also been widely criticized. The model does not account for relevant features of the organization external to the team or for the many boundaries that link and separate work teams within their organizations (Sundstrom et al., 1990). In fact, factors external to the team and boundary management have been found to affect internal task processes and communication (Ancona & Caldwell, 1992), coordination (Argote, 1982), productivity (Straus & McGrath, 1994), and group member attitudes (Trist, Susman, & Brown, 1977). In addition, empirical support for the IPO model has been mixed. For example, Gladstein (1984) found that group processes mediated the relationship between inputs and soft group outcomes such as members' attitudes, but they did not mediate the relationship between inputs and performance outcomes such as sales revenues.

Despite its shortcomings, the IPO model has been a useful framework to organize research findings (Hackman, 1987) and has provided a theoretical basis for the study of work groups in organizational settings (e.g., Barrick, Stewart, Neubert, & Mount, 1998; Campion, Medsker, & Higgs, 1993; West & Anderson, 1996). More importantly, the model signals that group members perform not only task functions, but they also engage in behaviors and develop attitudes that have the team itself or its members as ends. This characteristic of the model served as a reference for the choice of variables in this study. That is, both group processes (i.e., task cohesion, communication, task conflict, and cooperation) and outcomes related to objective (e.g., quantity and quality of output) and subjective (e.g., team viability) team performance are investigated.

In addition, because team phenomena are multilevel (i.e., take place at the individual-, intra-group- or inter-group levels), it is important to consider and clearly specify levels of theory, measurement, and analysis when conducting research on teams. According to Rousseau (1985), level of theory describes the focal unit of interest or the target the researcher intends to explain. Level of measurement refers to the source of data, and level of analysis relates to the unit to which the data are assigned for hypothesis testing and statistical analysis. For example, in team settings, perceptions of efficacy can occur both at the individual- and at the group-levels. That is because while individuals might possess self-held beliefs about their capabilities of performing a given task (i.e., self-efficacy), they can also hold individual beliefs about the team's ability to be effective on a specific task (i.e., collective efficacy) or share general perceptions that the group can perform successfully (i.e., group potency) (Guzzo, Yost, Campbell, & Shea, 1993; Prussia & Kinicki, 1996). When levels of theory, measurement, and analysis are incongruent, results might reflect the level of measurement, for example, rather than the appropriate level of theory, and conclusions might be erroneously drawn (Klein, Danssereau, & Hall, 1994). To prevent such problems, specifying levels of interest and ensuring that constructs, measures, and analysis reflect the appropriate levels are necessary steps to establishing sound research (Rousseau, 1985).

The focus of this investigation is on understanding relationships at the group-level[2]. Justifications for this choice are based on two factors. First, the IPO model and some empirical evidence suggest that group-level inputs impact team processes and outcomes. For example, group size needs to be large enough to enable teams to perform the tasks assigned to them. However, when group size is too large, performance might be compromised by communication and coordination demands (Campion et al, 1993; Gladstein, 1984). Second, empirical evidence about the effects of combinations of team member characteristics on team performance is scant. Specifically, many studies related to team composition have investigated the impact of isolated individual-level variables on the performance of teams (e.g., cognitive ability, Tziner & Eden, 1985; individualistic orientation, Wagner, 1995). While this type of research has provided some indication about which variables should be considered in team member selection, it has not provided evidence related to how characteristics of team members should be combined for increased group performance (Jackson, 1992). Nevertheless, a major challenge in team staffing is that organizations need to seek not only the best-qualified individuals for the job, but the best combination of individuals for the team (Hackman, 1990; Jones, Stevens, & Fischer, 2000; Klimoski & Zukin, 1999; Mohammed et al., 2000; Sundstrom, 1999). Because group-level inputs have the potential to affect team processes and outcomes and the effects of combinations of team member characteristics on team processes and outcomes have not been extensively researched, this study investigates the impact of group-level inputs (i.e., task- and team-related KSAs composition combinations) on group-level processes and outcomes.

[2] Levels of measurement and levels of analysis issues will be discussed in detail in the methods section.

Basic Team Elements and their Implications for Team Selection and Staffing

Task Interdependence

A consistent finding in the small group and work teams literature is that the type of task performed by a team is crucial for understanding the team itself (McGrath, 1984; Saavedra, Early, & VanDyne, 1993; Steiner, 1972). Despite different terminology to categorize tasks, researchers agree that the type of task is important for determining team composition (Cannon-Bowers & Salas, 1997; Cannon-Bowers, Oser, & Flanagan, 1992; Guzzo & Shea, 1992; McGrath, 1984; Mohammed et al., 2000; Owens et al., 1998; Steiner, 1972; Tesluk, Mathieu, Zacarro, & Marks, 1997). The type of task can influence the distribution and use of resources within a team (Doer, Mitchell, Klastorin, & Brown, 1996) and affect team members' contributions to the group's outcome (Steiner, 1972; Thompson, 1967). It can also impact team members' perceptions of each other (Jackson, 1992) and alter the role of individual difference variables in team composition (Barrick et al., 1998; Barry & Stewart, 1997).

Various task typologies have been proposed over the years [e.g., McGrath's (1984) task circumplex, Steiner's (1972) categorization based on the ways that members can combine their individual efforts]. However, when applied to work groups, many existing task typologies are limited in that only a few task types apply to the work place or they do not account for differing levels of team member interdependence. Task interdependence refers to the degree to which group members must rely on one another to perform their tasks effectively (Kiggundu, 1983; Saavedra et al., 1993) and it is a defining characteristic of work teams (Hackman, 1975, 1993; Guzzo & Shea, 1992; Saavedra et al., 1993; Salas, Dickinson, Converse, & Tannenbaum, 1992).

A major advantage of task classifications based on the degree of interdependence is their application across types of work groups and consequent suitability for generalizability of research findings. For example, Thompson (1967) and Van de Ven and Ferry (1980) describe tasks based on the work flow (Figure 2). Thompson proposes three types of work flow and Van de Ven and Ferry add a fourth type. Work flow refers to how team members rely on each other for inputs and information at every stage of the task. Work flows have both direction (i.e., order in which work moves from one person to another) and amount (i.e., relative quantity of work that flows between members of a group). It is the amount of work flow that indicates the degree of task interdependence within organizational units (Van de Ven & Ferry, 1980).

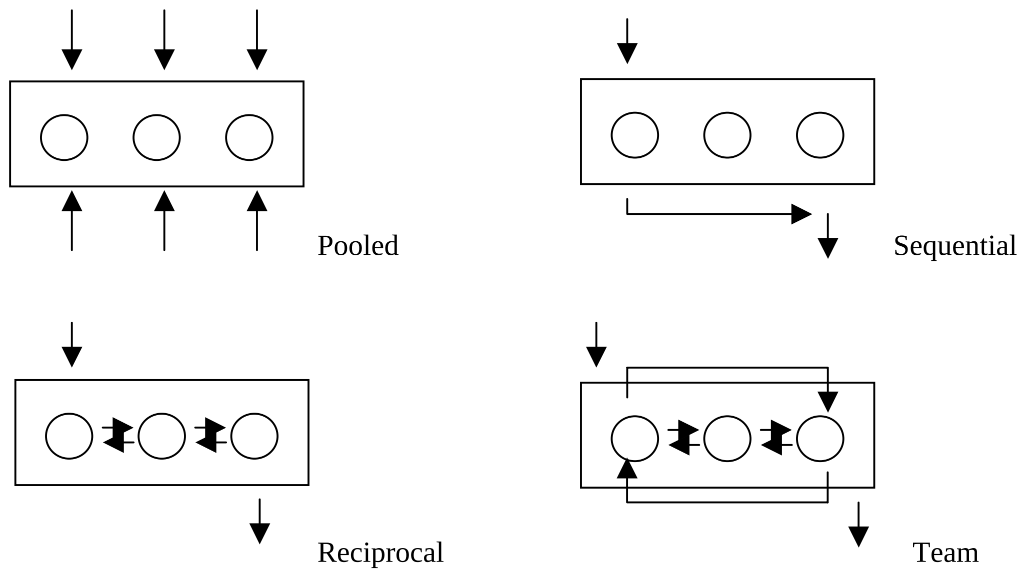


Figure 2. Task Work Flow (Van de Ven & Ferry, 1980)

In the independent work flow (see Pooled example in Figure 2), members contribute to the task independently without direct interactions with the other team members (e.g., data processing groups). Groups have a sequential work flow (see Figure 2) when group members have different roles, perform different tasks, and their activities flow mostly in one direction (e.g., admissions registration teams in hospitals). However, when group members have different roles but work and activities flow back and forth between group members over a period of time, the work flow is called reciprocal (e.g., social services group) (see Figure 2). When work and activities come into the team and members jointly diagnose, problem-solve, and collaborate to complete a task, then the team has an intensive or team work flow (e.g., surgery teams) (see Figure 2).

Task interdependence creates special job requirements (Klimoski & Jones, 1995). That is, to perform well as a work unit, team members must possess skills and abilities that allow them to deal with demands imposed on the group by greater levels of interdependence. For example, research has suggested that there is a positive relationship between member motor ability and group performance for groups working on motor tasks (Comrey 1953, 1954a, 1954b). However, Gill (1979) found that when members were required to collaborate simultaneously on motor tasks (i.e., the task was highly interdependent), the higher ability member could not compensate for the lower ability member's poor performance and the lower ability member dominated the group's performance. That is, the higher ability member performed at the level of the lower ability member[3]. In situations such as these, frustration or conflict might arise due to the extent of task interdependence required. Thus, it stands to reason that group members need the team–related skills necessary to address these challenges.

Conditions of higher interdependence demand greater flexibility, coordination, and communication skills of team members than conditions of low interdependence. In general, as interdependence becomes more complex, the greater the need that members rely on one another for effective task performance (Saavedra et al., 1993). Consequently, task interdependence poses requirements other than the ones that can be addressed with task-related KSAs alone. Therefore, as task interdependence increases, it becomes more necessary that group members possess the skills and abilities to collaborate and undertake mutual adjustments among themselves; in short, team-related KSAs increase in importance. Taken together, this suggests that evaluation of task interdependence can help determine expected levels of interaction among team members. Therefore, task interdependence can help establish team member requirements and how these should be distributed among group members for effective task performance.

---

[3]Comrey's (1953, 1954a, 1954b) and Gill's (1979) studies employed dyads not teams. However, since the current study employs a task that requires motor skills and studies about motor tasks and teams were not

Type of Team

It is also important to consider the type of team when discussing team selection and staffing. That is because predictors of team effectiveness vary by type of team (Cohen & Bailely, 1997). In fact, it has been suggested that individual KSAs need to be expanded based on the types of teams being staffed (Klimoski & Jones, 1995). For example, project development teams are required to interact intensively with other groups in an organization (e.g., marketing and production). These types of teams need to cope effectively with organizational politics and other external demands in the process of performing their tasks (Ancona & Caldwell, 1992; Argote, 1982). Therefore, group members in project development teams might need negotiation skills, initiative, and tolerance for uncertainty to cope with the external demands that impact the team during task completion. Examining the type of team, its role in the organization, and the division of labor within the team are all necessary steps in determining what will be required of team members for effective group performance (Jones et al., 2000; Klimoski & Zukin, 1999). Because these requirements will vary by type of teams, understanding the characteristics of the team for which individuals will be selected is very important.

Production teams. In this study, the team type of interest is production teams[4]. Production teams were chosen because they are considered a popular and common type of work team in industry (Cannon-Bowers et al., 1992). They are work units responsible for producing goods or providing services and are extensively employed in manufacturing and service settings (Cohen & Bailey, 1997; Flores et al., 1998; Gittleman et al., 1996). In addition, although research has been extensive on the effects of team characteristics in other types of teams such as quality circles, decision-making teams, semi-autonomous work groups, and research and development teams, production teams have not been systematically researched (Klimoski & Jones, 1995). In fact, they are

---

found, Comrey's and Gill's studies are described.

[4] The terms "work teams", "task-performing teams" and "production teams" are used interchangeably to refer to collection of three or more individuals who work interdependently to produce a product or service (Cohen & Bailey, 1997; Owens, Mannix & Neale, 1998).

often excluded from reviews of the team effectiveness literature (cf. Cohen & Bailey, 1997; Cannon-Bowers et al., 1992; Guzzo & Dickson, 1996; see Hackman, 1990 and Sundstrom, 1999 for exceptions).

Production teams engage in performance tasks, which require perceptual or motor skills and result in productivity (Jackson, 1992). Typically, production teams are more involved with creating large quantities of high-quality products and, consequently, they focus on efficient ways of operating production processes (Hackman, 1990; Sundstrom, 1999). Various degrees of task interdependence are possible in production teams, but functional responsibilities of team members tend to be broad (Klimoski & Jones, 1995). Members of production teams are usually trained to perform various duties within the team (Sundstrom, 1999). This allows for rapid shift of workers to perform a specific task (Hackman, 1990; Parker & Slaugther, 1988) and promotes integration (Flores et al., 1998).

There is no clear pattern of results for relationships involving characteristics of production team members and team performance (Haythorn , 1968; Jackson, 1992). For example, in regard to technical skills and abilities, while heterogeneity of types and levels of ability has been related to increased performance, these findings have only been consistent in studies involving decision making or creative tasks (Jackson, 1992; Jackson et al., 1995). Based on aging research, it has been suggested that groups composed of younger members will outperform groups composed of older members in tasks requiring speed of responding, fine motor responding, and sensory and perceptual sensitivity (Morgan & Lassiter, 1992). Nevertheless, these findings have not been replicated in work environments to assess their generalizability. Further, given the ethical and legal implications for selecting employees based on attributes such as age (Gatewood & Feild, 1998; Guion, 1998), these research findings have limited utility for team member selection and placement. Moreover, despite widespread use of teams in manufacturing settings (Flores et al., 1998; Gittleman et al., 1998; Owen, 1999), research on group composition and production teams is almost inexistent. Thus, it is important to address this gap in the literature and provide empirical evidence for the effects of team composition on groups performing production tasks.

Types of KSAs

The use of KSAs occupies a central place in personnel staffing and selection. KSAs refer to knowledge, skill, abilities and other specifications necessary for successful performance of a job. They are important to determine the requirements that job applicants need to meet upon organizational entry, serve as a reference to identify the content of personnel selection instruments, and are used to differentiate job applicants in selection processes (Gatewood & Feild, 1998). Even though KSAs have been extensively used as the basis for personnel selection and other human resource processes, the reliance on KSAs for this purpose is not free from challenges.

For example, the development and specification of KSAs is usually accomplished through job analysis. However, inferential leaps take place during the KSA determination process due to factors such as variations in job analysis techniques and the need to reduce all the KSAs necessary for performance of a job to a manageable number of KSAs (Gatewood & Feild, 1998). Thus, careless or superficial establishment of KSAs can cost organizations in a variety of ways. For instance, choosing KSAs that are not relevant, frequent, or critical can cause organizations to spend resources on unnecessary selection instruments or unintentionally select employees who are not prepared for the jobs at hand. Yet, the links between the requirements for effective performance and characteristics of applicants for specific jobs have been well studied in industrial and organizational psychology (Gatewood & Feild, 1998; Guion, 1998). In addition, performance has been successfully predicted with KSA based-systems (Stevens & Campion, 1994) and human resources processes based on carefully developed KSAs are more likely to be legally defensible (Gatewood & Feild, 1998).

However, the use of KSAs as the basis for selecting team members poses a more complex problem than when used for the selection of individuals for specific jobs (Jones et al., 2000). Selecting members to form new teams or to join existing groups, and selecting members for different kinds of teams, are aspects specific to team selection which impact the modes of determination, choice, and use of KSAs (Klimoski & Jones, 1995; Klimoski & Zukin, 1999). For example, when determining the KSAs for an existing team, is not sufficient to conduct a job analysis for a particular position. Rather, it is necessary to analyze the entire team to determine the necessary KSAs for the vacant job (Klimoski and Zukin, 1999). In the case of start-up teams, however, if the team is to have a formal leader, the KSAs for the team leader should be identified first. After the team leader is chosen, he or she should be involved in the process of determining KSAs for the other group members (Klimoski & Jones, 1999). Nevertheless, despite characteristics specific to team settings, the use of KSAs in team selection processes has not yet received comprehensive attention (Cannon-Bowen & Salas, 1997; Morgan & Lassiter, 1992; Stevens & Campion, 1994).

Two types of KSAs are investigated in this research: task- and team-related KSAs. While the former has been extensively used to select individual employees, recent theoretical developments suggest that team-related KSAs should also be assessed for the selection of team members (Cannon-Bowers & Salas, 1997; Cannon-Bower s et al., 1994; Stevens & Campion, 1994; Owens et al., 1998). Therefore, task- and team-related KSAs are distinguished and relevant theoretical and empirical works related to each are discussed.

Task-related KSAs. Describing a functional view of teams, Owens and colleagues (1998) state that high levels of team effectiveness[5] result from meeting a variety of task-directed functions. These functions refer to the production of a product or to some type of end-result that can be measured or evaluated. According to these authors, because of the importance of task functions, great attention should be given to technical skills, knowledge, expertise, and ability when composing teams. In fact, the traditional

---

[5] Team effectiveness is broadly defined by Hackman (1990) and Sundstrom and colleagues (1990) as encompassing the team's ability to work interdependently in the future, team members' satisfaction, and the team's output meeting standards set by output receivers.

approach to team staffing has been to select team members through ability-based systems (Kimoski & Jones, 1995).

Klimoski and Zukin (1999) refer to skills and abilities needed to perform a position in a team setting as individual position requirements. Examples of these include task-specific knowledge, cognitive ability, and conscientiousness. However, because most team environments require flexibility and versatility of team members, task-related KSAs, which address Owens and colleagues' task functions or Klimoski and Zukin's position performance requirements, are considered characteristics that all team members should meet (Stevens & Campion, 1994). That is, *all* team members are expected to be capable of responding to the technical demands of the job, as in any other type of job context. Even if it is only to facilitate communication and coordination processes within the team, group members are generally expected to know aspects of one another's jobs (Borman et al., 1997; Klimoski & Jones, 1995; Salas, Bowers, & Cannon-Bowers, 1995).

Tesluk and colleagues (1997) caution us that this generalization does not always hold because different types of task design may allow for load shifting and compensatory behaviors among team members. For example, complex task designs (e.g., team interdependence – see Figure 2) whereby team members diagnose, problem-solve, and collaborate to complete a task, allow teammates to compensate for individual weaknesses (Saavedra, Early, & VanDyne, 1993; Tesluk et al., 1997). Thus, in more complex task designs, compared to individual factors (e.g., differences in aptitude or skill), group factors (e.g., group levels of aptitude or skill) may play an important role in predicting team performance (Tesluk et al., 1997).

Interestingly, Morgan and Lassiter (1992) suggest that research investigating the relationship between task relevant abilities and team performance may have reached inconsistent results in part due to the differential nature of the task performed by various teams and the impact of group factors on the task. Examples of such conflicting findings come from studies of variables that after being consistently linked to performance at the individual-level have begun to be investigated at the group-level. For example, at the team-level of analysis, general cognitive ability effects on performance have differed for various team compositions and types of task (e.g., average group ability and lower ability member were related to team performance when the team carried out sequential tasks, but no effects were found when teams performed reciprocal tasks; O'Brien and Owens, 1969). Similarly, findings have also been mixed and dependent on task type and group factors for the effects of conscientiousness on work team performance [e.g. although group-level conscientiousness predicted performance of assembly and maintenance work teams (Barrick et al., 1998), it did not predict task completion when MBA graduate groups worked on business case problems as part of their course requirements (Barry & Steward, 1997)].

In summary, although task-related KSAs have been well researched in personnel selection at the individual-level, their role in team member selection and team composition at the group-level is yet to be understood. Because team members might be able to compensate for their task-related deficiencies, matching potential team members to specific task-related KSAs may not be such a straightforward process as it is when selecting applicants for a specific position. In fact, it can be speculated that *the team as a whole, not the individual team members, needs to meet technical requirements for effective performance*. Thus, the role of task-related KSAs at the group-level deserves further investigation in team composition research given that they have the potential to impact teams processes and outcomes.

In addition, even though studies have investigated general task-related KSAs at the group-level of analysis (e.g., cognitive ability and personality dimensions, Tziner & Eden, 1985; Barrick et al., 1998), few studies have examined the impact of specific group-level task-related KSAs on team performance (e.g., Comrey, 1953; Gill, 1979). While general task-related abilities (e.g., cognitive ability) are particularly useful for selecting employees for entry-level positions or for initial screening of job applicants, as jobs become more specialized it is important to determine the specific task-related KSAs associated with successful job performance (Gatewood & Feild, 1998). For example, some production tasks require attributes such as perceptual speed (i.e., the ability to make rapid discrimination of visual detail), eye-hand coordination (i.e., the ability to coordinate hand movements with visual stimuli), or manual dexterity (i.e., the ability to manipulate things with the hands) (Gatewood & Feild, 1998). Depending on the task, these attributes might be as important for selection purposes as general ones such as verbal comprehension and reasoning. Yet, even though these specifications are also utilized in the selection of team members (Klimoski & Zukin, 1999), empirical findings about their impact on group effectiveness at the group-level of analysis are scant.

Team-related KSAs. Owens and colleagues (1998) propose that high levels of team effectiveness come not only from task functions but also from relational functions. While task functions are directed toward the production of a product or service, relational functions refer to behaviors, directed internally or externally, which facilitate task performance. Relational functions foster team success by providing an appropriate setting for task performance through effective resolution of differences, opened communication, and management of team boundaries, for example. Thus, when forming work teams, one should consider both task function alignment (e.g., technical skills, knowledge, and expertise) as well as relational function alignment (e.g., compatibility of work related values, ease of communication, ability to access external information and resources) (Owens et al., 1998). However, requirements that meet relational functions were long neglected in selection processes. There had been an implicit assumption that groups composed of technically qualified individuals would perform effectively (Haythorn, 1968).

Recently, researchers have begun to stress the importance of including requirements other than technical ones when selection team members. For example, Morgan and Lassiter (1992) state that effective teams are distinguished on the basis of behavioral/process profiles, and that teamwork and interactions are important contributors to overall team performance. Similarly, Guion (1998) suggests that team member technical competencies need to be augmented by interpersonal skills. Therefore, team-related KSAs are also reviewed and their impact on group processes and outcomes are investigated in this study.

In a team setting, individuals not only need to be capable of performing the job, but they also need to possess characteristics that will enhance team processes and outcomes (Jones et al., 2000). Concerns with individual characteristics of team members which seemed related to team effectiveness grew out of the research on small group processes. Discussing how group settings bring in new elements such as coordination of team members' actions, Comrey (1953) suggested that "there may be a group of abilities possessed to different degrees by different individuals which determine in part how well they will perform in certain group situations" (p.209). In fact, research on small group processes and individual differences suggests that the presence of some individual differences variables within teams (e.g., individualistic orientation) contributes to processes that are detrimental to team performance (e.g., process loss, Steiner, 1972; social loafing and free-riding, Sheppard, 1993).

However, researchers have suggested that it is important to consider appropriate levels or types of KSAs when selecting candidates for jobs requiring teamwork (e.g., Cannon-Bowers & Salas, 1997; Cannon-Bowers et al., 1995). Cannon-Bowers and colleagues (1995) argue that prescriptions for the selection of team members should be based on a clear understanding of team competencies[6]. Team competencies are thought of as being separate from individual competencies. They refer to

> ...(1) the requisite knowledge, principles, and concepts underlying team's effective task performance, (2) the repertoire of required skills and behaviors necessary to perform the team task effectively, and (3) the appropriate attitude on the part of team members (about themselves and about the team) that foster effective team performance (Cannon-Bowers et al., 1995, p. 336-337).

---

[6] While Guion (1998) differentiates competency, which relates to "here and now" performance, from ability, which refers to aptitude for future performance, he states that these distinctions are difficult to make and not always useful. In this text, the terms KSAs and competencies are used interchangeably.

Also, teamwork competencies are not simply individual competencies applied to team tasks. Either shared or compatible among team members, some of the competencies required for teamwork only have meaning at the team level (e.g., shared knowledge of team members' styles, compatible expectations about task performance, interaction patterns, and norms; Cannon-Bowers & Salas, 1997). Teamwork competencies have been discussed as generic or specific competencies in relation to the team or to the task (Cannon-Bowers et al., 1995). Such categorization has helped determine how to best train team members and maintain team performance (Cannon-Bowers & Salas, 1997), and it has also signaled that when staffing teams, the type of task needs to be evaluated and included in the determination of work requirements.

Nevertheless, the lack of explicit guidelines on important team competencies for group effectiveness has led researchers (e.g., Cannon-Bowers et al., 1995; Stevens & Campion, 1994) to develop summaries of KSAs required for teamwork based on group literature from a variety of sources (e.g., sociotechnical systems theory, organizational behavior, industrial engineering, and social psychology). In the present study, Stevens and Campion's teamwork KSA definitions are used. This choice was based on the fact that Stevens and Campion's teamwork KSAs are grounded on sound group theory and research. In addition, these authors have developed and validated an instrument to assess teamwork KSAs, the Teamwork KSA Test (Steven & Campion, 1999). The Teamwork KSA Test has been referred as a useful measure of individual ability to work in teams (Borman et al., 1997; Klimoski & Zukin, 1999). In addition, previous team research has employed both Stevens and Campion's teamwork KSA definitions and instrument (e.g., Kichuck, 1996).

Stevens and Campion (1994) propose that two sets of teamwork KSAs are important for effective team performance and these should be assessed in selection procedures. First, interpersonal KSAs are those related to effective communication, maintenance of healthy working relationships, collaboration, and so on. These KSAs are divided into three subcategories: conflict resolution, collaborative problem solving, and communication KSAs. The second set of teamwork KSAs is self-management KSAs, which refer to characteristics that allow team members to contribute to the success of the team. These KSAs are further divided into two categories: goal setting and performance management, and planning and task coordination KSAs.

Stevens and Campion (1994) suggest that team members who possess teamwork KSAs will employ better communication, negotiation, and problem-solving strategies than team members who do not possess teamwork KSAs. Also, team members who possess teamwork KSAs will be more effective in goal setting, planning and coordination of team activities. Even though there is theoretical support for the use of teamwork KSAs in personnel related practices (Klimoski & Zukin, 1999; Klimoski & Jones, 1995; Tesluk et al., 1997), little empirical work has examined their role in understanding team performance. However, initial research suggests that teamwork KSAs might be of practical value for team member selection and team staffing.

For example, Stevens and Campion (1999) found that at the individual-level, team-related KSAs contributed incrementally beyond aptitude tests to predict teamwork and overall job performance for individuals working in teams at a pulp mill. They also reported that individual scores on the Teamwork KSA Test were significantly related to overall performance and to supervisor and peer ratings of teamwork performance for individuals working in teams at a cardboard box plant. Kichuck (1996) used the same test employed by Stevens and Campion to predict product quality for groups engaged in an engineering product design task. However, she did not find that the sum of group member scores or the variation of scores within teams on the teamwork KSA measure predicted team performance as measured by objective indicators.

Also, Mohammed and colleagues (2000) investigated the impact of taskwork and teamwork composition variables on two aspects of team effectiveness (i.e., task and contextual performance[7]) in groups that planned and supervised the preparation and service of meals in a cafeteria-style dinning room. They reported that while taskwork factors aggregated to the team-level accounted for 24% of the variance in group task performance, teamwork factors aggregated to the team-level accounted for an additional 28% of that variance. Furthermore, team-level teamwork factors accounted for 34% of the variance in contextual performance (see Appendix A for differences between the present study and the one by Mohammed et al., 2000).

In summary, few studies have been conducted on the impact of team-related KSAs on team performance. Further, different conclusions have been reached based on the levels of analysis considered, as exemplified by the previously reviewed studies. In addition, it has been suggested that various models for combining team members should be investigated (Stevens & Campion, 1999). Thus, the role of team-related KSAs in team composition at the group-level of analysis warrants additional investigation.

Purpose of the Present Study

A major challenge in team staffing is that organizations need to seek not only the best qualified individuals for the job, but the best combination of individuals for the team (Hackman, 1990; Jones et al., 2000; Klimoski & Zukin, 1999; Mohammed et al., 2000; Sundstrom, 1999). In the case of production teams, however, the available empirical evidence has not been sufficient to indicate how groups should be formed to increase performance on production-related tasks (Jackson, 1992). There has been enough theoretical support for the inclusion of abilities other than task-related ones in team selection processes (Cannon-Bowers & Salas, 1997; Cannon-Bowers et al., 1995; Klimoski & Zukin, 1999; Stevens & Campion, 1994). Further, there has been speculation regarding the best task- and team-related KSA combinations for team composition (Cannon-Bowers et al., 1995; Cannon-Bowen and Salas, 1997). Nevertheless, empirical evidence about the effects of task-and team-related KSAs at the

[7] Task performance refers to role prescribed, technical aspects of the job while contextual performance relates to aspects of performance that support the organizational, social, and psychological task context

group-level on team performance is scant (i.e., Kichuck, 1996; Mohammed et al., 2000; Stevens & Campion, 1999). Understanding the nature of the relationship between task- and team-related KSAs could provide insights into how best combine people to optimize team effectiveness.

In addition, there have been suggestions that some minimum level of interpersonal skills be present before teams can perform effectively (Salas et al., 1992) and that teams be staffed as high as possible on technical KSAs and at least moderate on interpersonal KSAs (Guzzo & Shea, 1992). However, a common proposition in personnel selection research is that hiring the highest level of skills possible is always better than settling for moderate or minimum skill levels (Guion, 1998; Stevens & Campion, 1994). Evidence about the nature of the relationship between task- and team-related KSAs could also indicate whether preferred strategies for task-related skills (i.e., top-down and rank-order, Gatewood & Feild, 1998; Guion, 1998) are also appropriate for team-related KSAs (Stevens & Campion, 1994, 1999).

Furthermore, despite the recognized impact of task interdependence on team composition and effectiveness (Kabanoff & O'Brien, 1979a, 1979b; Sundstrom, et al., 1990; Steiner, 1972; Thompson, 1964), there have been no studies investigating whether task interdependence moderates the relationship between task- and team-related KSAs and teams' internal processes and outcomes at the group-level of analysis. Thus far, task interdependence has been related to group processes (e.g., cooperation norms, quality of interpersonal processes, the degree to which members learn from each other, and intragroup conflict; Wageman, 1995; Saavedra et al., 1993) and to group outcomes (e.g., performance quantity and quality; Saavedra, et al., 1993). Although it is clear that as task interdependence increases, demands for group interactions also become more salient, it also stands to reason that requirements for effective group processes and performance might be impacted by task interdependence. That is, it is possible that task interdependence might function as a moderating mechanism between group-level inputs

---

(Borman & Motowidlo, 1997).

and group processes and outcomes. Specifically, tasks with different levels of interdependence may require that team members possess different levels or combinations of task- and team-related KSAs to perform effectively.

Studies of specific task-related abilities suggest that task interdependence needs to be taken into account when evaluating the impact of team member abilities at the group-level on team performance (e.g., Barry & Stuart, 1997; Gill, 1979; Tziner & Eden, 1985). To prevent organizations from spending unnecessary resources on selection processes and candidates from undergoing irrelevant selection assessments, it is important to determine conditions of interdependence in which task- and team-related KSAs should be considered in making selection decisions. Thus, it is essential to clarify the role of task interdependence on the relationship between these two types of KSAs and team processes and outcomes.

The present study contributes to the understanding of team member staffing and selection by assessing the effects of group-level task- and team-related KSA combinations on internal processes and outcomes of teams performing a task under two levels of task interdependence. This research adds to the team composition literature by attempting to provide empirical evidence about the nature of the relationship between task- and team-related KSAs and by investigating the role of task interdependence on team composition. Further, this study contributes to the literature on production teams by examining the impact of group-level inputs on team effectiveness in teams performing a production task.

Task- and Team-related KSAs, Task Interdependence and Internal Team Processes

Task cohesion. Cohesion has been one of the most examined processes in small group research (Carrow & Brawley, 2000; Mullen & Copper, 1994), but also a controversial topic when applied to work groups (cf. Cannon-Bowers et al., 1995; Carless, 2000; Carron & Brawley, 2000; Guzzo & Dickson, 1996). Cohesion is defined as the resultant of forces acting on members to bind them to each other and to the group (Guzzo & Shea, 1992; Klein & Mulvey, 1995; Mullen & Cooper, 1994) and has three components: attraction to the group, commitment to the task, and a feeling of group pride (Festinger, 1950). This has been a particularly appealing concept for work team research because of the assumption that cohesion enhances group coordination and has the potential to affect performance by facilitating interactions among group members (Cannon-Bowers et al., 1995; Guzzo & Shea, 1992; Mullen & Copper, 1994).

For many years, empirical research has provided mixed support for the cohesion-performance relationship. Although conceptualized as a multidimensional concept, cohesion was usually operationalized as a unitary construct. Specifically, measures of group cohesion tended to reflect only interpersonal attraction aspects of the construct, and this appears to have contributed to the mixed empirical support for the cohesion-performance relationship (Mullen & Copper, 1994; Zaccaro & Lowe, 1988). It has been demonstrated that the cohesion-performance relationship is primarily a function of the task cohesion component, which results from shared commitment to the task (Zaccaro, 1991; Zaccaro & Lowe, 1988). Specifically, task-based cohesion has been found to facilitate group productivity (Zacarro & Lowe, 1998) and decision-making (Mullen, Anthony, Salas, & Driskell, 1994) while interpersonal cohesion showed no relationship to performance (Zaccaro & Lowe, 1988). These empirical findings about task cohesion and performance are further supported by Mullen and Copper's (1994) meta-analytic review on the impact of the three components of cohesion on group performance. These authors concluded that efforts to increase interpersonal attraction or group pride are not likely to result in more effective groups. They state that task cohesion is the critical component of cohesion and suggest that efforts should be directed at understanding how to enhance groups liking and commitment to the task (Mullen & Copper, 1994).

In addition, in another meta-analysis, Gully, Devine, and Whitney (1995) demonstrated that issues related to levels of analysis had been overlooked in the examination of the cohesion-performance relationship. They found that when cohesion[8]

---

[8] Gully and colleagues (1995) averaged the effect sizes when both social and task cohesion were measured because there were too few studies to warrant a moderator analysis for type of cohesion.

was operationalized at the group-level with appropriate examination of within-group agreement, the relationship between cohesion and performance was stronger than when cohesion was operationalized at the individual-level. Thus, empirical evidence suggests that cohesion, specially task cohesion, is an important process for group performance. Nevertheless, the relationship between task- and team-related KSAs at the group-level and task cohesion has not yet been investigated. This study addresses this gap in the literature by examining the relationships among group composition based on task-requirements, task interdependence, and task cohesion.

Carron and Brawley (2000) propose that work teams composed of strangers might initially remain together for task reasons. That is, team members rely on their task-related characteristics (e.g., expertise on a piece of equipment, knowledge of materials and products) as a basis for their initial interactions. Task-related factors offer an appropriate reference for team member exchanges in the work place and may facilitate initial group performance. Interpersonal bonds, however, take time to be established and may come about as a byproduct of task-related exchanges. Interestingly, staffing teams with members who have little or no knowledge of one another is probably common in the selection of start-up teams (Jones et al., 2000). Thus, although both social (i.e., attraction to the group and group pride) and task (i.e., commitment to the task) components contribute to cohesion in a work group, at earlier stages of group development task factors should be more salient (Carron & Brawley, 2000). If this is the case, groups that are better prepared to meet the task-related requirements of the job should demonstrate higher task cohesion than groups that are less capable of answering to the task demands. Shaw (1981) suggests that when group members have specific abilities related to the task, in general they will be more active in the group and will make more contributions as the group attempts to complete the task.

In addition, levels of task interdependence are likely to impact the relationship between task-related KSAs and task cohesion. For example, it has been demonstrated that task interdependence moderates the strength of the cohesion-performance relationship. That is, cohesion was found to be more strongly related to performance on tasks that required large amounts group interaction such as coordination, communication and mutual performance monitoring (Gully et al., 1995). Similarly, because group members have more opportunities to interact in tasks with greater levels of interdependence, the team can more easily be made aware of its strengths and weaknesses in regards to its ability to perform the task and become more or less committed to the task at hand. Hence, tasks with higher level of interdependence should foster task-cohesion. It is expected that:

Proposition 1: The relationship between task-related KSAs and task cohesion will be moderated by task interdependence. Specifically, the relationship between task-related KSAs and task cohesion will be stronger when teams perform a reciprocal task (i.e., more task interdependence) than when they perform a sequential task (i.e., less task interdependence).

Communication. Communication is a basic group process and a component of several models of team effectiveness (e.g., Campion et al., 1993; Gladstein, 1984). It has been demonstrated that communication influences group effectiveness (Deutsch, 1949; Leavitt, 1951) and members' perceptions of group performance (Gladstein, 1984). Communication has also been related to objective measures of group productivity (Campion et al., 1993) and to group ratings of satisfaction (Gladstein, 1984). In small groups, communication is a combination of verbal communication, nonverbal communication, and expectations about communication characteristics which are developed within the group (e.g., appropriateness of vocabulary) (Harris & Sherblom, 1999). It is through communication that group members establish processes that structure the group's actions (e.g., norms) and the context for their interactions.

Although verbal and nonverbal communication occur simultaneously, complementing or contradicting each other, these two types of communication have different functions in small groups (Harris & Sherblom, 1999). Within work groups, verbal communication serves to order the task by establishing focus and creating understanding about group's purposes and processes. The forms in which verbal communication takes place, however, serve to reflect the norms that groups develop for exchanging information, ideas, etc. Verbal communication that is positive and supportive has been related to group member satisfaction with results of the interaction (Harris & Sherblom, 1999; Stevens & Campion, 1994). On the other hand, nonverbal communication encompasses all behaviors that are not consciously verbal and that are assigned meaning by one or both parties in a communication interaction (e.g., facial display, gestures, eye contact). Effective groups understand the importance of both verbal and non-verbal communication. That is because while verbal communication directs the task and processes, nonverbal communication forms the context in which the task and processes are discussed. Thus, in effective groups, communication is opened, receptive to information from all group members, behavior- or event-oriented, and based on congruence between verbal and non-verbal messages (Whetten & Cameron, 1998).

Listening is the counterpart of communication and also impacts team effectiveness (Stevens & Campion, 1994). Listening involves taking the message into consideration and understanding that selective attention and internal and external noises affect what is captured. Further, listening involves interpreting the message, evaluating it, and finally, responding to the message through feedback (Harris & Sherblom, 1999). Effective teams make use of active listening (Harris & Sherblom, 1999; Stevens & Campion, 1994). That is, members of effective groups actively participate in communication transactions and become responsible for understanding the speakers' intentions (Whetten & Cameron, 1998).

Communication skills are usually included as requirements for effective performance in team work environments (e.g., Klimoski & Zukin, 1999; Tesluk et al., 1997). Team settings require that people exchange information, ideas, and materials for group performance. Thus, teams higher on interpersonal skills are expected to engage in more effective communication than teams lower on interpersonal skills. However, task interdependence impacts how communication is structured within teams (Salas et al., 1992). That is, team members performing under conditions of low task interdependence are able to focus on the performance of their assigned tasks. Team members in conditions of high interdependence, however, need develop rich networks for communication. To successfully perform the task together, team members under conditions of high interdependence must communicate frequently and effectively. Therefore, it is proposed that:

> *Proposition 2:* The relationship between team-related KSAs and communication will be moderated by task interdependence. That is, the relationship between team-related KSAs and communication will be stronger when teams perform a reciprocal task than when they perform a sequential task.

Task conflict. Conflict has usually been described in terms of opposing interests or goals (Tjosvold, 1997). Thomas (1992) defines conflict as a process which begins when one party perceives that another party has frustrated, or is about to frustrate, some concern of his/hers. Conflict has been investigated primarily because it is deemed negative to performance and satisfaction (Jehn, 1997a, 1995; Tjosvold, 1997). Consequently, the views that conflict should be eliminated, avoided, or resolved are fairly well established and series of interventions have been developed to achieve such results (e.g., intergroup team-building and third-party peacemaking; French & Bell, 1995; Thomas, 1992).

More recently, researchers have begun to examine potential benefits of conflict to individuals, groups, and organizations. Tjosvold (1997) contends that conflict is a means to confront reality and when well managed, brings life and energy into relationships, and helps develop one’s individuality through the expression of needs, wants, and opinions. In work groups, conflict can be beneficial or harmful depending on the type of conflict and the situation in which it occurs. One type of conflict is referred to as relationship conflict. This type of conflict represents conflict in interpersonal relations and tends to disrupt task efforts by draining the group’s energy, motivating the involved parts to destroy each other, contributing to feelings of frustration, and leading to poor decision-making (Jehn, 1995, 1997a; 1997b; Simons & Peterson, 2000; Wall, Galanes, & Love, 1987).

A second type of conflict is task-related conflict. In contrast to relationship conflict, task conflict can be beneficial to a work group's productivity by expanding ideas, clarifying issues, alerting the group to necessary corrective actions, preventing from premature consensus, and so on (Jehn, 1995, 1997a; Simons & Peterson, 2000; Wall et al., 1987). For example, work groups at a freight transportation firm reported that moderate levels of task conflict were beneficial because they stimulated the discussion of ideas (Jehn, 1995). Similarly, Wall and colleagues (1987) found the same pattern of results for groups of undergraduate students performing a decision-making task. Stevens and Campion (1994) suggest that in effective teams, conflict is not suppressed or avoided, but constructively managed in a non-personal threatening manner. Indeed, it is desirable that teams recognize and encourage conflict that leads to fostering innovation and improving working processes. Hence, teams whose members are better equipped to recognize and address constructive conflict should not be disturbed by its occurrence. Given the potential benefits of task conflict for group performance, this study also investigates relationships between task conflict and group composition based on team-related KSAs.

Increased task interdependence allows for more interactions among group members and creates more opportunity for conflict to occur, including beneficial task-related conflict. Thus, in teams where team-related KSAs are high, task related conflict should be more likely to occur. Moreover, because increased task interdependence seems to facilitate the occurrence of conflict, it is proposed that:

Proposition 3: The relationship between team-related KSAs and task conflict will be moderated by task interdependence. Specifically, the relationship between team-related KSAs and task-conflict will be stronger when teams perform a reciprocal task than when they perform a sequential task.

In addition, a careful balance is required of teams as they go thorough conflict situations. Although disagreeing over task-related issues can bring awareness about new ideas or problems with the team's approach to a task, it is still important to maintain mutual respect in order to sustain open-mindedness and healthy working conditions (Tjosvold, 1997). In fact, consistent support has been found for a negative relationship between conflict, even task conflict, and satisfaction (Jehn, 1995, 1997a, 1997b; Wall et al., 1987). This suggests that the ability to manage conflict and utilize appropriate conflict management strategies is an important attribute for team members (Levine & Moreland, 1990; Saavedra et al., 1993; Steven & Campion, 1994; Sundstrom et al., 1990), and also deserves examination at the team-level of analysis.

That is because teams should be able to identify conflict sources and determine the best approach to resolve the conflict (Stevens & Campion, 1994). It is also desirable that teams employ conflict management strategies that promote trust, openness, and achieve that best solution for all parties involved. Distributive approaches to conflict management involve the use strategies in which a particular allocation of resources or outcomes is sought (e.g., competing, win-lose) (Thomas, 1992). Integrative approaches, however, aim at allocating outcomes in such a manner that satisfies the parties in conflict (e.g., collaborating, win-win) (Thomas, 1992). Integrative styles of conflict management have been found to produce higher quality of outcomes than distributive ones (Wall et al., 1987). Thus, it is expected that teams whose members are higher on team-related KSAs will be not only prepared to allow constructive conflict to take place, but also to recognize the source of conflict and implement an appropriate conflict resolution strategy. It is proposed that:

Proposition 3a: Teams that are high on team-related KSAs will exhibit more constructive conflict management than teams that are low on team-related KSAs.

Cooperation. Workplace cooperation has been defined as the willful contribution of employee efforts to the effective performance of interdependent tasks and it is an essential process whenever people have to coordinate activities among different tasks (Wagner, 1986, 1995). Whether motivated by the receipt of outcomes that benefit the entire group (i.e., collective motives) or contingent on the receipt of personal interests (i.e., individualistic motives) (Wagner, 1986, 1995), cooperation facilitates social interactions and productivity (Tjosvold, 1984). Cooperation has consistently been found to strengthen work relationships, morale, and particularly on complex tasks, to promote productivity (Tjosvold, 1984). For example, Campion and colleagues (1993) reported that workload sharing was related to objective measures of group productivity in a study where various criteria of group effectiveness were examined. Furthermore, in a study with blue-collar industrial workers, Seers (1989) found that the quality of reciprocity between the individual worker and his or her group significantly contributed to predictions of job satisfaction. In addition, cooperation has been associated with cohesion in work teams (Cohen & Bailey, 1997).

Cooperative behavior on the part of team members can also minimize process loss such as social loafing (Campion et al., 1993), increase the use of appropriate skills and abilities, and enhance task performance (Eby & Dobbins, 1997; Gladstein, 1984). Some tasks require group members to coordinate their efforts more in order to achieve successful performance while other tasks can be completed with less attention to demands of group interaction. In highly interdependent tasks, members need to rely on each other for information, materials, and maintenance of the work pace. This suggests that the cooperation requirements imposed by the task impact group effectiveness (Shaw, 1981). For example, Wageman (1995) found that interdependent tasks were better than individual or hybrid tasks in improving cooperation among team members (Wageman, 1995). In general, cooperation facilitates productivity, particularly in complex tasks (Tjosvold, 1984).

When tasks require that members cooperate with each other for successful group performance, group members develop expectations of their teammates. Reviewing cooperation theory, Tjosvold (1984) states that when tasks require cooperation, members expect mutual assistance, accurate communication, and granting of requests related to task execution. In addition, team members anticipate a positive attitude towards each other reflected in friendliness and support. Tasks that require cooperation are also a favorable ground for division of labor and for team members to encourage each other to complete the task. Thus, it follows that teams whose members are high on team-related KSAs would be more likely to engage in cooperative behaviors. Teams high on team-related KSAs would be better prepared to answer members expectations of task related assistance, encouragement, and support. However, because cooperation is impacted by levels of task interdependence, it is expected that:

Proposition 4: The relationship between team-related KSAs and cooperation will be moderated by task interdependence. That is, the relationship between team-related KSAs and cooperation will be stronger when teams perform a sequential task than when they perform a reciprocal task.

Task- and Team-related KSAs, Task Interdependence and Team Outcomes

Quantity and quality of output. To address the problem of a decreasing manufacturing sector due to the rise of foreign competition and trade imbalances, industries have been challenged to become more efficient, more productive, and raise the quality of their goods and services (Campbell & Campbell, 1988). Nowadays, not only is product availability important but successful products are marked by their quality (Kichuk, 1996). The shift from traditional assembly lines to teamwork has been one of the responses to the challenge of improving quality and productivity in many industries (e.g., Flores et al., 1998; Forth, 1999; Fuxman, 1999). As empirical studies begin to demonstrate the positive impact of work teams on manufacturing performance (e.g., Banker, Field, Schroeder, & Sinha, 1996), it becomes more important to understand how team composition relates to outcomes such as productivity and quality. From a theoretical perspective, it is necessary to identify group–level characteristics related to such team outputs so that the mechanisms by which possible effects take place may be investigated in the future. From a pragmatic standpoint, knowledge about composition characteristics of effective groups can be useful to practitioners as they strive to staff potentially effective work teams.

Models of team effectiveness purport that teams have the potential to enhance productivity (cf. Goodman, Ravlin, & Schmike, 1987; Sundstrom et al., 1990) and the idea that team member characteristics and interactions affect the team's capacity to improve performance and quality is well established. Indeed, most models of team effectiveness include a team composition component based on the assumption that what team members bring to the group affects processes within the team, which in turn impacts group outputs (Gladstein, 1984; Goodman et al, 1987; Guzzo & Shea, 1992; Hackman, 1987; Hackman & Morris, 1975; McGrath, 1984). In addition, research on group member individual differences, social loafing, and process loss has demonstrated that member characteristics, both at the individual- and group-level of analysis, as well as member interactions, affect group processes and outcomes (Barrick et al., 1998; Eby & Dobbins, 1997; Neuman & Wright, 1999; Wagner, 1995; Sheppard, 1993). Therefore, this study investigates relationships between group quantity and quality of outcomes and team composition based on task- and team-related KSAs.

The amount of task-related knowledge and skills that members bring to the group task is expected to impact the overall effectiveness of a work group (Hackman, 1987, 1990). Similarly, the amount of knowledge and skills related to teamwork might impact group performance because teamwork and group interactions contribute to overall group performance (Morgan & Lassiter, 1992). Theorists of group composition have emphasized that groups need to be not only technically capable but also possess the skills to function effectively as a group (e.g., Owens et al., 1998). In fact, initial empirical findings at the group-level of analysis suggest that both team- and task-related KSAs are important for predicting the task performance of a group (Mohammed et al., 2000). Therefore, it is necessary to better understand the kinds of effects that group-level task- and team-related KSAs have on team performance.

In addition, possible effects of task interdependence on the relationship between task- and team-related KSAs and group outcomes also need to be investigated. That is because levels of task interdependence have been found to impact group performance, but the impact of task interdependence on the relationship between task- and team-related KSAs at the group-level and teams' outcomes has not yet been investigated. Saavedra and colleagues (1993) demonstrated that conditions of greater interdependence were associated with higher group performance (i.e., quantity and quality of output). However, studies about task-related abilities, task interdependence, and group performance have provided more complex results. For example, O'Brien and Owens (1969) did not find a significant relationship between group average task-related KSA (i.e., cognitive ability) and group performance when the task required high task interdependence. Yet, they found significant relationships between group cognitive ability and performance when the team carried out the task under sequential interdependence (see Figure 2). Thus, it stands to reason that different conditions of task interdependence may influence the ways in which teams need to address task-related requirements for effective performance.

Steiner (1972) suggests that higher levels of task interdependence impact the group's ability to prevent process loss. Process loss or coordination loss denotes declines in the coordination of activities when several people are involved in performing the same task (Penner & Craiger, 1992). Process loss can be reflected in group performance phenomena such as social loafing (i.e., someone exerting less effort when working in group as compared to working individually) and impacts team productivity negatively (Shepperd, 1993). Individuals working in groups may be more likely to believe that their individual contributions have little effect on the group's performance and therefore may exert less effort. In fact, people generally tend to exert less effort when working together rather than when working individually (Sheppard, 1993). Consequently, individual decrements in effort and speed, for example, are likely to impact group's quantity of outcome when tasks allow team members to sum or compensate their work contributions (Steiner, 1972).

Groups high on team-related KSAs are expected to be more capable of addressing relational functions (i.e., communication, conflict management, assessing information and resources), and consequently better address difficulties that may result from process loss (e.g., convincing a less devoted member to pull his or her weight), which can facilitate task performance (Owens et al., 1998). Nevertheless, this capability in itself can be a deterrent to the group's quantity of outcome. That is because groups high on team-related KSAs might spend more time addressing process issues and ensuring group's harmony than devoting efforts to the task at hand. However, in groups whose task-related KSAs are low, team-related KSAs may prompt group members to help each other during task completion preventing possible negative consequences to the group's quantity of outcome. Thus, it is expected that:

> *Proposition 5:* Team-related KSAs will moderate the relationship between task-related KSAs and team performance. That is, for teams whose task-related KSAs are high, quantity of output will be greater when team-related KSAs are low than when team-related KSAs are high. However, for teams whose task-related KSAs are low, quantity of output will be greater when team-related KSAs are high than when team-related KSAs are low (see Appendix B for pictorial description of this proposition).

In addition, because conditions of high task interdependence allow group members to exercise team-related KSAs, the expected relationship between task-, team-related KSAs, and a team's quantity of output is expected to be accentuated in different conditions of task interdependence. That is, although the same pattern of relationship between task-, team-related KSAs and quantity of output is expected across conditions of task interdependence, mean differences in productivity are expected between groups that have similar task- and team-related composition but work under different conditions of task interdependence. For example, for teams whose task-related KSAs are high and team-related KSAs are low, quantity of output should be greater in conditions of low task interdependence than in conditions of high task interdependence. That is because in conditions of low task interdependence, group members are less likely to rely on each other for task completion, reducing the need that team members put their team-related KSAs to use. Conversely, for teams whose task-related KSAs are low and team-related KSAs are high, quantity of output should be greater in conditions of high task interdependence than in conditions of low task interdependence. In fact, task interdependence may allow team members to counterbalance for each others' task-related weaknesses. That is because in conditions of high interdependence, even when members have specific roles, they are required to coordinate their actions and exchange information about the task. Therefore, it is expected that:

> *Proposition 5a*: There will be mean differences in quantity of output between groups with similar task- and team-related KSAs as function of high and low task interdependence.

Conditions of task interdependence are also important for understanding output quality. For example, under conditions of high interdependence team members are in a better position to exchange feedback about their performance. That is, team members can more easily identify deficiencies in product quality and choose to assist a group member who has difficulties with particular aspects of the task. LePine, Hollenbeck, Ilgen, and Hedlund (1997) noted that team members were able to anticipate the needs of lower ability members and assist them in a decision-making task with reciprocal interdependence. Further, various production designs have embedded quality control steps, which encourage team members to help each other in order to maintain high group productivity (Parker & Slaughter, 1988).

Thus, team-related KSAs might be particularly beneficial in conditions of high task interdependence. In fact, the nature of the relationship between quality of output, task- and team-related KSAs is expected to be of a complex nature, varying by level of task interdependence. Specifically, in conditions of low task interdependence, groups high on task-related KSAs are not expected to benefit from team-related KSAs in regards to the group's quality of output. That is because low task interdependence does not foster the environment of cooperation and information exchange mentioned above, thus preventing team-related KSAs from being exercised by group members. However, in conditions of high task interdependence, both groups low and groups high on task-related KSAs might benefit from team-related KSAs. Nevertheless, it is expected that teams whose members are high on both task- and team-related KSAs will produce better quality of output in conditions of high interdependence than teams that are high on task- and team-related KSAs but perform in conditions of low task interdependence. Hence, it is proposed that:

> *Proposition 6:* Quality of output will be a function of task-, team-related KSAs, and task interdependence (see Appendix B for pictorial description of this proposition).

Team Viability. Team viability refers to members' satisfaction, participation, and the group's future prospects of working as a unit (Sundstrom et al., 1990). Team viability is particularly important in settings where groups do not disband after task completion. Production teams are example of such groups because they are characterized by stable membership (Sundstrom, 1999). Most models of team effectiveness include satisfaction of team members as a potential outcome of teamwork (cf., Goodman et al., 1987; Sundstrom et al., 1990). However, it has been suggested that "…it might be unreasonable to expect that team tasks designed to enhance productivity will also – automatically - improve attitudes" (Cannon-Bowers et al., 1992, p. 373). In fact, empirical support for a relationship between teamwork and group member attitudes has been mixed.

For example, Gladstein (1984) did not find statistically significant associations between the structure of work team activities (e.g., role and goal clarity, work norms, and task control) and various forms of satisfaction, including team satisfaction. Interestingly, Barrick and colleagues (1998) found that a set of team composition variables predicted team viability, which has member satisfaction as a component. That is, teams higher on cognitive ability, more extraverted, and more emotionally stable were more likely to want to remain together. In addition, Campion and colleagues (1993) demonstrated that member satisfaction was associated with relative group size and heterogeneity of skills, also group-level characteristics.

Therefore, even though conclusive support has not been established for a relationship between task characteristics and team member attitudes, it is possible that composition characteristics at the group-level related to the task and to team may impact team members' attitudes about their work groups. This study takes this suggestion further by examining relationships between team viability and team composition characteristics based on task- and team-related KSAs. For example, group members may be more satisfied and more willing to remain together when all of them have the task-related abilities required for the job. Groups high on task-related KSAs may be more capable of efficiently approaching and taking the task to completion. In addition, all members would have the potential to "pull their weight", which could contribute to making the group's success more likely. Furthermore, team-related KSAs might facilitate the coordination and use of team member's task abilities. Groups that are not only capable of performing the task but do so in a manner that is satisfying to its members, may be more viable units than groups that have the potential to perform, but lack in abilities to address team-related issues. Pressures from coordinating multiple aspects of the task or disagreements over distribution of the workload may contribute to unpleasant feelings towards the group or its members. Thus, it is proposed that:

> *Proposition 7:* Team viability will be a function of task- and team-related KSAs. It is expected that, teams high on task- and team-related KSAs should be more willing to remain together than teams that are low on task- and team-related KSAs (see Appendix B for pictorial description of this proposition).

Levels of task interdependence may also contribute to the team's ability to maintain itself as a viable unit. That is because highly interdependent tasks allow members more opportunities to develop familiarity, which refers to specific knowledge relevant to performing work in a particular setting (Goodman & Shah, 1992). In work groups, familiarity encompasses not only knowledge of task-related aspects such as the equipment, materials, and environmental conditions, but also knowledge of group properties (e.g., norms, strategy) and relationships within the group, among other aspects. Group members who work in more interdependent tasks are more likely to become familiar with each other's work styles. Further, group-level familiarity has been linked to group performance (Goodman & Leyden, 1991).

Therefore, even though the same pattern of relationship between task-, team-related KSAs and team viability is expected across conditions of task interdependence, mean differences in team viability are expected between groups that have similar task- and team-related composition but work under different conditions of task interdependence. For example, teams that are high on task- and team-related KSAs and work in an environment that facilitates the development of knowledge about the task and the team might be more willing to remain together. Thus, it is proposed that:

Proposition 7a: There will be mean differences in team viability between groups with similar task- and team-related KSAs as function of high and low task interdependence. It is expected that teams high on task- and team-related KSAs performing a reciprocal task will be more willing to remain together than teams high on task- and team-related KSAs performing a sequential task.

CHAPTER 3

METHODS

Phase I

Procedure

Participants signed up in mixed sex sessions of 10-16 people and responded to the task- and team-related KSA measures: the Teamwork KSA test, the Inspection test from the Flanagan's Industrial Tests battery, and finger dexterity exercises (Appendices C, D, and E, respectively). The first 100 participants (21 males and 79 females) in the study provided the normative data for the task- and team-related KSA measures (Table 1). These individuals were eligible to take part in the second phase of the study as long as they met the group composition criteria. That is, individual scores on the task- and team-related KSA measures were referenced against the normative distributions, and each individual's participation in the second phase of the study was determined based on pre-determined cut scores for team composition. Specifically, participation in the various conditions of the main study was established as follows.

Participants were categorized as high or low in team-related KSAs if they scored 1/3 standard deviation above and below the mean, respectively, for the team-related KSAs distribution (i.e., combined scores on interpersonal skills and self-management KSAs – see discussion about team-related KSA composite below). In addition, participants were categorized as high or low in task-related KSAs if they scored 1/3 standard deviation above and below the mean, respectively, for the task-related KSAs distribution (i.e., combined scores on attention to detail and manual dexterity – see discussion about task-related KSA composite below). Thus, participants were assigned to the high teamwork KSAs condition if they were categorized as high on team-related KSAs and assigned to the low teamwork KSAs condition if they were categorized as low on team-related KSAs. Similarly, participants were assigned to the high task KSAs condition if they were categorized as high on task-related KSAs and assigned to the low task KSAs condition if they were categorized as low on task-related KSAs (see cut-off scores in Table 1).

Groups were created using such a strategy to avoid problems associated with the median split-type method used in previous studies that manipulated team composition (e.g., Tziner, 1988). In the median split strategy, individuals who score close to the median are arbitrarily classified into high and low groups. This procedure reduces measurement precision and the magnitude of bivariate relationships, and it also diminishes power for detecting true effects (Maxwell & Delaney, 1993; Pedhazur, 1997). The strategy chosen for assigning participants to groups in this study is similar to that employed in other small group studies whereby standard deviation from the mean or percentiles were used (e.g., Eby, Cader & Noble, 2001; Hall, Workman & Machioro, 1998; Waung & Thomas, 1998). In addition, the choice of a cut-off score 1/3 of a standard deviation from the mean is consistent with practices of real organizations in which attempts are made to avoid setting cut-off scores that are either too high or too low (G. Stokes, personal communication, September 15, 2000).

Sample Characteristics

A total of 1,283 undergraduate students (72% female) from a southeastern university were screened for task- and team-related KSAs. Their average age was 19 (*SD* = 2.3), 82% of them were White/Non-Hispanic, 8% African American, and 7%, Hispanic, Asian American, or reported their race as Other. Participants were mainly freshman (40%) and sophomores (30%) from 102 different majors. Less than half of the participants were working at the time of the study (40%) and only 12% reported experience in a manufacturing or production environment (see Table 2 for other sample descriptive information).

Using the predetermined cut-scores, eligible participants from Phase I were randomly placed, within experimental conditions (discussion below), into groups of four people for participation in the second phase of the study. The remaining participants from Phase I were dismissed. All participants received research credit for their participation in the first phase of the study and those who completed the second phase of the study received additional research credit.

Phase II

A fully crossed mixed design with two between-subjects variables (i.e., task- and team-related KSAs) and one within-subject variable (i.e., levels of task interdependence) was employed. Teams of four individuals were formed in a manner that systematically manipulated team composition according to the four possible task- and team-related combinations (discussed above). Then, each team performed a production task under two levels of task interdependence.

A power analysis was performed to determine the number of teams necessary to attain the desired power to test the hypotheses and detect possible effects at a specified alpha level. The analysis indicated that a total of 43 teams were needed for power of .80 to detect a medium effect size with alpha set at .01 (Appendix F). Therefore, it was anticipated that 176 participants divided into 44 groups would complete the second phase of the study.

Sample Characteristics

A total of 176 participants divided into 44 groups participated in the second phase of the study: 11 groups per experimental condition. The average age of participants in the second phase of the study was 19.4 years (*SD* = 1.9) and 67% of them were female. Participants were predominantly White/Non-Hispanic (85%), 9% were African American, and the remaining 6%, Hispanic, Asian American, or reported their race as Other. They were from 54 different majors, primarily freshman (50%) and sophomores (24%). Thirty six percent of the participants were working at the time of the study and 10% reported experience in a manufacturing or production environment (see Table 3 for other sample descriptive information).

Because team composition research related to gender, race, and other demographic variables has yielded conflicting findings (Harrison, Price, & Bell, 1998;

Morgan & Lassiter, 1992) and because the composition of the workforce is currently very diverse, no attempts were made to control for gender or race when forming the groups. In fact, after the task- and team-related KSAs had been combined according to the specific conditions, participants randomly signed up for groups within experimental conditions despite demographic variables. However, these variables were examined as possible covariates (i.e., control variables) when differences were found on the task-, team-related, or dependent measures (please refer to the section on Control Variables for details).

Procedure

Groups of four members participated in the second phase of the study. Initially, participants were trained on the assembly of a circuit board (this task is discussed in detail below). Following recommendations from the team training literature, groups were trained as units (Swezey & Salas, 1992) and individual task skills were mastered before members practiced the task as a group (Salas et al., 1992). Because the skills required for the circuit board assembly were task-specific, training on the assembly of the circuit board involved cross-training (i.e., all members were trained in all phases of the circuit board assembly) and guided task practice (Cannon-Bowers et al., 1995).

The complete training took approximately 15 minutes. This was the average time necessary for participants to become comfortable with assembling the circuit board during the pilot of the experimental task (see Chapter VI). For training on the assembly of circuit boards, the researcher introduced all circuit board components to the group members and demonstrated how the circuit board was assembled. After the demonstration, the researcher guided group members through the assembly process as they individually assembled circuit boards for practice (Appendix G). Before performing the task, group members were also given the opportunity to practice as a group (Cannon-Bowers et al., 1995). Individual and group practice opportunities were allowed also as a means to prevent practice effects given that improvements with repeated trials are common in studies requiring motor performance (Keren, 1993).

After the general training, participants assembled circuit boards as a group based on two different levels of task interdependence: sequential and reciprocal (see Figure 2). These levels were chosen because they reflect increasing levels of interdependence and because they represent common levels of interdependence of teams in manufacturing settings (Fuxman, 1998, 1999; Parker & Slaughter, 1988). The pooled level (see Figure 2) was excluded because group members work independently (not a characteristic of teams). The team level (see Figure 2) was also excluded because it does not reflect typical interdependence in manufacturing settings (Fuxman, 1998, 1999; Parker & Slaughter, 1988).

To prevent order effects, which result from participants' performance in the course of an experiment being affected by the presentation of the various treatments conditions in a specific order, attempts were made to counterbalance the order in which groups performed the task based on the two levels of task interdependence. However, it was not possible to evenly counterbalance the groups. Thus, 20 groups worked under sequential interdependence first, under the reciprocal second, and the task interdependence order was reversed for the remaining 24 groups. Nevertheless, potential task order effects were investigated as possible covariates (i.e., control variables) when performance differences due to task order were found (please refer to the section on control variables for details). Also, to prevent practice effects when performing the task for the second time, participants took on any role but the one performed under the previous method. Therefore, except for the restriction of not performing the same role twice, participants were also randomly assigned to roles for the assembly of circuit boards.

Experimental Task

The Circuit Board Assembly Task © (Irwin & Browning, 1997) is a group production task consisting of the assembly of small circuit boards following different work processes. When assembled correctly, the circuit board's buzzer buzzes and its lights light (see Appendix H for circuit board components). Initially developed as team-building exercise, the Circuit Board Assembly Task © was adapted for use in the selection of employees who will work in teams in manufacturing environments. The task has been used successfully for selection purposes in the fiber optic and carpet industries. Similar to the sample in this study, job candidates who have gone through the Circuit Board Assembly Task © had a high school degree or one to two years of college education, and some or no manufacturing work experience.

The Circuit Board Assembly Task © was chosen for this study because it is a production related task. Although production tasks have not been widely employed in team research, the widespread use of teams in production/manufacturing industries requires a better understanding of the impact of team composition in groups performing production related tasks (Fuxman, 1999). Also, the Circuit Board Assembly Task © met important criteria of being interdependent, intrinsically interesting and realistic to group members, and amenable to changes in how the task is completed.

In this study, the Circuit Board Assembly Task © was modified to reflect two conditions of task interdependence or methods of exchange of information and resources: sequential (i.e., low interdependence) and reciprocal (i.e., high interdependence). In the sequential condition of team interdependence, each group member has a specific role and is responsible for one step in the production process. For this type of interdependence, a member must act before another member can act, the work sequence flows in only one direction, and it is necessary that each step of the work be performed correctly to maintain the process flow (Saavedra et al., 1993; Van de Ven & Ferry, 1980). In the reciprocal condition of team interdependence, group members also have specialized roles (Saavedra et al., 1993). However, group performance requires coordination of time-lagged two-way interactions between group members (Saavedra et al., 1993), which makes the work sequence flow more flexible.

Therefore, under the sequential task interdependence condition, group members took on the roles of Set-Up Operator, Lighting Operator, Quality Control Operator, and Rework Operator (see Appendix I for job descriptions). These roles served different functions in the circuit board production process. The production process began at the Set-Up station with the attachment of a buzzer to the board. Then, the circuit board was sent to Lighting. Once a resistor and lights had been attached to the board, the product was completed. The complete board was sent to Quality Control to be checked for two quality standards (i.e., buzzer buzzed and lights lit). If the board met the quality standards, it moved to Shipping. If the board failed to meet the quality standards, it went to Rework to be repaired. Once Rework repaired the board, it went back to Quality Control for another check (see Appendix J for the sequential process). In the sequential condition, each group member was also responsible for recording information about his or her work station (e.g., materials used, units produced - see Appendix K for daily report forms).

Under the reciprocal task interdependence condition, group members took on the roles of Circuit Board Operators and worked at four different work stations: Set-Up, Lighting, Quality Control, and Inventory stations (see Appendix L for job descriptions). Although their roles were still specialized, group coordination was required for task performance. Group members also needed to exchange information about materials being used, quality problems and work pace, request and/or offer assistance as needed, and coordinate their activities during the production process.

Thus, the production process began with setting-up the buzzer onto the circuit board. From Set-Up, the board went through its first phase of Quality Control. If the buzzer worked, the board moved to the next production step, Lighting. If the buzzer did not work, the board went back to Set-up for rework. Once the problem with the board was corrected, it went through the quality check again. When the product was sent to Lighting, a resistor and lights were added and the circuit board was complete. Then, the complete board was sent to the second phase of Quality Control. If the lights lit, the board met the second quality standard and it was moved to Shipping. If the lights did not light, the board went back to Lighting for rework. Once the board was repaired, it went through Quality Control one more time. The fourth member of the group was responsible for tracking all used materials, for keeping the group informed about its productivity every few minutes, and for helping the other group members as needed (see Appendix M for the reciprocal process and Appendix N for daily report forms).

Teamwork Analysis

A teamwork analysis was carried out to identify worker requirements for the Circuit Board Assembly Task ©. Teamwork analysis refers to an examination of the team's role in the organization, the division of labor as well as the function of each position within the team (Jones et al., 2000; Klimoski & Zukin, 1999). Because the teams in this study worked in a laboratory setting, only division of labor and function of positions were investigated to determine the team member requirements.

Team member requirements are developed around four categories: individual position, team task management, team process management, and team boundary management requirements (Klimoski & Zukin, 1999). Individual position requirements refer to the skills and abilities needed to perform the position such as task-specific knowledge or abilities. Team task management requirements are associated with the team members' responsibility for assisting each other during task execution. The knowledge of one's own task and those of other team members and communication skills are examples of such requirements. Team process management requirements are related to the team maintenance functions such as conflict management. Team boundary management is associated with the adaptive functions and the skills necessary for effective interactions with factors outside the team such as negotiation skills. Once more, because of the experimental nature of the task, only the first three components of team member requirements were developed from the team analysis for this study.

Two industrial and organizational psychologists assisted the researcher in establishing the individual position, team task management, and team process management requirements for the groups performing the Circuit Board Assembly Task ©. These subject matter experts (SMEs) participated in the adaptation of the Circuit Board Assembly Task © for personnel selection purposes. They also had vast experience in the implementation of this task as a component of selection processes in a variety of industries. Together, they administrated the Circuit Board Assembly Task © more than 80 times. One of the SMEs was also responsible for developing the facilitator's guide for the task and for the training of facilitators.

Communication and coordination skills were identified as important team task management requirements, and conflict management skills as team process requirements for successful performance in the Circuit Board Assembly Task ©. To perform the various roles in the assembly of the circuit board, it was identified that team members should possess attention to detail and finger dexterity. In addition, the task required basic mathematical skills (i.e., counting whole numbers, sum, and subtraction), writing and reading skills (at the 8th grade level). The KSAs derived from this analysis were grouped into task- and team-related KSAs. Then, measures to assess those characteristics were identified.

Instruments – Phase I

Assessment of task-related KSAs

Finger Dexterity, the ability to quickly carry out skillful and coordinated movements with the fingers of one or both hands and to grasp, place or move small objects (Fleishman & Reilly, 1995) was assessed by two dexterity exercises specifically designed for this study. Although dexterity tests are commercially available, the following aspects prevented their use in this study. First, commercial tests assessed other motions besides the ones required for the task used in this study (i.e., twisting and inserting). Second, commercial tests usually required individual administration, which created a logistical barrier for data collection from the research pool available for this study. Third, the high cost of commercially available instruments that could be adapted for group administration prohibited the researcher from using those measures.

Hence, following procedures identified by Gatewood and Feild (1998) and by Guion (1998) for the development of performance tests, the tasks involving finger dexterity in the Circuit Board Assembly Task © were judged according to frequency, importance, time required, level of difficulty, and consequence of error. Such evaluation determined the content of the dexterity exercises developed for this study. The Manipulation Exercise assessed whether participants were able to manipulate small objects without the assistance of tools while the Pegboard Exercise evaluated whether participants were able to insert thin objects into small holes quickly and accurately (Appendixes E and O).

In the Manipulation Exercise, participants fastened two screws onto a clasp, forming a unit. While holding the clasp with one hand, with the other hand they inserted a screw on one side of the clasp from the bottom up and placed the fastener onto it from the top. This operation was repeated for the other side of the clasp. The clasp used in the Manipulation Exercise resembled the buzzer used in the Circuit Board Assembly Task © (e.g., same material and shape, approximate size and weight) and the motions required to perform the exercise were the same ones needed to attach the buzzer onto the board. These characteristics of the exercise were important for content validity (Crocker & Algina, 1986). Participants performed this exercise twice with the objective of completing five units per round. The times required for completion of each round were recorded and averaged for the total score on the exercise.

The Pegboard Exercise required participants to place small pegs onto a board and was performed four times. The same motion necessary to complete the Pegboard Exercise was required to insert the resistor and lights onto the circuit board. During the first two rounds, with their dominant hand participants placed as many pegs onto the board as possible under the time limit of one minute. In the third and fourth rounds, participants also placed as many pegs onto the board as possible in one minute, this time using the non-dominant hand. Scores from the four rounds were averaged for the total score on the exercise.

Attention to Detail was assessed by the Inspection Test from the Flanagan Industrial Tests (FIT) battery (Flanagan, 1975 - Appendix D). This instrument was designed to ascertain one’s ability to identify flaws and imperfections in a series of articles quickly and accurately. The Inspection test has been validated for use in a variety of industrial occupations including electrician, mechanics, and machinists (Flanagan, 1975), positions that share characteristics with the ones in the present study (e.g., installing and repairing electrical wiring, repairing machinery in accordance with diagrams, trouble-shooting, etc.). The test score is obtained either by counting the number of correct answers and subtracting the number of errors or by counting the number of correct answers only. Because quality of outcomes is one of the criteria for evaluation of group performance in this study, the first form of score computation was chosen.

Basic Mathematical, Reading, and Writing Skills were assessed through self-report of Scholastic Aptitude Test (SAT) and Grade Point Average (GPA), but were not used as criteria for group composition. This is because study participants had at least a high school degree and met the criteria for college admission, which includes a combination of SAT and GPA scores so that the lower the SAT score the higher the GPA required on college preparatory courses. Thus, restriction of range on basic math, reading and writing skills is present in this sample given that participants have formal education beyond the 8th grade level. Nevertheless, these variables were examined as possible covariates (i.e., control variables) when they were related to the dependent variables (please refer to the section on control variables for details).

Assessment of team-related KSAs

Stevens and Campion's (1999) Teamwork-KSA Test (Appendix C) was used to assess participants' team-related KSAs. This test assesses interpersonal and problem-solving KSAs by asking respondents to make decisions about situations that are frequently found in team environments. The test focuses on learnable behaviors rather than personality traits or dispositions. Ten questions assessed **Self-Management KSAs**, which refer to managerial and supervisory skills that team members should possess to perform basic managerial duties in a team setting (e.g., coordinating activities, information exchange, and establishing team goals). **Interpersonal KSAs** were assessed by 25 questions covering the areas of conflict resolution, collaborative problem solving, and communication. Scores on the Teamwork-KSA Test were computed by adding the correct number of answers.

The 35-item, multiple-choice instrument has been validated through concurrent validation studies conducted in manufacturing settings (Stevens & Campion, 1999). Results suggest acceptable criterion-related validity against overall (r = .23 to .52), technical (r = .25 to .56), and teamwork (r = .21 to .44) performance criteria as well as against supervisor (r = .21) and peer (r = .23) ratings of teamwork (Stevens & Campion, 1999; 1998). The validation studies also indicate that the test was able to predict incremental individual-level job performance above and beyond predictions from traditional aptitude tests.

Task- and Team-related KSA Composites

In order to assign participants to the two task-related KSA conditions, scores on the inspection test and on the two finger dexterity exercises were combined. However, because the scores on these instruments were in different metrics, they were first transformed into *Z*-Scores. Then, an equal-weighted composite of these instruments was used to assign participants to the two task-related KSAs conditions. To assign participants to the two team-related KSA conditions, the total score on the Teamwork KSAs instrument was used (see criteria in Table 1).

Instruments – Phase II

Measures of dependent variables

Two sets of variables were assessed as dependent measures: team internal processes and team outcomes. Specifically, four process variables (i.e., task cohesion, communication, task conflict, and coordination) and three team outcome variables (i.e., quantity of output, quality of output, and team viability) were investigated. Items appear in Figure 3, organized by content area and scale. For all scales, but the conflict management scale, reliability and validity evidence has been demonstrated in previous studies. However, reliability and dimensionality of the scales employed in this study were further investigated (see below).

Careful choice of measures and procedures is important in any scientific research. However, investigations into work team phenomena bring with them some additional considerations related to measurement issues (Baker & Salas, 1997). For example, although general guidelines for item writing should be observed (e.g. Crocker & Algina, 1986; Hinkin, 1995), it is also important that the referent in the items provide team members a framework that allows similar evaluation of the matter in question (Saavedra et al., 1993). In this study, care was taken to ensure that expressions such as “our group”, “everyone in this group”, “other group members” were present as referents in all the questions related to the team as a whole.

Team viability (5 items)
I found it personally satisfying to be a member of this group.
I was proud to be a member of this team.
Certain members of this group did not pull their weight. (R)
Everyone on this group did his or her share of the work.
Everyone on the group would choose to work together on future tasks.

Task cohesion (4 items)
Our group was united in trying to reach its goals for performance.
I’m unhappy with my group’s level of commitment to the Circuit Board Assembly task. (R)
Our group members had conflicting aspirations for the team’s performance (R)
This group did not give me enough opportunities to improve my personal performance (R)

Communication (5 items)
Group members helped each other express their ideas.
Group members listened attentively to others’ ideas.
Group members paid attention when someone was talking.
Group members pointed out positive aspects of other member’s ideas.
Group members responded to the non-verbal behaviors of other group members (e.g., posture, eye contact, fidgeting).

Figure 3. Measures of dependent variables

Task Conflict (4 items)
How often did people in your group disagree about opinions regarding the work being done?
How frequently was there conflict about ideas in your group?
How much conflict about the work you did was there in your group?
To what extent were there differences of opinion in your group?

Conflict Management (6 items)
In our group, when conflict occurred…
group members tried to work with each other for a proper understanding of the problem.
group members strove to thoroughly investigate the issue.
the group worked together to create solutions for the problem.
the group tried to use everyone's ideas to generate solutions to the problem.
group members suggested solutions that combined a variety of viewpoints.
the group tried to find solutions that were good for everyone.

Cooperation (14 items)
Other group members usually let me know what they expected from me.
I normally checked with other group members before I did something that might affect them.
I usually let other group members know when I did something that affected their work.
Other group members usually let me know when I did something that affected their work.
I often made suggestions to other group members about better work methods.
I had a clear understanding of the problems associated with the Circuit Board Assembly process and the needs of my group members during the production task.
Other group members clearly understood my needs and problems related to the performance of the Circuit Board Assembly Task.
I got constructive criticism from other group members.
I often helped other group members solve problems associated with the Circuit Board Assembly Task.
When I was busy, other group members often volunteered to help me out.
When other group members were busy, I often helped them out.
Other group members were flexible about switching responsibilities to make things easier for me.
I was willing to help finish work that had been given to other group members.
Other group members were willing to finish work that was assigned to me.

Note. Scales measured on Likert-type scales: Task Conflict scale: 1=Never, 2=Seldom, 3=Occasionally, 4=Frequently, 5=Always; Conflict Management Scale: 0=Not applicable, 1=Strongly disagree, 2=Disagree, 3=Neither agree nor disagree, 4=Agree, 5=Strongly agree; All other scales: 1=Strongly disagree, 2=Disagree, 3=Neither agree nor disagree, 4=Agree, 5=Strongly agree. (R) indicates reverse scored item.

Figure 3. Measures of dependent variables – continued

Also, temporal dimensions impact measures of group phenomena because stages of group development and duration of a group's interaction can impact group's processes, outcomes, and individual's perceptions regarding team experiences (Goodman et al., 1987; Hackman, 1990; Wageman, 1995). Thus, careful attention was given to the choice of constructs being assessed in this study due to the length of the group membership. Also, measures of processes and outcome variables were taken after the group task was completed. Although these seem logical procedures, they have not always been applied in team research (cf. Klein & Mulvey, 1995).

Two objective indicators reflected the team's **Quantity and Quality of Output,** following the approach taken by Neuman and Wright (1999). The total number of completed circuit boards sent to Shipping indicated quantity of output in each production run (see Appendices K and N for report forms). Quality of output was assessed by the number of defects found in the circuit boards completed in each production run (see Appendices K and N for report forms). A self-report measure was used to assess **Team Viability**. The five-item scale was developed by George, Perkins, Sundstrom, and Meyers (1990) and was used as in Eby, Meade, Parisi, and Douthitt (1999). Scale content refers to members' satisfaction, participation, and the group's future prospects of working as a unit.

Self-report measures were used to assess the process variables. **Task Cohesion** was operationalized as the extent to which the group is united and committed to achieving the work task (Careless & DePaola, 2000) and it was assessed by Careless & DePaola's (2000) scale. Item content reflects group unity in performing the task and members' effort in performing the task. To assess **Communication**, five items from Eby and colleagues (2001) was used. The items cover various aspects of effective communication (e.g., attentive listening, feedback, openness, and attention to non-verbal behaviors).

Task Conflict was measured with Jehn's (1995) four-item task conflict scale. Task focused conflict refers to conflict involving the content and issues of the task (Jehn, 1995; Pinkley, 1990). Item content reflects perceptions of the amount of disagreements about the task performed by the group. **Conflict Management** was assessed with six items developed for this study based on works by Janssen and Van de Vliert (1996), Putman and Wilson (1982), Rahim (1983), Riggs (1983), and Whetten and Cameron (1998). Although many scales have been developed to assess conflict management, most of the scales revised reflected dyadic interactions, various styles of conflict management, and decision-making or interpersonal related conflict resolution. The content of the items used in this research refers to aspects such as identifying the source of the group conflict, determining the best approach to solve the conflict, promoting trust among team members during conflict resolution, and striving for the best solution for all team members.

Cooperation was assessed by Seers (1989) 14-item Team Member Exchange Quality scale. The scale was designed to assess the reciprocity between a group member and his or her group. Items assess perceptions of group members' willingness to exchange information and assist each other during the process of task completion. The scale was used in this study as it was in Eby and Dobbins (1997). That is, combining the two underlying constructs proposed by Seers (1989): exchange of information and exchange of effort.

Data Analysis

Manipulation Checks and Evaluation of Task- and Team-related KSA Measures and Composites

Two manipulation checks were carried out to ensure that participants were able to differentiate between the two conditions of task interdependence in the experimental task. After completing the production runs under each of the conditions of task interdependence, participants chose a pictorial description of their work flow (Van de Ven & Ferry, 1980) and answered Campion and colleagues' (1993) 8-item scale of task interdependence (see scales in Appendix O). Data from these two scales were used to assess the effectiveness of the manipulation.

Task- and team related KSA measures and composites were also evaluated. Descriptive statistics and correlations were calculated for these measures. In addition, group comparisons were performed to assess potential differences in performance due to gender.

Evaluation of Dependent Variables' Measures

Item analyses were carried out to assess the distributions of items' scores in the various measures. After descriptive statistics were examined, reliability analyses were conducted to ensure the psychometric properties of the scales used to assess the dependent variables (Crocker & Algina, 1986). Item-total correlations were examined and Cronbach's alpha coefficients were computed as estimates of reliability. Then, correlations between the various measures were calculated and examined. This was followed by confirmatory factor analyses of scales that correlated highly with each other. This last step was performed to ascertain the dimensionality of questionable scales. Results from these analyses indicated whether or not modifications were needed on the various scales prior to hypotheses testing.

In addition, steps were taken to prevent response sets (e.g., social desirability, acquiescence) from contaminating scales' results. For example, assurance of participants' confidentiality, use of negatively worded items through out the various scales, careful attention to the questionnaire's design, and use of different types of anchors were some of the actions taken to discourage participants from responding in a particular way to the various scales regardless of their content. However, two aspects caused the researcher to be concerned specifically about socially desirable responding. First, even though group members did not share their answers with each other, participants completed questionnaires about their experiences during the experimental task in the same room as the other group members and in relative proximity to each other. Second, some of the items in the dependent measures could have been interpreted as behavior expectations when working in teams (e.g., I often helped other group members solve problems associated with the Circuit Board Assembly Task – cooperation scale) and, consequently, be more susceptible to socially desirable responding.

Therefore, at the end of the experimental session, participants also answered Paulhus' (1984, 1998) 40-item Balanced Inventory of Desirable Responding (BIDR), which contains two subscales. The self-deceptive enhancement subscale assesses respondents' tendencies to give honest, but unconsciously inflated self-descriptions and the impression management subscale measures tendencies to give consciously inflated self-descriptions (Paulhus, 1984). Given the nature of the task in the present study and the context in which participants answered to the dependent measures, correlations between the complete BIDR and the various dependent measures were evaluated to assess whether socially desirable responding, either conscious or not, had impacted participants answers to the various scales.

Potential Control Variables

General mental ability (GMA). Considerable attention has been devoted to GMA in research on work teams. Studies have indicated that GMA not only plays an important role in team's performance, but different methods of GMA operationalization in team's research (e.g., mean score or higher score in the group) provide results with distinct implications for team composition (Barrick et al., 1998). In addition, it has been shown that GMA is related to team viability and supervisor's ratings of team performance (Barrick et al., 1998), to supervisor ratings of the team's overall technical skills, and teamwork and team performance (Stevens & Campion, 1994, 1999). Because of GMA's potential impact on some of the variables included in this study (e.g., team viability and team performance), it was deemed appropriate to investigate potential relationships between GMA and the various variables included in this research.

Participants who went on to the second phase of the study signed a statement authorizing the researcher to obtain their Scholastic Aptitude Test (SAT) college admission scores from the university's registrar office. SAT scores are considered reliable measures of GMA (Gottfredson & Crouse, 1986; Hunter, 1986; Jensen, 1986) and have been used as such in previous teams' research (e.g., LePine et al., 1997).

Previous studies have demonstrated that higher mean levels of GMA were associated with higher supervisor ratings for team performance (Barrick et al., 1998), higher quantity of output (Neuman & Wright, 1999), and higher ratings of team viability (Barrick et al., 1998). Therefore, in the present study SAT scores were averaged for each team and the correlations between mean SAT scores and the various dependent variables were examined.

Group gender composition. Groups were both homogeneous and heterogeneous in regards to gender across experimental conditions (see Table 4). Because conflicting findings related to demographic variables and research about teams have been presented in the literature (Harrison, Price, & Bell, 1998; Morgan & Lassiter, 1992), a gender composition variable was created to assess potential group differences due to gender. Due to the smaller number of males participating in the study, the percentage of males in the group was used as the group gender composition indicator. This variable was then correlated with the dependent variables and those correlations were examined.

Context effects. To ascertain whether the order in which the teams worked under the different levels of task interdependence affected the groups' performance in the second production run, *t*-tests for independent means were computed for all dependent variables within experimental conditions.

Data Aggregation and Levels of Analysis

Measurement strategies are dependent on the task and on the characteristics being studied (Barrick et al., 1998; Steiner, 1972). Barrick and colleagues (1998) demonstrated that it is necessary to consider the type of task when determining the appropriate team-level operationalization. For example, consistent with the additive and conjunctive nature of tasks performed, mean and minimum methods were the most important predictors of team success in a study where groups were involved in the assembly of small appliances and in the manufacturing of rubber (Barrick et al., 1998). In the present study, the mean of group members' scores on the dependent variables were used as team-level data due to the additive (i.e., summed contributions of all members was required for task performance) nature of this study's task.

To ensure proper aggregation of scores it was necessary that conceptual and statistical conditions be satisfied. Theoretically, the construct must be meaningful at a higher level, or the effects of interest should be expected at the higher level, to justify aggregation (Roberts, Hulin, & Rousseau, 1978). That is, there should be correspondence between the level of theory and the level of observation. This was the case for all the dependent variables in the study. For example, cooperation is a group process (Kabanoff & O'Brien, 1979; VandeVen & Delbeq, 1976), and team viability and team cohesion are conceptualized as group shared perceptions (Barrick et al., 1998; Mullen & Copper, 1994). Because the dependent variables of interest reflected team-level attributes, there was theoretical justification for aggregation of scores in this research. In addition, the measures of dependent variables utilized in this research were either designed to assess attributes about the team (e.g., item wording) or were assessed at the team-level (e.g., quantity or output).

On statistical grounds, it was necessary to show agreement of individual responses and reliable differences between groups before measures could be aggregated (James, Demaree, & Wolf, 1984; Klein et al., 1994). Lindell, Brandt, and Whitney's revised (1999) measure of within-group agreement for multi-item ratings of a single target (i.e., $r^*_{wg\,(J)}$) were computed to demonstrate that team members were interchangeable in their judgments about the process and outcome variables. The $r^*_{wg\,(J)}$ index was chosen because it is invariant with respect to the number of response options and it is easier to interpret than other versions of the index. That is, in the case of a five-point rating scale for example, the index falls into the interval $-1.0 <= r^*_{wg\,(J)} <= +1.0$, where the zero point of the index is equated with random responding, negative values reflect polarized responses, and agreement is indicated by positive values (Lindell et al., 1999).

Although guidelines have been proposed about the necessary r_{wg} values in order to demonstrate homogeneity within each group (e.g., George, 1990), Lindell and Brandt

(2000) emphasize that not only groups with $r^*_{wg\,(J)}$ >= .70, or other arbitrary values, should be selected for aggregating member's responses to the group-level. That is because screening out groups with low values of $r^*_{wg\,(J)}$ reduces the number of groups available for analysis, consequently reducing the number of degrees of freedom for bivariate statistics. In addition, the removal of groups with low values of $r^*_{wg\,(J)}$ produces restriction of range in the agreement values of the remaining groups, which can potentially impact the strength of relationships between variables of interest. Therefore, all groups were kept for analyses when average $r^*_{wg\,(J)}$ for the variable of interest approached moderate to high positive values. That is, $r^*_{wg\,(J)}$ mean values approaching .60 and higher were interpreted as indicating agreement.

In summary, team- and task-related KSAs were assessed at the individual-level and then, teams were formed according to the various experimental conditions. For all process variables, team viability, and cognitive ability, data were collected at the individual-level but aggregated to the team-level for data analysis. Data for quantity and quality of outcomes were assessed at the team-level. The analysis of all hypotheses was conducted at the group-level, therefore allowing results to be interpreted at the focal level of interest (Rousseau, 1985), the team-level. Furthermore, decisions regarding which hypotheses should be tested were based on results from one-way analyses of variance. These were computed to demonstrate that between group differences on the dependent measures justified hypothesis testing (Klein et al., 1994).

Hypothesis Testing

Hypotheses were tested using SAS univariate repeated-measures program. Both analysis of variance (ANOVA) and analysis of covariance (ANCOVA) were used. ANCOVA was utilized in the analyses that required control of extraneous variables. In experimental designs, ANCOVA is used to remove bias that results from situations that prevent random assignment to experimental conditions on extraneous variables believed to affect the dependent variable (Wildt & Ahtola, 1978; Winer 1971). By partitioning out the variability in the dependent variable that is attributed to variables concomitant to the independent variable, the influence of the independent variable on the dependent variable can be more accurately estimated. That is, the precision of the model parameter estimates is increased. Thus, for hypotheses that required statistical control of extraneous variables, the covariates were entered in the model first, followed by the main effects and interactions of interest in order to decompose the total variance into the various terms necessary for hypothesis testing. Then, the appropriate adjusted sum of squares was used for hypotheses testing. For the hypotheses that did not require statistical control of extraneous variables, the main effects were entered first, followed by the interactions of interest in order to decompose the total variance into the various terms necessary for hypothesis testing. Then, the appropriate unadjusted sum of squares was used for hypotheses testing

Most of the hypotheses reflected planned comparisons and therefore were tested as such. That is, following recommendations by Keppel and Zedeck (1989), single degree of freedom comparisons were tested without correction for family wise error, which refers to the probability that a Type I error be committed somewhere among the various tests conducted in the analysis. In addition, within-subjects designs operate under the assumption that the correlations between all possible pairs of multiple measures obtained from the same subjects are equal (Keppel & Zedeck, 1989). Violations of this assumption affect the evaluation of F-values and are usually prevented by adopting a more conservative probability level (Cohen, 1998). Nevertheless, single degree of freedom comparisons are not affected by these violations when appropriate error terms are used for these tests (Keppel & Zedeck, 1989). Therefore, single degree of freedom comparisons were tested without the adoption of more stringent significance levels.

CHAPTER 4

RESULTS

The results of the data analysis are presented in this chapter. First, results from Phase I are provided. Specifically, the task- and team-related KSAs as well as the composites of those measures are evaluated. This is followed by the presentation of results from Phase II. That is, results from the task manipulation check are presented. Then, the evaluation of the measurement system is described, followed by the presentation of rationale for the inclusion of potential control variables. Next, statistical conditions for data aggregation are demonstrated. Finally, results from hypotheses testing are presented after considerations about statistical assumptions are made.

Phase I

Evaluation of Task- and Team-related KSA Measures and Composites

Descriptive statistics for the task- and team-related measures and composites are presented in Table 5. The distributions of all task-related measures, but the Manipulation Exercise, team-related measures, and both composites were negatively skewed. The correlations between task-, team-related measures and composites are shown in Table 6. Small correlations between task- and team-related measures suggested that the task- and team-related measures assessed different types of KSAs. Within KSA types, correlations were small or moderate, also indicating that different KSA aspects were being tapped by the measures.

Over four rounds of Pegboard Exercise, females inserted on average more pegs onto the pegboard than did males (M = 29.3, SD = 3.0 and M = 26.7, SD = 3.1, respectively). Results from a t-test for independent means indicated that this difference was statistically significant ($t(1,232) = -13.15$, $p < .001$). The average time to complete five units in the Manipulation Exercise was 2 minutes and 27 seconds (SD = 39 s). In general, average time to complete five units was higher for males than females

(*M* = 2 min 34 s, *SD* = 38 s and *M* = 2 min 24 s, *SD* = 39 s, respectively). Results from a *t*-test for independent means indicated that this difference was statistically significant ($t(1{,}232) = 2.38$, $p < .05$). In addition, the mean and standard deviation for the total score on the Inspection Test across groups approached that presented in the examiner's manual (*M* = 14.74, *SD* = 6.3, *N* = 1,283 in this study's Phase I sample and *M* = 12.56, *SD* = 5.53, *N* = 490 in the manual; Flanagan, 1975). There were no statistically significant differences between males and females in the number of correct answers or errors to the Inspection Test.

Analysis of the Teamwork KSAs Test indicated lower internal consistency reliability for the test in this study's sample ($\alpha = .54$) than the one reported in the examiner's manual (i.e., $\alpha = .80$; Stevens & Campion, 1998). Furthermore, results indicated that there were mean score differences between male (*M* = 22.55, *SD* = 4.29) and female groups (*M* = 23.19, *SD* =3.63; $t\ (1{,}232) = -2.64$, $p < .01$), which were also found in studies reported in the examiner's manual. Across groups, the mean and standard deviation for the total score on the Teamwork KSAs Test approached that presented in the examiner's manual (*M* = 23.0, *SD* = 3.8, *N* = 1,283 in this study's Phase I sample and *M* = 22.4, *SD* = 5.3, *N* = 388 in the manual; Stevens & Campion, 1998).

Gender differences were found in two of the task-related KSA measures and in one of the team-related KSA measures. That is, females inserted more pegs in the Pegboard Exercise and completed the Manipulation Exercise in less time than did males. Also, female scores on Interpersonal KSAs were higher than male scores. Significant statistical differences were also present between female and male groups in the task- and team related KSA composites (see Table 7 for descriptive statistics and *t*-tests of measures and composites by gender). Because a single cut-off score was used to assign participants to experimental conditions in the second phase of the study, females were more likely to qualify for the high task KSAs conditions than males, and males were more likely to qualify for the low task KSAs condition than females.

Although it could be suggested that these group differences indicate that the measures were biased against males, such concerns are not warranted. The measures were designed and chosen based on careful analysis of the KSAs associated with the experimental task KSAs. This was done to ensure that the measures would be closely related to the main task- and team-KSAs. In addition, "aggregate differences between groups are likely to occur on any reliably measured variable" (Arvey & Faley, 1988, p.122). It is the case that differences between males and females in finger dexterity (cf. Maccoby & Jackin, 1974) and interpersonal skills (cf. Eckes & Trautner, 2000) have been well documented in the literature.

In the present study, participants randomly signed up for the various groups within conditions in the second phase of the research. This resulted in mixed gender groups in all four experimental conditions. Scheduling constraints for their return to the second phase further contributed to a mix of homogeneous and heterogeneous gender groups across experimental conditions. Nevertheless, potential group gender composition effects were investigated (see below).

Phase II

Experimental Task Manipulation Check

Results from the pictorial description of the work flow (Appendix O) under the two conditions of task interdependence indicated that the sequential condition was described as one in which the group had low levels of interdependence by 70% of participants. Also, 78% of participants described the reciprocal condition as one where moderate to high levels of group interdependence were present. Similarly, analysis of responses to Campion and colleagues' scale indicated that participants perceived differences in levels of task interdependence between the two experimental conditions (sequential task interdependence - $\alpha = .64$, $M = 26.3$, $SD = 5.4$; reciprocal task interdependence - $\alpha = .66$, $M = 30.9$, $SD = 4.8$); ($t(175) = -8.97$, $p < .001$).

Evaluation of the Measurement System

Item analyses were carried out to assess the distributions of items' scores in the various measures. After descriptive statistics were examined, reliability analyses were conducted to ensure psychometric properties of the scales used to assess the dependent variables (Crocker & Algina, 1986). Means, standard deviations and range of item-total correlations for the various scale items are presented in Tables 8 and 9. All item-total correlations across scales were above .30, except for one item in the cooperation scale in the low task interdependence condition. However, removal of that item would not improve the scale's internal consistency and therefore, the scale was left in its original form. All scales had acceptable reliability estimates for research purposes. Cronbach's alpha coefficients ranged between .63 to .94, for scales in the condition of low task interdependence, and between .70 and .94, for scales in the condition of high task interdependence (descriptive statistics and reliability estimates for the dependent measures are shown in Tables 10 and 11).

In addition, correlations between the dependent measures were generally of small magnitude suggesting little content overlap among the various measures (see Tables 10 and 11). The exceptions were moderate to high correlations between measures of task viability and task cohesion (r = .56) and cooperation and communication (r = .62) in the condition of low task interdependence. Also, in the condition of high task interdependence, moderate to high correlations between measures of task viability, task cohesion, cooperation and communication (r = .51 - .59), and between measures of cooperation and communication (r = .64). Therefore, to evaluate the dimensionality of these scales and assess whether modifications were needed prior to hypotheses testing, a series of confirmatory factor analyses were carried out.

Specifically, correlation matrices with the items from scales that had demonstrated moderate to high correlations were used to test whether the scales provided a better fit to the data in their original, theoretically developed form, or modifications to their factor structure produced better alternatives. That is, for the pairs of scales with high correlations (e.g., cooperation and coordination), models with two and one factors were tested. Similarly, for the four scales with moderate correlations (i.e., task viability, task cohesion, cooperation and communication), models with four, three, two, and one factors were evaluated. This was accomplished by inputing the correlation matrices for the items from scales of interest into LISREL8.2 computer program (Joreskog & Sorbom, 1998) and constraining parameter estimates in the Lambda-X and Phi matrices according to the model being evaluated.

Tables 12 to 15 present goodness-of-fit indexes, which are useful for evaluating the fit of various models against each other in conjunction with the chi-square statistic (Vandenberg & Lance, 2000), for the various models tested. In these analyses, particular attention was given to the Tucker-Lewis index (TLI), which is less affected by sample size than the other indexes (Marsh, Balla, & McDonald, 1988), and to the significance of change in the chi-square statistic. Across analyses, even though changes in the chi-square statistics were statistically significant, suggesting that there were differences between the models as theoretically proposed (i.e., target models) and the various constrained models, the goodness-of-fit indexes did not improve as constrains were placed upon the target models. In fact, most goodness of fit indexes did not meet acceptable critical values normally used to indicate good model fit (i.e., CFI > .90; Hu & Bentler, 1998; SRSMR < .10, TLI > .90, and RMSEA < .08; Vandenberg & Lance, 2000). The exceptions were the target models in the condition of high task interdependence (i.e., SRSMR = .10). This suggested that the various target models provided better fit to the data than the constrained ones. In addition, across target models, only 4 out of 74 item loadings on the Lambda-X matrices were under .40. Combined, these results indicated that the scales could be left in their original forms.

As for the potential impact of social desirable responding on the answers to the various scales, correlations between the various dependent measures and the scale of social desirability were all of small magnitude. These ranged between -.04 to .23, in the condition of low task interdependence, and -.06 to .32, in the condition of high task interdependence (Tables 10 and 11). The results indicated that the researcher's concerns about socially desirable responding were not warranted.

Potential Control Variables

Cognitive ability. While SAT scores were obtained for most of the participants, scores were missing for 11 of them. That is because students who transfer from other universities are not required to provide SAT scores. Because missing scores affected less than 10% of the sample, the average SAT score for the whole sample was used as a replacement for those participants whose SAT data were missing, following the recommendation of Donner (1982). Correlations between mean cognitive ability and dependent variable measures are presented in Tables 16 and 17. These correlations were generally small and not statistically significant, with the exceptions of team viability, in the low task interdependence condition (r = -.36), and quantity of output, in the high task interdependence condition (r = .31). Therefore, mean cognitive ability was statistically controlled when propositions involving team viability and quantity of output were tested.

Group's gender composition. Correlations between the percentage of males in the group and the various dependent variables are also displayed in Tables 16 and 17. Most of these correlations were of small magnitude and not statistically significant, with only three exceptions. That is, group gender composition was significantly correlated with quality of output (r = .34), task cohesion (r = -.15), and communication (r = -.33), in the low task interdependence condition. Thus, group's gender composition was statistically controlled when propositions involving quality of output, task cohesion, and communication were tested.

Context effects. Order effects within experimental conditions are presented in Table 18. Results of the t-tests revealed order effects for team viability, task cohesion, and communication, when responses to the scales were provided during the low task interdependence condition, and for all scales but task conflict, in the high task interdependence condition. These results suggest that the order in which the teams worked under the different levels of task interdependence affected some of the groups' performance in the second production run and also their responses to most of the dependent measures. Therefore, task interdependence order was statistically controlled before all propositions were tested, except for the one involving task conflict.

Data Aggregation

The amount of consensus within groups was investigated to evaluate whether team members' responses about the process and outcome variables were interchangeable. That is because group members' ratings should be relatively similar in order to justify the aggregation of individual data to the team-level (George, 1990). Lindell and colleagues' (1999) revised measure of within-group agreement (i.e., $r^*_{wg\ (J)}$) was calculated for each of the dependent variables whose responses were to be combined within groups. The average $r^*_{wg\ (J)}$ per scale was examined as one of the criteria to make decisions about whether or not to aggregate (cf., Barry& Stewart, 1997; Simons & Peterson, 2000). Because response biases were not expected (see results for social desirable responding above), uniform distributions were used as the null distribution in the calculation of the $r^*_{wg\ (J)}$ [variance of the uniform distribution equal to 2.0, in the case of five-point response scales, and 2.917, for six-point response scale, following guidelines by James et al., (1984)]. Thus, the indexes of agreement were expected to range between $-1 <= r^*_{wg\ (J)} <= +1$, for all five-point response scales, and between $–1.43 <= r^*_{wg\ (J)} <= + 1$, for the conflict management scale, a 6-point response scale.

Table 19 presents $r^*_{wg\ (J)}$ values for the measures that required aggregation prior to hypotheses testing. In general, average values were moderate to high for all but two variables. In their responses to the cooperation items, 20% of the groups had $r^*_{wg\ (J)}$ values between -.01 and .32, in low task interdependence condition, and 33% had values between .03 and .31, in the high task interdependence condition. These results indicate that group members had randomly answered the items or that they demonstrated little consensus in their assessment of the construct. In the case of conflict management, $r^*_{wg\ (J)}$ values ranged from lower to upper bound suggesting that groups had randomly responded to the items, completed disagreed or completed agreed in their evaluations of the construct. For the conflict management scale, the average $r^*_{wg\,(J)}$ was negative in both conditions of task interdependence. In addition, a small percentage of groups (27 % and 14%, in the low and high conditions of task interdependence, respectively) demonstrated positive values of $r^*_{wg\,(J)}$ for this scale. Therefore, because statistical agreement could not be demonstrated for these variables, propositions related to conflict management and cooperation were not tested (i.e., Propositions 3a and 4, respectively).

Before hypotheses testing, it was also necessary to show differences between groups. Results from one-way analyses of variance are displayed in Tables 20 and 21. All of them met Hays' (1988) criterion of F- value greater than 1.0 (cf. Eby & Dobbins, 1997). These results indicate that there were between group differences in the various dependent variables, which justified the test of the propositions in this study.

The following propositions were tested after the soundness of the measurement system was examined and the statistical conditions for data aggregation were met. Each proposition is presented in Table 22 with the variables that were statistically controlled before the proposition was tested. The numbers of the propositions correspond to their numbers in Chapter 2.

Hypotheses Testing

Statistical assumptions. ANOVA was employed to test Proposition 3. Statistical assumptions underlying the use of this analytical procedure are that treatment populations are normally distributed, that these populations have equal variances, and that the individual observations are independent of other observations, within or between treatment populations (Keppel & Zedeck, 1989). Examination of univariate statistics for the dependent variable in Proposition 3 (i.e., task conflict under the low and high conditions of task interdependence) indicated that the distributions were slightly positively skewed and kurtotic. Nevertheless, the F statistic, which is used for evaluating the null hypothesis in ANOVA, is insensitive to even major violations of the assumptions of normality and homogeneity of variances (Hays, 1994) suggesting that ANOVA could be used.

As for the assumption of interdependence, even though subjects were randomly assigned to teams and roles within teams, the within-subjects component of the design employed in the present study violates the interdependence assumption. That is, within-subjects designs operate under a counter assumption that measures obtained from the same subjects are not independent but are equal between all possible pairs of treatment (Keppel & Zedeck, 1989). Violations of the assumption of interdependence in within-subjects designs affect the evaluation of *F* statistic and are usually prevented by adopting a more conservative probability level (Cohen, 1998). However, single degree of freedom comparisons are not affected by these violations when appropriate error terms are used for the tests (Keppel & Zedeck, 1989). Therefore, because single degree of freedom comparisons were needed for the test of Proposition 3 and attention was given to error terms, ANOVA was deemed appropriate to test this proposition.

ANCOVA was used to test Propositions 1, 2, 5, 6, and 7. The assumptions underlying ANOVA also apply to ANCOVA. Univariate statistics for the variables to be included in the various analyses were examined. Results indicated that violations of the assumptions were not present in the data with the following exceptions. The distributions for quantity of output in the condition of low task interdependence, cognitive ability, and the dichotomous variables (i.e, order of task presentation, group gender composition) were kurtotic. Also, the distributions for quality of output in both conditions of task interdependence were slightly positively skewed. Moreover, only single degree of freedom comparisons were required to tests the propositions above, addressing the within-subjects design assumption.

Additional analyses were carried out to ensure that specific ANCOVA assumptions were addressed. First, the assumption of linear regression (i.e., residual scores are normally and independently distributed in the population with mean of zero and homogeneous variance; Keppel, 1991) was evaluated through the examination of studentized residuals. Results indicated that across all scales, only four of the observations had studentized residual values greater than 2.7 (range 2.78 – 3.67).

Therefore, it was anticipated that adjustment to the means due to the inclusion of covariates would be beneficial. ANCOVA also assumes homogeneity of group regression coefficients. That is, regression coefficients are expected to be constant for the different treatment populations (Hays, 1994; Keppel, 1991). Although ANCOVA is generally robust with regards to homogeneity particularly when group sample sizes are equal (Keppel, 1991), Keppel suggests that group differences in regression coefficients should be tested. When these differences are not significant, greater confidence can be placed on the results from ANCOVA.

When more than one covariate is used, “the assumption of homogeneity of regression becomes equivalent to the assumption that the same true variance-covariance matrix exists within each population under study” (Hays, 1994, p. 837). Thus, tests for homogeneity of variance-covariance matrixes were performed, *Box M* tests, following recommendation by Hays (1994). Results were not significant for task cohesion, communication, task conflict, and quantity of output indicating that the observed variance-covariance matrixes were equal across groups. Results for quality of output and team viability were significant, suggesting assumption violation. However, because the *Box M* test is overly sensitive to non-normality, Hays (1994) advises that the test should be interpreted with caution. Therefore, regression coefficients reflecting interactions between the treatment groups and the covariates were examined. There were no significant relationships between the covariates and levels of treatment, indicating that there were no violations of the homogeneity of regression assumption. Because major violations of ANOVA and ANCOVA assumptions were not found, ANCOVA was considered appropriated for testing the propositions above.

Hypotheses testing results. Proposition 1 anticipated that the relationship between task-related KSAs and task cohesion would be moderated by task interdependence. Group gender composition and the order in which the teams worked under the different levels of task interdependence were statistically controlled in the analysis of this proposition. After the group means were adjusted for the two covariates, the main effect for task-related KSAs was not statistically significant ($_{Adj}M$ = 16.73, *SE* = .29 and $_{Adj}M$ = 16.49, *SE* = .29, low and high task-related KSAs, respectively). Similarly, the main effect for task interdependence was not statistically significant ($_{Adj}M$ = 16.11, *SE* = .22 and $_{Adj}M$ = 17.11, *SE* = .23, low and high conditions of task interdependence, respectively). In addition, the interaction between task-related KSAs and task interdependence did not reach statistical significance. Thus, Proposition 1 was not supported. Results from the repeated measures analysis of covariance for this proposition are presented in Table 23.

Results for Proposition 2 are presented in Table 24. It was expected that the relationship between team-related KSAs and communication would be moderated by task interdependence. After the group means were adjusted for group gender composition and the order in which the teams worked under the different levels of task interdependence, the main effect for task-related KSAs was not statistically significant ($_{Adj}M$ = 16.90, *SE* = .41 and $_{Adj}M$ = 17.34, *SE* = .41, low and high team-related KSAs, respectively). The main effect for task interdependence, however, was statistically significant ($F(1,40) = 9.075$, $p < .01$). Adjusted group means were 16.10 (*SE* = .35) for the low condition of task interdependence, and 18.14 (*SE* = .32) for the high condition, indicating that teams demonstrated more effective communication in a context of high task interdependence. Nevertheless, the interaction between team-related KSAs and task interdependence was not statistically significant. Therefore, Proposition 2 was not supported.

Proposition 3 stated that the relationship between team-related KSAs and task conflict would be moderated by task interdependence. Results for the repeated measures analysis of this proposition are displayed in Table 25. No significant main effects were found for team-related KSAs (*M* = 4.72, *SE* = .15 and *M* = 4.83, *SE* = .15, low and high team-related KSAs, respectively). A statistically significant main effect was found for task interdependence ($F(1,42) = 6.56$, $p < .05$), suggesting that teams engaged in more task-related conflict in conditions of high task interdependence (*M* = 4.59, *SE* = .09 and

M = 4.96, *SE* = .15, low and high conditions of task interdependence, respectively). The interaction between team-related KSAs and task interdependence was not statistically significant. Consequently, there was no evidence to support Proposition 3.

Table 26 presents the results from the repeated measures analysis of covariance for Proposition 5. This proposition anticipated that the relationship between task-related KSAs and quantity of output would be moderated by team-related KSAs. The main effect for task-related KSAs was statistically significant ($F(1,38) = 13.88$, $p < .001$), after group means were adjusted for cognitive ability and the order in which the teams worked under the different levels of task interdependence. These results indicated that teams high on task-related KSAs produced more units than teams low on task-related KSAs ($_{Adj}M = 22.40$, $SE = .95$ and $_{Adj}M = 17.39$, $SE = .95$, high and low conditions of task-related KSAs, respectively). The main effect for team-related KSAs and the interaction between task- and team-related KSAs were both not statistically significant. Therefore, Proposition 5 was not supported.

However, the main effect for task interdependence was significant ($F(1,38) = 3.97$, $p < .05$; $_{Adj}M = 18.93$, $SE = .62$ and $_{Adj}M = 20.86$, $SE = .93$, low and high conditions of task interdependence, respectively) and the interaction between team-related KSAs and task interdependence approached statistical significance ($F(1,38) = 3.64$, $p = .06$). That is, mean quantity of output was higher in the high task interdependence condition than in the low task interdependence condition for teams low on team-related KSAs. In addition, mean quantity of output was about the same for teams high on team-related KSAs in spite of task interdependence conditions.

Proposition 5a predicted mean differences in quantity of output between teams with similar task- and team-related KSAs as a function of high and low task interdependence. This proposition was tested with t test for paired means using the values adjusted for cognitive ability and order of task interdependence obtained from the ANCOVA of Proposition 5. Results are presented in Table 27. There were significant mean differences in the quantity of units produced by groups high in team-related KSAs but low on task-related KSAS and by groups low on both task- and team-related KSAs. That is, groups low on task-related KSAs produced more units under conditions of high task interdependence than they produced under conditions of low task interdependence. There were no significant mean differences in quantity of output produced under the two conditions of task interdependence for teams low on team-related KSAs but high on task-related KSAs and for teams high on both task- and team-related KSAs.

Results for Proposition 6 are presented in Table 28. It was expected that quality of output would be a function of task-, team-related KSAs and task interdependence. Group gender composition and the order in which the teams worked under the different levels of task interdependence were statistically controlled in the analysis of this proposition. After the group means were statistically adjusted, there were no significant main effects for task-related KSAs (${}_{Adj}M = 4.71$, $SE = .50$ and ${}_{Adj}M = 5.20$, $SE = .50$, low and high task-related KSAs, respectively[1]) or for task interdependence (${}_{Adj}M = 4.43$, $SE = .43$ and ${}_{Adj}M = 5.48$, $SE = .57$, low and high conditions, respectively[6]). However, the main effect for team-related KSAs approached statistical significance ($F(1,38) = 3.53$, $p = .07$). That is, teams high on team-related KSAs had a lower rate of defects than teams low on team-related KSAs. Nevertheless, the interaction between task-, team-related KSAs and task interdependence was not significant. Therefore, Proposition 6 was not supported.

Proposition 7 stated that the relationship between task-related KSAs and team viability would be moderated by team-related KSAs. Results for the repeated measures analysis of Proposition 7 can be found in Table 29. Group means were adjusted for cognitive ability and the order in which the teams worked under the different levels of task interdependence. No significant main effects were found for task-related KSAs (${}_{Adj}M = 19.47$, $SE = .43$ and ${}_{Adj}M = 19.05$, $SE = .43$, low and high task-related KSAs, respectively) or for team-related KSAs (${}_{Adj}M = 19.39$, $SE = .40$ and ${}_{Adj}M = 19.13$, $SE = .40$), low and high team-related KSAs, respectively). The interaction between task-

---

6 Higher numbers indicate more defects and, consequently, lower quality.

and team-related KSAs was also not statistically significant. Then, Proposition 7 was not supported.

Because Proposition 7 was supported, it was not logical to proceed with the test of Proposition 7a. That is because this proposition anticipated mean differences between teams with similar task- and team-related KSAs as a function of high and low task interdependence. Table 30 presents a summary of the results of the propositions tested.

CHAPTER 5

DISCUSSION

This study was designed to investigate the nature of the relationship between task- and team-related KSAs and the internal processes and outcomes of groups performing a production task under different levels of task interdependence. Specifically, two overarching questions guided the study's design and the formulation of propositions. First, are performance differences predicted by task- and team-related KSAs the result of additive or non-additive relationships? Second, does task interdependence moderate the relationship between KSA types and team's internal processes and outcomes? That is, are task- and team-related KSAs differentially important under different conditions of task interdependence? In this chapter, the findings related to specific propositions are discussed. This is followed by an evaluation of the current study's limitations. Then, in light of this study's findings, theoretical and practical implications are presented along with suggestions for future research.

Discussion of Findings

Task- and Team-related KSAs, Task Interdependence, and Internal Team Processes

Task cohesion. In recent years, task cohesion has consistently been shown to facilitate group performance (Mullen & Cooper, 1994: Zaccaro, 1991; Zaccaro & Lowe, 1988). Therefore, it is important to understand how to enhance groups liking and commitment to their task (e.g., Carless, 2000; Mullen & Cooper, 1994). It was expected that groups better equipped to meet the task-related requirements of the job would demonstrate higher task cohesion than groups that were less capable of addressing those demands. In addition, conditions of higher task interdependence were expected to moderate that relationship by fostering team members' exchange of their strengths and weaknesses in regards to their abilities to perform the task. Specifically, Proposition 1 anticipated that the relationship between task-related KSAs and task cohesion would be moderated by task interdependence. Even though this proposition was not supported by the data, it seems premature to abandon research examining potential task-related KSAs – task cohesion relationships. Most notably because this is the first study to specifically examine the relationship between task-related KSAs at the group-level and task cohesion and several factors may have contributed to the absence of findings in this research.

For example, temporal issues might be responsible for the absence of significant results. That is, Carron and Brawley (2000) propose several possible changes in the structure of cohesion over time. Specifically, they suggest that different components of group cohesion (i.e., social cohesion, task cohesion, and group pride) might be more or less important at different stages of the group's life. Even though it is acknowledged that groups are dynamic entities that develop and change over time, Carless (2000), in a reply to Carron and Brawley's paper, cautious researchers that there has been very little research on temporal issues as they relate to groups (cf. Sundstom et al., 1990) and, specifically, to group cohesion. For example, there is some empirical evidence that social cohesion may be an antecedent of task cohesion. In a study with undergraduate students, Zaccaro and Lowe (1988) reported that social cohesion, operationalized as interpersonal attraction, increased commitment to the task, which then enhanced productivity. In addition, Carless (2000) found moderate correlations between task cohesion and social cohesion.

It stands to reason that in some groups, social factors might be more salient during early stages of group formation than task-related factors. In the current study, observation of the teams' initial interactions lends anecdotal support to this idea. In general, group members did not know each other previously. Only five teams were composed of members who knew each other as acquaintances and no more than two members had known each other prior to working together in the experimental task. Thus, in several groups, team members asked each other about their majors, hobbies, and interests once they began working on the assembly of the circuit boards. The implication of this observation for the lack of effects for task-related KSAs on task cohesion is that, perhaps, despite working together for one and a half hours, the various groups in this research did not interact long enough for task cohesion differences to appear. Throughout the experimental task, group members might have been engaged in establishing social cohesion. Consequently, proposing a relationship between task-related factors and task cohesion for teams whose members have little or no previous knowledge of each other may have been premature or even inappropriate. Thus, concurring with Carless (2000), more longitudinal research on group cohesion is needed to clarify which different components of cohesion impact groups' early and long-term interactions. Furthermore, research is also needed on the conditions that might affect such changes (e.g., type of group, type of task, length of group membership, etc.).

One additional explanation for the lack of findings is that the setting for the study (i.e., research participation in exchange for credit in an introductory psychology class) may have prevented task cohesion differences from developing, even under the different conditions of task interdependence. That is because task cohesion results when group members need to work together in order to obtain outcomes that would not otherwise be attainable through individual efforts (Zaccaro, Gualtieri, & Minionis, 1995). In the current study, participation in the second phase of the experiment resulted in additional research credit. Even though this is a common procedure when student pools are involved in research, participation in both phases of this study accounted for half of all research credits required for the academic semester. Obtaining half the research credits for the semester may have been the outcome that would not be attainable in an individual context. That is because even though the same amount of research credits could have been achieved by attending other studies or writing papers, this would require participation in various experiments (between three and six) in different days and times. In addition, because team members did not have a standard to compare their team's performance and only the participation in the experiment was needed for research credit, it is not likely that group members would have been unhappy about their group's level of commitment to the task or that they would have developed conflicting expectations for the group's productivity. Therefore, regardless of task-related KSAs and task interdependence conditions, groups may have maintained enough commitment to the experimental task in order to complete the experiment and obtain research credit.

Another possible explanation for the lack of findings is related to the nature of the groups in the current study and consequent reduction in statistical power to detect a potential effect. That is, in a meta-analytical review of studies investigating the relationship between cohesion and performance, Muller and Cooper (1994) found that the effects for the cohesion-performance relationship were affected by the nature of the group. Specifically, effects tended to be stronger in real groups than in artificial ones (i.e., magnitude of effects around .20 - .50 and .10 - .15, respectively). The teams in this research were created specifically for the purpose of this study; they were artificially formed. Artificial groups do not have as much invested in their group participation as real groups. In artificial teams, group membership is temporary, poor group performance does not usually reflect serious consequences, and commitment to the task may not be as strong. A potential relationship between task-related KSAs and task cohesion could also be affected by the nature of the group. Similar to other cohesion relationships, it may be that effect sizes of relationships between task cohesion and task-related KSAs are also smaller in artificial groups than in real teams. Because the current study was designed to uncover effects of medium size, smaller effects were not likely to be found. Thus, low statistical power may have contributed to the absence of significant findings.

Communication. Effective communication is an important requirement for successful performance in team environments (Klimoski & Zukin, 1999). It was anticipated that groups high on interpersonal skills would engage in more effective communication than groups lower on interpersonal skills. In addition, it was expected that levels of task interdependence would affect this relationship because team members in conditions of high interdependence are required to communicate more often and more effectively. Thus, Proposition 2 predicted that the relationship between team-related KSAs and communication would be moderated by task interdependence. In the current study, teams demonstrated more effective communication in a context of high task interdependence than in a context of low task interdependence. Nevertheless, no main effects were identified for team-related KSAs and the interaction between these variables was also not supported.

These findings are troubling because the communication scale utilized in the current study is designed to assess specific aspects of *effective* communication (i.e., attentive listening, feedback, openness, and attention to non-verbal behaviors). Yet, it is unlikely that groups low on team-related KSAs would be able to communicate as effectively as groups high on team-related KSAs, simply by working under conditions of higher interdependence. Unfortunately, the low reliability of the Teamwork KSAs Test in this study's sample (i.e., $\alpha = .54$) does not offer assurances that teams were well differentiated on their interpersonal skills, even though groups in the two conditions of team-related KSAs differed on the team-related KSAs composite ($t(42) = 22.05$, $p < .001$). Furthermore, the even lower internal consistency reliability for the Communications KSAs subscale in the Teamwork KSAs Test (i.e., $\alpha = .22$, 12 items, 1,235 responses) does not justify further examination of those data.

Nevertheless, a plausible explanation for the finding that communication means were significantly higher in conditions of high task interdependence is that the structure of the task may have affected the frequency of communication in the teams. Specifically, when team subtasks are highly interrelated, team members must coordinate the flow of individual work input and outputs and consequently need to communicate more often. Conversely, when subtasks are not highly interrelated, requirements for coordinating the flow of input and outputs are lessened and communication frequency can be reduced. Thus, group members may have simply communicated more frequently in the high task interdependence condition. Later, when responding to the questionnaires, they may have answered more favorably to the communication items in the high task interdependence conditions reflecting the increased communication in the group.

In addition, seating arrangements have been found to influence the pattern of communication. In the condition of low task interdependence, group members were seating side by side in separate desks. However, in the high task interdependence condition, group members were seating around a table facing each other (Appendixes, J and M). The physical arrangement of group members has been associated with changes in the flow of communication, both verbal and non-verbal (Shaw, 1981). By seating face-to-face, team members may have been in a better position to attend to each other's comments and pay attention to non-verbal behaviors than when seated side by side. Together, the structure of the task and the seating arrangements may have contributed to increasing communication frequency in the high task interdependence condition, leading group members to inflate their answers to the communication items after having completed the experimental task under conditions of high task interdependence.

Task conflict. Disagreements about the content of the task being performed and different ideas and opinions about the work can lead to innovation and improvement of work processes. It was expected that groups whose members were better equipped to recognize and address task-related conflict would not be disturbed by its occurrence and would let it take place. In addition, conditions of high task interdependence would create more opportunities for task conflict to develop. Thus, Proposition 3 anticipated that the relationship between team-related KSAs and task conflict would be moderated by task interdependence. Consistent with theories about conflict in the workplace, task-related conflict occurred more often under conditions of high task interdependence than low task interdependence. Higher task interdependence contributes to a sense of uncertainty, which is a major source of conflict (Rahim, 2001). As task interdependence increases, so do requirements for work coordination, communication and adjustments to maintain performance, and these may cause group members to disagree.

Interestingly, the presence of significant mean differences in the amount of task conflict under low and high conditions of task interdependence did not correspond to a display of high levels of task conflict by the teams in the present study. Response options for the task conflict scale ranged from 1 (never) to 5 (always) and item means were between 1.1 and 1.3 (Tables 8 and 9). This is a positive factor because groups performing routine tasks can have their performance negatively affected by task-related conflict. Jehn (1995) found that members of groups performing tasks with low levels of variability, generally familiar, and repetitive, felt that high levels of conflict over task related issues were detrimental to the group and contributed to low performance and dissatisfaction of group members. Given the production nature of the experimental task, task conflict may have been low because group members understood that it was beneficial to keep occurrences of task conflict at lower levels. However, it is also possible that low levels of task conflict were present because groups did not possess the skills to manage conflict efficiently and avoided task conflict. The absence of main effects for team-related KSAs and uncertainty about how well differentiated were low and high team-related KSAs groups in regards to their abilities to manage conflict contribute to the ambiguity in the interpretation of the finding that the amounts of task conflict were generally low.

Nevertheless, a potential explanation for the low levels of task conflict is that role clarity regarding team member's task responsibilities may have precluded the need for excessive conflict over task related issues. Roles are expectations of behavior that specify what people should do when they occupy certain positions in a group (Hackman, 1992; Shaw, 1981). In small groups, role conflict occurs when a group member is required to perform two or more roles that require incongruent or contradictory activities (Rahim, 2001). The occurrence of simultaneous pressures, make it difficult for group members to carry their tasks to completion. Furthermore, these structural or situationally imposed constraints may lead to tension and anxiety, which can result in intragroup conflict about the task. However, in the present study, team members' roles were clearly defined. Group members were given verbal and written instructions about their job responsibilities (Appendixes I and L), materials to assist in the performance of the various components of the circuit board assembling task (i.e., circuit board squematics and trouble shooting guides), and were asked to follow those instructions closely. Such clear delineation of team member's roles and responsibilities for completion of the experimental task may have prevented groups from disagreeing about how the work was being done or from expressing competing ideas about how to assemble the circuit boards.

Despite lower levels of task conflict, it was surprising that the indices of agreement demonstrated such high variability in the conflict management scale (i.e, $-1.14 <= r^*_{wg\ (J)} <= .94$ and $-1.50 <= r^*_{wg\ (J)} <= .84$, low and high task interdependence conditions, respectively), which prevented Proposition 3a from being tested. A closer examination of those data indicated that in only one team, in the low task interdependence condition, did all members agree that conflict management behaviors had not taken place. This could reflect a problem in the interpretation of response options. That is, research participants may have chosen the not applicable response option as they answered to the conflict management scale because conflict did not take place during the assembly of the circuit boards. Another possibility is that option was checked because group members did not express the conflict management skills reflected in the measure (e.g., involving all members in generating solutions to the problem). One more alternative explanation for the low agreement in group member's responses to the conflict management scale is that some group members might have been evaluating the management of affective conflict. Recent theoretical and empirical work by Jehn and Chatman (2000) indicates that it is not appropriate to assess only one type of conflict. In fact, they contend that the most common conceptualization of conflict may be incomplete and hinder the usefulness of the research. That is because absolute levels of conflict do not describe the nature and effects of conflict within groups. They suggest that both the proportion of the conflict composition should be investigated as well as group members' perceptions of conflict composition. Future research attempting to address potential relationships between team-related KSAs and task conflict may benefit from these new developments in conflict measurement and theory.

Task- and Team- related KSAs, Task Interdependence, and Team Outcomes

Theorists of group composition have proposed that the amounts of task- and team-related KSAs that members bring to the group task are expected to impact the overall effectiveness of a work group (Owens et al., 1998; Hackman, 1987, 1990). Levels of task interdependence have been found to impact group performance (Saavedra et al., 1993), but the impact of task interdependence on the relationship between task- and team-related KSAs at the group-level and teams' outcomes had not yet been investigated.

Quantity of output. Proposition 5 predicted that the relationship between task-related KSAs and quantity of output would be moderated by team-related KSAs. The significant main effect for task-related KSAs, after group means were adjusted for cognitive ability and the order in which the teams worked under the different levels of task interdependence, indicates that teams high on task-related KSAs produced more units than teams low on task-related. This finding contributes empirical evidence to the suggestion that the amount of task-related KSAs that members bring to the group task has the potential to impact the overall effectiveness of a work group (Hackman, 1987, 1990). In addition, because group members were homogeneous in their task-related abilities, either high or low, this finding also supports the assertion that all team members should meet task function or position performance requirements (Klimoski & Zukin, 1999; Owens et al., 1998). Nevertheless, because research about group-level task-related KSAs is in its initial stages, such interpretation is made with caution because of task types. That is, Neuman and Wright (1999) reported a similar finding for groups performing tasks in which the least capable member determines the group's performance. In their study, team job-specific clerical skills at the group-level were significantly related to work completed by the group. In the present study, higher levels of task-related KSAs across team members benefited groups performing a task in which members' inputs were averaged together to arrive at the team outcome. Therefore, these findings provide initial evidence that specific task-related KSAs at the group-level may have an important role in determining group's output in both conjunctive and compensatory tasks. Nevertheless, it is important that other studies replicate these findings and investigate whether they extend to additive tasks, which require summing of resources for performance, and disjunctive tasks, which require only one team member to perform well in order for the team to succeed.

Conditions of task interdependence also impacted group's productivity in this research. Consistent with Saveedra and colleagues' (1993) findings, groups performing the circuit board assembly task under conditions of high task interdependence produced more units than groups performing the task under conditions of low task interdependence. Previous research has demonstrated that task interdependence impacts group members' choices related to how they go about performing the group task (Saavedra et al., 1993). Therefore, one interpretation of the present study's finding is that the increased requirements for exchange of resources and information in the high task interdependence condition may have contributed to making team members coordinate their efforts more effectively in order to reach greater quantity of output.

Another explanation is that task characteristics in the high task interdependence condition may have contributed to preventing process loss. That is, tasks that are intrinsically motivating and allow team members to contribute in a unique and visible manner have been found to prevent process loss and, therefore, increase group productivity (Shepperd, 1993). In the present study, the experimental task was intrinsically interesting. Research participants' comments during debriefing suggest that they generally enjoyed the circuit board assembly task and were particularly pleased with the hands-on component of the task. Second, even though all group members had been trained in all aspects of the task, during the production rounds, their contributions in assembling the circuit board were unique. Third, these contributions were also visible by other group members given that they were in close proximity to each other. Steiner (1972) proposed that potential declines in quantity of outcome are likely when tasks allow team members to sum or compensate their work contributions. However, the present study demonstrates that compensatory tasks do not always lead to declines in productivity. High task interdependence may impact quantity of productivity positively when tasks incorporate characteristics that can help team members prevent process loss.

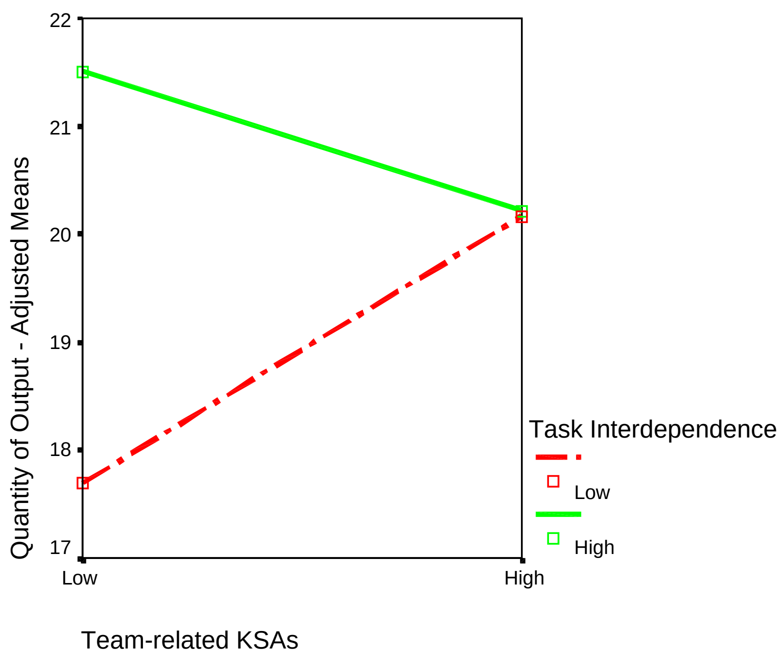


Figure 4. Plot of Quantity of Output as a Function of Team-related KSAs and Task Interdependence.

Because the interaction between team-related KSAs and task interdependence approached statistical significance in the present study, a tentative interpretation of how high task interdependence may have facilitated the increase of group productivity is presented. However, it is necessary to consider that the team-related KSAs conditions may have not been well differentiated due to reliability limitations of the Teamwork KSA Test. Figure 3 presents a plot of quantity of output means, adjusted for cognitive ability and task order, as a function of team-related KSAs and task interdependence. Quantity of output is noticeably higher in conditions of high task interdependence than in conditions of low task interdependence for teams low in team-related KSAs. However, mean quantity of output is about the same for teams high in team-related KSAs in spite of task interdependence conditions. It appears that groups high on task-related KSAs are capable of addressing relational functions (i.e., assessing information and resources) particularly well in conditions of low task interdependence. In fact, they seem to overcome potential barriers imposed by the limitations in the interactions of group members in conditions of low task interdependence. However, in conditions of high task interdependence, groups high on team-related KSAs might spend more time addressing process issues and ensuring group's harmony than devoting efforts to the task at hand. Thus, their productivity does not benefit from high task interdependence. Conversely, groups low in team-related KSAs may not be as successful in conditions of low task interdependence. In fact, conditions of low task interdependence associated with low team-related KSAs may impair group performance. That is because when group members face difficulties in performing the task, they do not possess the skills to reach out to other group members and either request or offer the needed assistance. Moreover, the compartmentalized structure of the task further prevents them from doing so. However, in conditions of high task interdependence, team members are required to coordinate their efforts and exchange materials and information about the task. By assisting each other, they may be able to overcome difficulties in individual performance, contributing to a higher group output.

In the present study, despite concerns with the Teamwork KSAs test, the explanation above seems plausible because group members were crossed-trained. That is, group members were trained in all aspects of the task before they were randomly assigned positions within the teams. Conditions of high task interdependence may have allowed team members to assist each other when difficulties with the task were present. In the condition of high task interdependence, team members were closer to each other, were able to observe the other group members as they worked, and therefore might have been more comfortable sharing information about the task. Conversely, in the condition of low task interdependence, group members would have to solicit assistance and information from other members when facing task related problems.

Proposition 5a anticipated mean differences in quantity of output between teams with similar task- and team-related KSAs composition would be accentuated as a function of high and low task interdependence. Significant mean differences in the number of units produced were found for groups with low task-related KSAs composition. Specifically, groups low on task-related KSAs produced more units under conditions of high task interdependence than they produced under conditions of low task interdependence. However, for groups with high task-related KSAs composition differences in quantity of output were not statistically significant in the two conditions of task interdependence. Therefore, it appears that although groups benefited from high task interdependence across experimental conditions, differences in quantity of output were accentuated for groups low on task-related KSAs. Higher conditions of task interdependence may have allowed team members of groups low on task-related KSAs to counterbalance for each others' task-related weaknesses. The structure of the experimental task under high interdependence may have facilitated coordination of actions and exchange of task-related information.

Quality of output. A complex relationship was expected between task-, team-related KSAs and task interdependence in relation to team's quality of output. That is because it was anticipated that team-related KSAs would impact task-related KSAs differently in different conditions of task interdependence. Nevertheless, the data did not support Proposition 6. Interestingly, the main effect for team-related KSAs approached statistical significance. That is, after quality means were adjusted for the groups' gender composition and task order, teams high on team-related KSAs had a lower rate of defects than teams low on team-related KSAs. Although the following interpretation is made with caution, group-level differences in team-related KSAs may have contributed to fewer defects during the assembly of circuit boards. Group members in teams high on team-related KSAs may have been better prepared to provide feedback about each other's task performance, share ideas for solving potential quality problems, and choose to assist members who might have had difficulties with the task. Conversely, members of teams low on team-related KSAs may have not been able to assist each other when facing task related problems. Thus, the exercise of team-related KSAs may have benefited the groups high on team-related KSAs with greater quality of output.

The absence of significant main effects is especially surprising for task interdependence because previous research has demonstrated that high conditions of task interdependence are beneficial for quality of output in teams (Saavedra et al., 1993). Nevertheless, an explanation for the lack of findings comes from Hackman and Oldham's (1980) ideas on group norms about performance processes. They propose that before final criteria of group work (i.e., quantity and quality of output, group's member satisfaction, and team viability) are evaluated, task performance strategies employed by the team need to be assessed for appropriateness. That is, these authors argue that as group members approach a task, they make decisions about how to perform the work. For example, group members may decide to focus their efforts on checking and re-checking for errors, which would probably result in higher quality products. Alternatively, they may divide the group into subgroups, each of which completes a part of the overall task. Hackman and Oldham state that group members agree upon these task strategies, either explicit or implicit, early in their time together. More importantly, group members derive these strategies from the clues provided by the design of the task and may choose strategies that benefit the group (i.e., strategies congruent with the group's effectiveness criteria, thus appropriate) or that may hinder their performance (i.e., inappropriate task strategies).

Task interdependence has been found to impact group members' choices related to how they go about performing the group task (Saavedra et al., 1993). In the present study, groups had one member responsible for quality control in both conditions of task interdependence. Although group members were aware that two criteria were being employed to evaluate their production (i.e., quantity and quality), the group as a whole may have decided to concentrate on producing as many boards as possible and leave quality control as a responsibility of the group member responsible for that subtask. It is possible that, across task interdependence conditions, group members may have adopted a task strategy of focusing on quantity over quality of output. Because high interdependence seemed to have facilitated higher quantity of output, potential differences in quality of output may have been evened out across task interdependence conditions. In fact, anecdotal evidence suggests that teams may have focused on quantity. That is, some teams expressed enthusiasm over producing more circuit boards in the last production run, some team members asked the researcher about the highest quantity of boards produced by a team, and sometimes, group members encouraged each other to work faster.

Team viability. Research evidence for a relationship between group composition variables and group members' attitudes has been mixed. Nevertheless, models of team effectiveness usually propose an association between these variables. Therefore, the purpose of Proposition 7 was to investigate whether the relationship between task-related KSAs and team viability would be moderated by team-related KSAs. The data in the present study did not support Proposition 7. That is, differences in team-related KSAs were not associated with differences in members' satisfaction, participation, and the group's future prospects of working as a unit. In addition, task-related KSAs did not have an impact on team viability. Previous research by Gladstein (1984) also demonstrates that group composition variables related to the task are not always associated with team satisfaction. That is, group members' perceptions of adequacy of skills and abilities and the degree of group heterogeneity were associated with the structuring of group activities but not with subjective measures of group effectiveness, all of which reflected aspects of satisfaction, including team satisfaction (Gladstein, 1984). Because team viability reflects group member attitudes about their group, a potential explanation for the lack of significant findings for group-level composition variables is that the expectation of task- and team-related KSAs impacting group attitudes may not be the most appropriate.

Specifically, attitudes are usually defined as a combination of three distinguishable reactions to a certain object (Aronson, Wilson, & Akert, 1999; Hewstone, Stroebe, & Stephenson, 1996). These reactions are affective (i.e., emotions), cognitive (i.e, beliefs), and behavioral (i.e., behavioral intentions or actions). One of the lessons from years of conflicting and null findings in the job satisfaction literature is that correspondence between attitudes and behaviors is important (Roznowski & Hulin, 1992). That is, when attitudes are used to predict specific behaviors, it is necessary to ensure that specific attitudes toward that behavior and behavioral intentions be identified and measured. In the present study, knowledge, skills and abilities were being related to group members' attitudes. Although it could be argued that team members who possess the knowledge, skills, and abilities to work in a team environment are more likely to hold attitudes that favor team work, will engage in behaviors that are team oriented, and consequently develop favorable attitudes towards the team, there is not yet empirical evidence to support such argument. In the present study, the operationalization of team- and task-related KSAs does not correspond to emotions, beliefs, and behaviors associated with team viability. Thus, although composition variables may impact performance related outcomes such as quantity of output (i.e., Proposition 5) they may be less likely to impact group members' attitudes.

To illustrate the explanation above, bivariate correlations were computed between measures of affectivity, collectivist orientation and team viability. When participants were screened for Phase II of the experiment, in addition to the task- and team-related KSAs measures, they provided answers to a scale of positive affect (i.e., Positive and Negative Affect Schedule; Watson, Clark & Tellegen, 1988) and to a measure of collectivist orientation (i.e., Beliefs, Values, and Norms Concerning Individualism-Collectivism; Wagner, 1986). Interestingly, the correlations between team viability and group-level positive affectivity, beliefs, values, and norms concerning collectivism indicate positive relationships between these variables (in bold - Table 31), with only one exception. However, the correlations between team viability, task- and team-related

KSAs are all close to zero. Thus, in the current study, it appears that it may have been more likely to obtain effects for positive affectivity, which has been associated with satisfaction (Watson et al., 1988), and beliefs, values, and norms related to collectivism, which have been associated with attraction to collective activities (Campion et al, 1993; Wagner, 1995), as they relate to team viability than for task- and team-related KSAs.

In addition, participants' characteristics and the reason for their participation in the experimental task may have contributed to the lack of statistically significant effects for team- and task-related KSAs. Specifically, team membership was temporary with the final goal of achieving research credit. Furthermore, assembling circuit boards was probably not a task that had consequences for the study's participants beyond the setting of the experimental session. Thus, it is unlikely that participants would have been proud to be a member of the team or that team membership would lead to feelings of satisfaction.

Summary. In the present study, levels of task interdependence were related to two group internal processes: communication and task conflict. Specifically, conditions of high task interdependence were associated with more effective communication among group members than conditions of low task interdependence. Similarly, high task interdependence was associated with more task conflict than conditions of low task interdependence. Task interdependence was also associated with one type of group outcome: quantity of output. Teams working under conditions of high task interdependence were able to produce more circuit board units than teams working under conditions of low task interdependence. In addition, teams low on task-related KSAs appear to have particularly benefited from high task interdependence. Thus, consistent with theory (e.g., Hackman & Morrins, 1975) and previous research (e.g., Campion et al., 1993; Saavedra et al., 1990; Wageman, 1995), this study also demonstrates that task interdependence affects group member behavior and the outcomes of groups working on a production task. Even though the findings in the present study appear simple and intuitive, they serve to remind us about the importance of task interdependence.

Hackman (1993) suggests that the group task is one of the primary sources of ambient stimulation for the team. More importantly, the task content and design can be manipulated to make certain group member behaviors more salient. Task content and design affect both the motivation of individual group members and the pattern of interactions that take place among them (Cannon-Bowers et al., 1992; Hackman, 1993; Hackman & Oldham, 1980; Saavedra et al., 1990). Production teams are usually low rank and have limited authority; various groups in the organization perform the same task and specialization is low to moderate within teams due to cross-training (Sundstrom, 1999). These characteristics of production teams may contribute to making it less likely that organizations adopt interventions such as self-management teams (Parker & Slaughter, 1988) to improve team motivation. That is, providing production teams with conditions and resources so that they become “groups whose members have the authority to handle internal processes as they see fit in order to generate a specific group product, service, or decision” (Hackman & Oldham, 1980, p. 164). However, modifying the task to reflect higher levels of interdependence seems to be a feasible alternative, which may prove particularly beneficial for production teams by facilitating group processes and impacting productivity positively.

The present research also found that specific task-related KSAs at the group level were associated with quantity of productivity. In the present study, teams higher on task-related KSAs produced more circuit board units than teams low on task-related KSAs. This is an important finding because it suggests that, in addition to general task-related KSAs (Barrick et al., 1998; Mohammed et al., 2000; Tziner & Eden, 1985), specific abilities also need to be considered at the group-level. Moreover, it provides support to assertions that great attention should be given to technical skills, knowledge, expertise, and abilities when composing teams (Klimoski & Zukin, 1999; Owens et al., 1998). In tasks such as the one in this research, where team members can compensate for potential deficiencies in their task-related abilities, allowing the whole team to meet technical requirements of the of the task appears to be a means to improving productivity.

Furthermore, this finding also indicates that composing groups with team members who are capable of addressing specific task demands might be beneficial for tasks that require specific abilities (e.g., eye-hand coordination) and some degree of specialization.

Unfortunately, based on the current findings is not possible to answer the questions that guided the study's design and the formulation of propositions. Except for task-related KSAs at the group level being associated with quantity of productivity, none of the main effects for team- and task-related KSAs or the interactions between these KSAs were significant. Therefore, initial evidence about the nature of the relationship between task- and team-related KSAs is not provided by the present study. Consequently, further research is needed in order to determine whether these KSAs complement each other or compensate one another. However, some initial evidence is provided to the question of whether task- and team-related KSAs are differentially important under different conditions of task interdependence. In the present study, high task interdependence appears to have been beneficial for quality of output in teams whose members were low on team-related KSAs. The fact that the interaction between team-related KSAs and task interdependence approached statistical significance signals the importance of assessing the potential impact of this variable in future studies about team composition.

Limitations of the Current Study

Before considering potential implications for research, theory, and practice in light of the present research process and findings, it is important to acknowledge the study's limitations. For example, laboratory research has been criticized and considered by some as inappropriate for the study of work teams (Gordon, Slade, & Schmitt, 1986). Most of the critics are based on the characteristics of laboratory research, such as reliance upon college students as experimental participants, control and manipulation of variables, and random assignment to experimental conditions. Nevertheless, it is precisely the characteristics of laboratory research that allow for understanding why some work behavior processes take place within real teams (Driskell & Sallas, 1992; Hackman &

Morris, 1975). In the present study, adopting a field setting would have allowed for the inclusion of task- and team-related KSAs associated with team's role in the organization and with the functions necessary for effective interactions with factors outside the team (e.g., negotiation skills – see Teamwork Analysis in Chapter 3). The addition of such KSAs would have answered requests for including the context in research about teams (cf. Sundstrom et al., 1990) but it would have also made focusing on the study's questions more difficult.

That is, one of the advantages of the laboratory setting is allowing for the examination of conditions that would probably have no counterpart in real settings (Mook 1993). Even though production facilities could have approved modifications in the production process (e.g., Doerr, Mitchell, Klastorin, & Brown, 1996) to reflect different levels of task interdependence, it is unlikely that an organization utilizing real teams would grant the researcher permission to select and hire teams composed of members whose task- and team-related KSAs were low. Therefore, given that empirical investigations on the possible impact of task- and team-related KSAs on group effectiveness have just started and investigations about the nature of the relationship between these variables are still needed, the laboratory setting was deemed appropriate for this study. The appropriateness of the laboratory for research should be evaluated according to the extent that it helps our understanding of the processes in work behavior (Dobbins, Lane, & Steiner, 1988). Later, principles found through studies such as the present one can contribute to improving research and be translated to applied settings (Driskell & Sallas, 1992).

Nevertheless, some sample characteristics may have limited the findings in this research. First, participants' test-taking motivation would have probably been different in a real selection scenario. That is, in the first phase of the study, participants were informed that they were going to take several tests related to important knowledge, skills and abilities for performance of a the task in the second phase of the study. They were also told that the second phase of the study involved the performance of a production task in a group setting and that the combinations of their test scores would determine their continued participation in the study. However, research participation (i.e., potential participation in the second part of a study) holds a different appeal from a potential job (Chan, Schmitt, DeShon, Clause, & Delbridge, 1997). In addition, real job applicants would probably have had more information about the position for which they applied and about the job requirements. Furthermore, even when the first phase of the study is regarded as a learning experience on test taking for job related purposes, it is not likely that participants from so many different majors would have highly benefited from taking dexterity and attention to detail measures related to manufacturing settings. Thus, even though the present findings are relevant to research about team composition involving task- and team-related KSAs, their generalizability to populations of real applicants cannot be assumed without caution. That is because research has demonstrated that the motive structure of individuals taking employment tests can influence their resulting performances (Arvey, Strickland, Drauden, & Martin, 1990). In fact, previous research indicates that applicants taking tests for research purposes perform differently on tests than "real" applicants (Green, 1951; Jeske & Whitten, 1975). Nevertheless, participants in the present research appeared to have been motivated to achieve research credit and taken the first phase of the study seriously.

Second, participants' efforts in performing the assembly of the circuit boards probably would have been different in case performance evaluations were to take place or quotas had to be met, as it is in the case of real teams. That is, changes in the naturalness of the team due to manipulations of group membership and task processes and the artificiality of the laboratory setting may have caused performance by these groups to be less natural than that of teams working in real production facilities. Nevertheless, "they are still real groups in sense that members interact face to face, freely, through all interaction channels" (McGrath, 1984, p. 47). Therefore, inferences can still be made about their activities, as long as the conditions in which those activities took place are acknowledged. Third, college students do not expect to apply for production types of jobs. At the end of the study, several participants mentioned that they would not take a production job and that they were attending college in order to avoid jobs such as the ones in the experimental task. Thus, it is possible that another type of task (e.g., decision-making, product development) might have been more motivating to participants in this study. In fact, focus groups conducted with undergraduate students in the planning phases of this research indicated that when offering suggestions for team-related tasks, undergraduates were more likely to recommend creative, decision-making, and managerial types of tasks than production related ones. Nevertheless, a production task was needed for this research and effort was placed into making it as intrinsically motivating as possible.

Short task duration and temporary group membership have been other criticisms of team research in artificial groups (Driskell & Sallas, 1992; McGrath, 1984). In fact, in the present study, temporary membership might have been responsible for the lack of findings related to task cohesion and team viability. Nevertheless, group members were trained together in the assembly of the circuit board for 15 minutes, spent about 5 minutes receiving instructions for the task under each level of task interdependence, and prior to the 20-minute production run, they practiced the task together for 5 minutes. Previous research has allowed far less time for the group work (e.g., 8 to 12 minutes; Prussia & Kinicki, 1996; Straus & McGrath, 1994) and has trained team members individually (e.g., Straus & McGrath, 1994). Thus, within the constraints posed by the laboratory setting, attempts were made to increase the time group members interacted with each other and worked together on the experimental task.

Of greater concern, however, is that the utilization of the Teamwork KSAs Test in this study's sample appears to have been detrimental for the present research. The reliability estimate for the whole scale was far below the one reported in the test's manual and reliability estimates for the instruments' subscales were also low (see Table 32). Nevertheless, Crocker and Algina (1986) remind us that reliability is a property of the scores on a test for a particular group of examinees. The Teamwork KSAs Test is a knowledge test with situational questions (Stevens & Campion, 1999). The instrument measures learnable skills and, as such, it is most appropriate to assess what test takers know and can to in regards to team-related KSAs at the time they take the test (Cascio, 1998; Landy, 1985). In fact, "questions assessing (teamwork) KSAs have correct answers that cannot be easily identified by candidates without the adequate level of the KSA…" (Stevens & Campion, 1994, p.518). The reliability estimates in the test manual were based on worker's samples. However, over 55% of the participants in this research were not working at the time of the study and given their age, average 19, their work experience may have not been extensive. In addition, although 92% of them referred team experience, information was not obtained regarding whether these experiences were related to work, school or recreational activities. Thus, when answering the Teamwork KSAs Test, participants may have guessed responses or based their choices on non-work related experiences.

In addition to reliability constraints, the factor structure of the measure in this study's sample does not correspond to the proposed theoretical structure. That is, confirmatory factor analysis (CFA) was conducted to assess whether the data in the current study reflected teamwork KSAs as proposed by Stevens and Campion (1994). CFA was performed instead of a common factor analysis because there is sufficient theoretical (cf., Borman et al., 1997; Stevens & Campion, 1994, 1999; Klimoski & Zukin, 1999) and empirical (Stevens & Campion, 1999) basis to specify the models and impose a specific number of factors (Fabrigar, Wegener, MacCallum, & Strahan, 1999). Therefore, the fit of models with one, two, and five factors were evaluated. These models were tested because they reflected the complete scale, the two broad team-related KSAs categories (i.e., interpersonal and self-management KSAs), and the five specific team-related KSAs subscales (i.e., conflict resolution, collaborative problem solving, communication, goal setting and performance management, and planning and task coordination KSAs).

A correlation matrix with the items from Teamwork KSAs Test was input into LISREL8.2 computer program (Joreskog & Sorbom, 1998) and parameter estimates were constrained in the Lambda-X matrix according to the model being evaluated. Off-diagonal parameters in the Phi matrix were permitted to be freely estimated. Table 33 presents goodness-of-fit indexes for the various models tested. For all three models, even though changes in the chi-square statistics were statistically significant, suggesting that there were differences between the models, the goodness-of-fit indexes did not improve as constrains were placed to reflect the models being evaluated. In fact, none of the goodness of fit indexes met acceptable critical values normally used to indicate good model fit (i.e., CFI > .90; Hu & Bentler, 1998; SRSMR < .10, TLI > .90, and RMSEA < .08; Vandenberg and Lance, 2000). Furthermore, in the one-factor model and in the two-factor model all loadings on the Lambda-X matrix were under .40. Similarly, in the five-factor model, only one out of 35 loadings on the Lambda-X matrix was above .40. Together, these results suggest that the models did not fit the data in this study's sample and these data do not reflect teamwork KSAs as proposed by Stevens and Campion (1994).

As a consequence of the poor psychometric properties of the instrument employed to assess team-related KSAs in this research, hypotheses testing might have also been compromised. That is because another assumption of ANCOVA "that is often overlooked and may lead to misleading results either by inflating or obscuring the true differences among treatment means" (Hays, 1994, p.839) is that the X values are measured without error. Although this is a stiff assumption to meet, assurances against misleading conclusions are usually prevented by ensuring that the X variables are measured with the least amount of error possible. Despites its limitations, the appropriateness of the Teamwork KSAs Test to assess team-related KSAs associated with the experimental task in this research was based on careful analysis of the circuit board assembly task (see Teamwork Analysis – Chapter 3). In addition, the development of the Teamwork KSAs Test was anchored in sound group theory and research (Stevens

& Campion, 1994, 1999), the instrument has been validated in manufacturing settings (Stevens & Campion, 1999), and it has been recommended for use in research and practice (cf. Borman et al., 1997; Klimoski & Zukin, 1999). Furthermore, because the test had been pilot tested with a sample of undergraduate students, it was not anticipated that the psychometric properties of the instrument would be so different in the present study. However, it seems important that the usefulness of the Teamwork KSAs with samples in which participants are undergraduate students or have little work experience be assessed before further research is conducted based on the instrument.

Implications for Future Research

The reduced number of findings in the present study makes it even more salient the need for future research on task- and team-related KSAs at the group-level. The study of work group composition at the group level has just started (e.g., Barrick et al., 1998; Neuman & Wright, 1999; Mohammed et al., 2000). Consequently, more research is needed to understand how KSAs operate at the at the group-level (Sundstrom, McIntyre, Halfkill, & Richards, 2000).

Future investigations on the nature of task- and team-related KSAs may benefit from group-level KSAs that are defined at the group-level, instead of simply operationalized at the group-level. Thus far, researchers have usually relied on isomorphic models as they approach team phenomena (e.g., self-efficacy and collective efficacy), including team composition (e.g. examination of individual difference variables). That is, constructs and variables that have been found to impact performance at the individual-level are examined at the group-level for their potential impact on group effectiveness (cf. Barry & Stewart, 1997; Klein & Mulvey, 1995). In team composition research, this approach has been applied to the study of general cognitive ability (e.g., LePine et al., 1997) and personality (e.g., Barrick et al., 1998), quite often demonstrating that individual-level variables behave differently at the group-level. Applying individual-level constructs and models to the group-level has advanced knowledge about teams in various areas (e.g., cohesion) and has provided an empirical and theoretical basis for the study of work teams. Nevertheless, utilizing individual-level constructs to understand group-level job requirements may also be limiting our efforts in understanding team composition. Discussing team member selection, Guion (1998) suggests a set of individual traits that might be worth investigating when team performance is the criterion (i.e, adaptability, versatility, decision making skills, leadership, situational awareness, interpersonal skill, communication skills, and group orientation). Similarly, Stevens and Campion's (1994) teamwork KSAs dimensions, which were developed based on group theory and research, have been proposed as a means to assess individual skills for teamwork. Propositions such as Guion's and Stevens and Campion's are important because members compose groups and individuals, not groups as a whole, are selected for positions within teams. Nevertheless, Guion emphasizes that although the constructs he proposes seem to be adequate for team formation, their appropriateness has not been empirically demonstrated. Similarly, the suitability of Stevens and Campion's dimensions for team member selection is still in its evaluation stages.

A potential answer for uncovering and understanding team composition constructs at the group-level or potential team differences, using terminology by Hough and Oswald (2000), could come from the use of qualitative methodologies. Qualitative research methodologies have already been proven successful in other areas of team research. For example, Gersick (1998) has utilized an inductive approach to investigate team development and Wageman (1995) has employed observational data to assist in the interpretation of quantitative findings. Similarly, Jehn (1997) has made use of observation and semi-structured interviews as a component in the development a conflict model in work groups. Qualitative methodologies could be used to identify overarching constructs related to team formation in *work* groups. Qualitative evaluations could also be incorporated to explore which aspects of team formation should be studied for specific types of teams (e.g., production teams). Group-level composition KSAs derived from *work* groups could in turn be used to develop the individual requirements for team performance.

Team composition research could also benefit from other forms of assessment besides written tests. To date, research investigating the impact of KSAs at the group level has relied on written tests of cognitive ability (e.g., Barrick et al., 1998; Mohammed et al., 2000), personality (e.g., Mohammed et al., 2000; Neuman & Wrigth, 1999), and knowledge tests about teamwork KSAs (e.g., Kichuck, 1996). Stevens and Campion (1994) have suggested that interviews, assessment centers, and biodata may be instrumental in team selection by assessing social and interpersonal attributes, group problem solving, and previous life experiences of social nature. Anecdotal evidence suggests that other personnel selection tools, besides written tests, have been used in organizations for the purpose of selecting team members (cf. Sundstrom 1999). Because different assessment tools have limitations, the utilization of different instruments to measure similar KSAs could shed light into the usefulness of the tools presently available for team member personnel selection. It is possible that team characteristics and the context in which tasks are performed may impact how group-level KSAs are assessed, perhaps even leading to the development of new assessment methods.

Furthermore, because team formation research relies on tests and assessments, it seems necessary that attention be devoted to issues of test validation in team settings. The Teamwork KSAs test employed in this research, for example, has been validated against measures of individual performance in a teamwork environment (Stevens & Campion, 1999), but it had not been related to the performance of teams as it was in the present study. Traditionally, measurement validation has been conducted at the individual level of analysis (Guion, 1998). That is, data are collected from individuals and interpreted as predictors of individual performance. Nevertheless, Tables 34 to 36 illustrate some of the challenges that face researchers utilizing tests that have been validated at the individual level for group-level research.

In the present study, individual performance data were available for two of the group members during the circuit board assembly task. Specifically, quantity of outcome was recorded for the Set-Up and Lighting Operators. Correlations between the individual-level task-related KSAs measures and quantity of outcome for the Set-Up Operator under conditions of low and high task interdependence are displayed in Table 34. In the condition of low task interdependence, somewhat an individual performance setting for the Set-Up Operator, correlations between the various measures and quantity of outcome were moderate and statistically significant. However, in the high task interdependence condition, correlation magnitudes were smaller and not all of them were statistically significant. In the high task interdependence condition, the group member responsible for inventory could assist the other group members as needed. Therefore, quantity of output for the Set-Up Operator in the high task interdependence does not reflect only individual performance. Table 35 shows correlations between the task-related KSAs measures and quantity of outcome for the Lighting Operator under conditions of low and high task interdependence. The quantity of output produced by the Lighting Operator was impacted by the quantity of output produced by the Set-Up Operator, in the low task interdependence condition, and by the work of the Set-Up and Quality Control Operators in the condition of high task interdependence. In the low task interdependence condition, correlations between measures and quantity of output for the Lighting Operator were similar to those of the Set-Up Operator. The exception was the correlation between quantity of output and the Manipulation Exercise, which assessed an ability not utilized by the Lighting Operator. However, in the condition of high task interdependence, correlations between measures and quantity of output for the Lighting Operator were not statistically significant and generally smaller when compared to those of the Set-Up Operator in the task interdependence condition.

Despite the small sample size, these data indicate that even when individual data are used to validate selection instruments for team selection, different results may be obtained due to conditions of task interdependence. Different results in different conditions of task interdependence are even more noticeable when group-level data are used (see Table 36). These examples demonstrate that while individual traits may be the focus of team formation and replacement of members, the utilization of individual-level criterion alone may not be a sensible approach to the validation of instruments employed in team selection (Guion, 1998). Furthermore, the utilization of either individual- or group-level data for the validation of team-related assessment tools without considering the conditions in which those data were produced may also be inappropriate. Schneider and colleagues (2000) suggest that quasi-experimentation methods be used to evaluate predictive relationships at the group-level. Nevertheless, research is still needed in order to demonstrate how validation studies involving measures for team member selection should be conducted.

One factor that can facilitate the study of team composition is the adoption of a common and systematic way to describe the teams (Cohen & Bailey, 1997; Morgan & Lassiter, 1992). For example, the utilization of a common reference to describe tasks would facilitate the identification of areas in need of research and the accumulation of findings. Unfortunately, task typologies available have little applicability for organizational settings (Guzzo & Shea, 1993) and fail to incorporate the amount of interaction required by the team members in the performance of their duties (Morgan & Lassiter, 1992). However, teams have been described in terms of interdependence. In fact, there is agreement in the literature that shared responsibility and interdependence are minimum defining features of work teams (Cannon-Bowers et al., 1992; Guzzo & Shea, 1992; McGrath, 1984; Steiner, 1972; Sundstrom, 1999).

Sundstrom (1999) proposes that forms of interdependence can be used to assist in strengthening team definition. Specifically, he suggests that interdependence of roles, goals, and outcomes can be used to strengthen the definition of work teams. Sundstrom's types of interdependence in conjunction with Steiner's (1972) (i.e., interdependence of materials and resources) and broad categories of task content (e.g., production, parallel, project and management teams; Cohen & Bailey, 1997) could be used by team composition researchers as a systematic way to describe teams in their studies. Specifically, Sundstrom (1999) suggests that interdependence of roles, goals, and outcomes can be used to strengthen the definition of work teams. Role interdependence refers to the how team members complement each others roles, such as the ones linked by technology expertise or shared responsibility. Goal interdependence encompasses collective goals that are achieved only through cooperation. Finally, outcome interdependence reflects teams sharing the results of cooperative effort, such as bonuses, rewards. In addition to Sundstrom's suggestions, Steiner's (1972) materials and resources interdependence could be added in the description of teams. In the case of the present study, for example, team members were cross-trained contributing to making the team less role interdependent; the assembly of the circuit board task was designed to reflect high goal interdependence; potential outcomes were individual thus reflecting low outcome interdependence; and materials and resources interdependence was experienced both at low and high levels. In addition, the team's task content was production-related. The utilization of a common system to describe teams would be especially beneficial for identifying categories of group-level KSAs for specific types of task content and facilitate the identification of areas in need of research and the accumulation of findings.

Implications for Theory

In the early 90's, Morgan and Lassiter (1992) reviewed the literature of the time in which it was suggested that team interactions and processes and team performance were significantly impacted by input factors related to individual- (e.g., personality) and team-difference (e.g., team's size) variables. One of their conclusions after examining this literature was that optimum strategies for the selection of team members could not be developed based solely on the basis of individual- and team-differences variables due to the complexity of relationships when these variables were examined in conjunction with task and situational variables. Recently, Sundstrom and colleagues (2000) reviewed the last 20 years of published research about group effectiveness conducted in work settings. One of their conclusions was that very few robust predictors of team effectiveness had emerged across types of teams and settings. Together, these reviews signal one of the challenges of conducting team composition research. Specifically, how to best decide on variables of interest when the models of group effectiveness available are so general? In addition, how to best accumulate findings from composition research so that empirical evidence may assist practitioners as they develop systems for selecting team members?

Goodman and colleagues (1987) argue that most of the influential models of team effectiveness (e.g., Gladstein, 1984; Hackman 1987; McGrath, 1984) are so general in nature that, instead of being classified as models, they should be regarded as representations of general classes of variables that relate to work group effectiveness. General or heuristic models are common in the industrial and organizational psychology literature and they presuppose application across settings. Even though general models are important at the initial stages of examining a phenomenon, more specific models can lead to the identification of critical variables and complex relationships, providing a more fine-grained understanding of the phenomenon in question (Cohen & Bailey, 1997). For example, Goodman and his colleagues contend that as research and knowledge about group effectiveness is advanced, more specific models can help us understand processes that contribute to making some groups more effective than others. Thus far, research about work teams and group effectiveness has consistently indicated that task types and situational variables impact group effectiveness (Cohen & Bailey, 1997; Sundstrom et al., 2000). Consequently, it has been suggested that perhaps there should be different models of team effectiveness for different types of teams (Cohen and Bailey, 1997; Goodman et al., 1992). As researchers begin to focus their efforts on understanding how group-level inputs impact team effectiveness, group composition research could particularly benefit from more bounded models of team effectiveness.

That is because team composition research may be more effective by investigating the types of composition variables associated with group effectiveness in specific types of groups than groups in general. In the present study, for example, a general model of team effectiveness was used to guide the choice of variables. Despite the study’s limitations, there may be another alternative explanation for the absence of findings for some of the processes and outcomes investigated in this research. That is, it is possible that some of the variables included in the present study may not reflect processes that take place within or are relevant for production teams. Production teams engage in performance tasks that require performance and motor skills (Jackson, 1992). They are involved in creating large quantities of product and are usually cross-trained and have low levels of autonomy (Sundstrom et al, 1990). Thus, it is possible that specific task-related group-level input factors may be especially relevant for production teams, whereas other work groups such as project teams, which frequently draw members from different disciplines and functional units, may depend on team-related group-level input factors to a larger degree. Similarly, whereas the effectiveness of project teams may be greatly influenced by team members' commitment to the task and group-level team-related KSAs, production teams may be less affected by their members' team-related KSAs due to their focus on technical aspects of the job. Specific models of team effectiveness for production teams could assist in advancing team composition research by providing the boundaries to determine processes and outcomes specific to production teams.

Twenty years of research has already indicated that few predictors of team effectiveness have emerged across types of teams and settings (Sundstrom et al., 2000) and it has been suggested that some processes might be more important for some types of groups than others (Cohen & Bailey, 1997). In addition, most reviews about team composition variables seem to provide conflicting information (e.g., Morgan & Lassiter, 1992), making the application of findings particularly difficult. Group effectiveness theory that is specific to group types could not only make the choice of variables for research more effective. Specific models could also facilitate the accumulation of findings. Consequently, as research progressed and empirical evidence were accumulated, recommendations specifically related to production teams could be drawn and provide support for the development of selection systems.

Another area of theory development that could benefit team composition research is team composition theory itself. Work group composition theory is scant, almost inexistent (Morgan & Lassister, 1992; Moreland & Levine, 1998; McGrath, 1998).

Consequently, research on work group composition seems conceptually scattered (McGrath, 1998) and researchers do not have a common ground to discuss their findings. Recent advances in group composition theory may provide researchers with a more systematic way to investigate and evaluate work group composition related issues. Specifically, Moreland and Levine (1998) have attempted to integrate relevant theory and research about group composition and propose that composition can be regarded as a consequence, as a context, and a cause. Group composition as a consequence reflects the operation of certain psychological or social processes. For example, the size of natural groups may reflect its members' needs for protection or a means to reduce the number of competitors and avoid conflict. As a context, group composition would regulate or moderate social psychological phenomena. In this case, most of the effects of group composition would be observed at the individual level but could also be found at the group level. For instance, the popularity of specific team members within the group may be affected by the groups' perceptions about aggressive behavior. Similarly, group norms may impact how the whole group approaches a task, which leads to consequent increase or decrease in performance. In addition, a group's structure, dynamics, or performance may all depend on the group composition. Group composition as a cause has been the most popular approach among researchers, including work group researchers. Issues related to group heterogeneity and group member abilities would fall under this category.

Moreland and Levine's work is particularly important because it calls attention to group composition as an important area of small group research and raises the possibility that composition can have multiple effects in the group. Furthermore, their work brings attention to the role of time in composition research. In the present study, for example, the absence of findings for task cohesion and team viability suggests that some group processes and outcomes may not be affected by group-level input variables, at least in the early stages of group formation. However, it is possible that as the group matures, team members' task- and team-related KSAs may impact how attracted the group becomes to the task and how viable the group develops as a unit. Establishing when group-level input variables may behave as cause or context may be one potential avenue for advancing composition research.

Another recent theoretical development in group composition theory is work by Arrow, McGrath and Berdahl (2000). These authors describe groups as complex, adaptative, dynamic systems, which are composed of three sets of elements: individuals (i.e., group members), intentions (i.e., group projects and members needs), and resources (i.e., the group's technology). In addition, groups pursue simultaneous sets of objectives. They strive to achieve their projects, fulfill the needs of its members, and maintain the viability of the system. Arrow and colleagues' theory is fairly complex and a detailed description of its many components is not appropriate here. However, this theory may be particularly important for work group composition research because it incorporates four sets of member attributes, which can be investigated in work environments. That is, these authors suggest that group members bring to the group four sets of attributes: knowledge, skills and abilities, values, beliefs and attitudes, personality, cognitive and behavioral styles, and individual and organizational demographic characteristics.

Although these attributes are not new to composition researchers, Arrow and colleagues propose potential relationships between them and suggest that a thorough exploration of group composition effects should include all four sets of attributes. In the present study, the absence of significant effects for KSAs on team viability may indicate that a different set of group member attributes such as values, beliefs and attitudes, could be contributing for the development of that team outcome. Or, other sets of group member attributes could be impacting potential effects of KSAs on outcomes such as team viability. Moreland and Levine's as well as Arrow and colleagues' works are encouraging theoretical developments for team composition research. Hopefully, work group composition will be better understood with systematic ways to evaluate research findings and plan additional studies.

Implications for Practice

The present research provides empirical evidence to the assertion that high levels of team effectiveness result from meeting a variety of task-directed functions (Owens et al., 1998; Klimoski & Zukin, 1999). The finding that task-related KSAs at the group levels impact quantity of output indicates that the mix of team members' task-related KSAs can affect group performance. In addition, it signals how to compose work groups to work in compensatory types of tasks. To perform compensatory tasks effectively, teams may benefit from being formed by members high on specific task-related abilities. Furthermore, organizations might gain increases in productivity through selection efforts directed at composing teams where all team members are capable of responding to the technical demands of the job, as in any other type of job context.

In addition, levels of task interdependence should not be ignored when teams are being formed. The present study also indicates that conditions of high task interdependence may impact group productivity and processes. When quantity of output is of main interest, as it can be the case in some production facilities, groups may be formed with members low on team-related KSAs and still reap the benefits of quantity of output when conditions of task interdependence are high. Together, these findings provide initial empirical evidence to indicate how groups could be formed to increase quantity of output in compensatory production-related tasks.

In addition, recent teamwork analysis methodologies, such as the one proposed by Klimoski and Jones (1999), are important tools in designing selection systems appropriate for team member selection. Their use should be fostered and documented. Performing teamwork analysis, like performing a job analysis, is an important component of the process of establishing the appropriate task-related KSAs for the team member selection. Moreover, the teamwork analysis also determines other requirements that will affect the group and should be considered during the design of the selection system for the teams of interest. For example, the inclusion of work requirements beyond the individual position permits that the impact of levels of task interdependence on group's work be assessed. Such information can be especially beneficial when available applicant pools do not possess the training or experience in teamwork environments.

As for measures of team-related KSAs, the experiences with the Teamwork KSAs Test in this research indicate that the instrument should be used with prudence when applicants have little work experience or lack formal knowledge about work related behavior. Until validity evidence on team-related KSAs can be provided across types of teams and industries, validation information should be collected at the various organizations utilizing the instrument when individual measures of performance are available.

Conclusion

This research was designed to investigate the effects of team composition based on task- and team-related KSAS, on internal processes and outcomes of teams working on a production task under two levels of task interdependence. The present study contributes to the team composition and to the team selection and staffing literatures by examining KSAs other than cognitive ability and personality at the group-level. The study also investigated the impact of levels of task interdependence on team composition and provides tentative evidence for the impact of levels of task interdependence on team-related KSAs. Thus, it addresses a specific call for considering team circumstances in the study of team composition (cf. Hough & Oswald, 2000). Furthermore, this research focused on the group-level of analysis by exploring the impact of group-level inputs and their effects on group level processes and outcomes. The current study provides evidence that specific task-related KSAs at the group-level can impact team productivity. In doing so, this study contributes to the team composition literature by taking initial steps towards understanding how task- and team-related KSAs operate at the group level (cf. Sundstrom, McIntyre, Halfkill, & Richards, 2000). Nevertheless, further research related to KSAs and their impact at the group-level is still needed. Given that basic empirical and theoretical advances have just started in this area, the study of team composition presents itself as a promising area for future research.

REFERENCES

Ancona, D. & Caldwell, D. (1992). Bridging the boundary: External activity and performance in organizational teams. *Administrative Science Quarterly, 37*, 634-665.

Argote, L. (1982). Input uncertainty and organizational coordination in hospital emergency units. *Administrative Science Quarterly, 27*, 420-434.

Aronson, E., Wilson, T., & Akert, R. (1999). *Social Psychology* (3rd ed.). New York, Longman.

Arrow, H., McGrath, J., & Berdahl, J. (2000). *Small groups as complex systems: Formation, coordination, development and adaptation*. Thousand Oaks, CA: Sage Publications.

Arvey, R., & Faley, R. (1988). *Fairness in selecting employees*. Readin, MA, Addison-Wesley.

Arvey, R., Strickland, W., Drauden, G., Martin, C. (1990). Motivational components of test taking. *Personnel Psychology, 43*, 695-716.

Baker, D. & Salas, E. (1997). Principles for measuring teamwork: A summary and look toward the future. In Brannick, M., Salas, E., & Prince, C. (Eds.). *Team performance, assessment and measurement*. Mahwah, NJ, Lawrence Earlbaum.

Banker, R., Field, J., Schroeder, R., & Sinha, K. (1996). Impact of work teams on manufacturing performance: A longitudinal field study. *Academy of Management Journal, 30*(4), 867-890.

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

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

Borman, W. & Motowidlo, S. (1997). Task performance and contextual performance: The meaning for personnel selection research. *Human Performance, 10*(2), 99-109.

Borman, W., Hanson, M. & Hedge, J. (1997). Personnel selection. *Annual Review of Psychology, 48*, 299-337.

Campbell, J. & Campbell, R. (1988). Introduction: What industrial-organizational psychology has to say about productivity. In J. Campbell and R. Campbell (Eds.). *Productivity in organizations: New perspectives from industrial and organizational psychology*. San Francisco: Josseey-Bass.

Campion, M., Medsker, G. & Higgs, C. (1993). Relations between work team characteristics and effectiveness: implications for designing effective work groups. *Personnel Psychology, 446*, 823-850.

Cannon-Bowers, J., Oser, R. & Flanagan, D. (1992). Work teams in industry: A selected review and proposed framework. In R. Swezey & E. Salas (Eds.). *Teams: Their training and performance* (pp. 355-377). Norwood, NJ: Ablex Publishing.

Cannon-Bowen, J. & Salas, E. (1997). Teamwork competencies: The interaction of team member knowledge, skills, and attitudes. In H. F. O'Neil (Ed.). *Workforce readiness: Competencies and assessment*. (pp. 151-174). Mahwah, NJ: Lawrence Erblaum.

Cannon-Bowers, J., Tannenbaum, S., Salas, E., & Volpe, C. (1995). Defining team competencies: Implications for training requirements and strategies. In R. Guzzo and E. Salas (Eds.). *Team effectiveness and decision making in organizations*, (pp. 333-380). Place: Jossey-Bass.

Carless, S. (2000). Reply to Carron and Brawley. *Small Group Behavior, 31*(1), 107-119.

Carless, S. & DePaola, C. (2000). The measurement of cohesion in work teams. *Small Group Behavior, 31*(1), 71-88.

Carron, A. & Brawley, L. (2000). Cohesion: Conceptual and measurement issues. *Small Group Behavior, 31*(1), 89-105.

Cascio, W. (1998). *Applied psychology in human resource management.* Upper Sadle River, NJ; Prentice-Hall.

Chan, D., Schmitt, N., DeShon, R., Clause, C., & Delbridge, K. (1997). Reactions to cognitive ability tests: The relationship between race, test performance, face validity perceptions, and test-taking motivation. *Journal of Applied Psychology, 82*(2), 300-310.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

Cohen, S. & Bailey, D. (1997). What makes team work: Group effectiveness research from the shop floor to the executive suite. *Journal of Management, 23*, 239-290.

Comrey, A. (1953). Group performance in a manual dexterity task. *Journal of Applied Psychology, 37*, 207-210.

Comrey, A. & Deskin, G. (1954a). Further results on group manual dexterity in men. *Journal of Applied Psychology, 38*(2), 116-118.

Comrey, A. & Deskin, G. (1954b). Group manual dexterity in women. *Journal of Applied Psychology, 38*(3), 178-180

Crocker, L. & Algina, J. (1986). *Introduction to classical and modern test theory*. Orlando, FL; Harcourt, Brace & Jovanovich.

Deutsch, M. (1949). An experimental study of the effects of cooperation and competition upon group processes. *Human Relations, 2*, 199-231.

Dobbins, G., Lane, I., & Steiner, D. (1988). A note on the role of laboratory methodologies in applied behavioral research: Don't throw the baby with the bath water. *Journal of Organizational Behavior, 9*, 281-286.

Doer, K., Mitchell, T., Klastorin, T., & Brown, K. (1996). Impact of material flow policies and goals on job outcomes. *Journal of Applied Psychology, 81*, 142-152.

Donner, A. (1982). The relative effectiveness of procedures commonly used in multiple regression for dealing with missing values. *The American Statistician, 36*, 378-381.

Driskell, J. & Salas, E. (1992). Can you study real teams in contrived settings? The value of small group research to understanding teams. In R. Sweeny and E. Salas (Eds.). *Teams: Their training and performance*, (pp. 101-123). Norwood, NJ; Ablex Publishing.

Eby, L. & Dobbins, G. (1997). Collectivistic orientation in teams: An individual and group level analysis. *Journal of Organizational Behavior, 18*, 275-295.

Eby, L., Cader, J. & Noble,C. (2001). Why do high self-monitors emerge as leaders in small groups? A comparative analysis of the behavior of high and low self-monitors. Manuscript submitted for publication.

Eby, L., Meade, A., Parisi, A., & Douthitt, S. (1999). The development of an individual-level expectations for teamwork measure and the application of within-group agreement statistic to assess shared team-level expectations for teamwork. *Organizational Research Methods, 2,* 366-394.

Eckes, T. & Trautner, H. (2000). *The developmental social psychology of gender.* Mahwaw, NJ; Lawrence Erlbaum

Fabrigar, L., Wegener, D., MacCallum, R., & Strahan, E. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods, 4*(3), 272-299.

Festinger, L. (1950). Informal social communication. *Psychological Review, 57*, 271-282.

Flanagan, J. (1975). *Flanagan Industrial Tests (FIT) – Examiner's manual.* Minneapolis, MN; McGraw-Hill.

Fleishman, E. & Reilly, M. (1995). *Handbook of human abilities: Definitions, measurement, and job task requirements*. Bethesda, MD; Management Research Institute, Inc.

Flores, B., O'Leary-Kelly, S. & Vokurk, R. (1998). Approaches to manufacturing improvement: Use and performance implications. *Productions and Inventory Management Journal, 39*(2), 42-48.

Forth, K. (1999). Team concept boosts productivity. *Furniture Design and Manufacturing, 71*(5), 40-49.

French, W. & Bell, C. (1995). *Organizational development: Behavioral sciences interventions for organizational improvement* (5th ed.). Englewood Cliffs, NJ; Prentice Hall.

Fuxman, L. (1998). Teamwork and productivity improvements in mixed-model assembly lines. *The Journal of Applied Business Research, 15*(2), 31-47.

Fuxman, L. (1999). Teamwork in manufacturing: The case of the automotive industry. *International Journal of Commerce and Management, 9*(1/2), 103-130.

Gatewood, R. & Feild, H. (1998). *Human resource selection* (4th ed.). Fort Worth, TX; Dryden Press.

George, J. (1990). Personality, affect, and behavior in groups. *Journal of Applied Psychology, 75*, 698-709.

George, J., Perkins, M., Sundstrom, E., & Meyers, S. (1990, Sept). Work team context development and effect in manufacturing organization. *Proceedings of the 1990 International Conference of Self-Managed Work Teams*. Dallas, TX.

Gersick, C. (1988). Time and transition in work teams: Toward a new model of group development. *Academy of Management Journal, 31*, 9-41.

Gill, D. (1979). Prediction of group motor performance from individual member abilities. *Journal of Motor Behavior, 11*, 113-122.

Gittleman, M., Horrigan, M. & Joyce, M. (1998). Flexible workplace practices: Evidence from a national representative survey. *Industrial and Labor Relations Review, 52*(1), 99-115.

Gladstein, D. (1984). Groups in context: A model of task group effectiveness. *Administrative Science Quarterly, 29,* 499-517.

Gooodman, P. & Leyden, D. (1991). Familiarity and group productivity. *Journal of Applied Psychology, 76*(4), 578-586.

Goodman, P. & Shah, S. (1992). Familiarity and work group outcomes. In S. Worchel, W. Wood, & J. Simpson. *Group processes and productivity*. Newbury Park, CA; SAGE.

Goodman, P., Ravlin, E. & Schmike, M. (1987). Understanding groups in organizations. *Research in Organizational Behavior*, *9*, 121-173.

Gordon, J. (1992). Work teams: How far have they come? *Training*, (October), 59-65.

Gordon, M., Slade, L., & Schimitt, N. (1986). The science of sophomore "revisited": From conjecture to empiricism. *Academy of Management Review, 11*(1), 191-207.

Gottfredson, L. & Crouse, J. (1986). Validity versus utility of mental tests: Example of the SAT. *Journal of Vocational Behavior, 29*, 363- 378.

Green, R. (1951). Does a selection situation induce testees to bias their answers on interest and temperament tests? *Education and Psychological Measurement, 11*, 503-515.

Guion, R. (1998). *Assessment, measurement, and prediction for personnel decisions*. Mahwah, NJ: Lawrence Erlbaum Associates.

Gully, S., Devine, D. & Whitney, D. (1995). A meta-analysis of cohesion and performance: Effects of level of analysis and task interdependence. *Small Group Research*, *26*(4), 497-520.

Guzzo, R. & Dickson, M. (1996). Teams in organizations: Recent research on performance and effectiveness. *Annual Review of Psychology, 47*, 307-338.

Guzzo, R. & Shea, G. (1992). Group performance and intergroup relations in organizations. In M. Dunnette & L. Hough (Eds.). *Handbook of industrial and organizational psychology*, Vol.3, 2nd ed. Palo Alto, CA: Consulting Psychologists Press.

Guzzo, R., Yost, P., Campbell, R., & Shea, G. (1993). Potency in groups: Articulating a construct. *British Journal of Social Psychology, 32*, 87-106.

Hackman, J. (1987). The design of work teams. In J. Lorsch (Ed.). *Handbook of organizational behavior* (pp.315-342). Englewood Cliffs, NJ: Prentice Hall.

Hackman, J. (1990). *Groups who work (and those who don't).* San Francisco: Jossey-Bass.

Hackman, J. (1992). Group influences on individuals in organizations. In M. Dunnette & L. Hough (Eds.). *Handbook of industrial and organizational psychology*, Vol.3, 2nd ed. Palo Alto, CA: Consulting Psychologists Press.

Hackman, J. & Morris, C. (1975). Group tasks, group interaction process, and group performance effectiveness: A review and proposed integration. In L. Berkowitz (Ed.). *Advances in experimental social psychology, 8*, 45-99.

Hackman, J. & Oldham, G. (1980). *Work redesign*. Reading, MA; Addison-Wesley Publishing Co.

Hall, R., Workman, J. & Machioro, C. (1998). Sex, task, and behavioral flexibility effects on leadership perceptions. *Organizational Behavior and Human Decision Processes, 74*, 1-32.

Harris, T. & Sherblom, J. (1999). *Small group and team communication*. Boston, MA: Allyn and Bacon.

Harrison, D., Price, K. & Bell, M. (1998). Beyond relational demography: Time and the effects of surface- and deep-level diversity on work group cohesion. *Academy of Management Journal, 41*, 96-107.

Hattrup, K., O'Connell, M. & Wingate, P. (1998). Prediction of multidimensional criteria: Distinguishing task and contextual performance. *Human Performance, 11*(4), 305-319.

Hays, W. (1988). *Statistics* (4th ed.). Forth Worth, TX: Harcourt Brace.

Hays, W. (1994). *Statistics* (5th ed.). Forth Worth, TX: Harcourt Brace.

Haythorn, W. (1968). The composition of groups: A review of the literature. *Acta Psychologica*, *28*, 97-128.

Haythorne, W. (1953). The influence of individual members on the characteristics of small groups. *Journal of Abnormal Social Psychology, 48,* 276-284.

Hewstone, M., Stroebe, W., & Stephenson, G. (1996). *Introduction to social psychology: A European perspective*. Oxford, Blackwell Publishers, Ltd.

Hinkin, T. (1995). A review of scale development practices in the study of organizations. *Journal of Management, 21*(5), 967-988.

Hough, L. & Oswald, F. (2000). Personnel selection: Looking toward the future-remembering the past. *Annual Review of Psychology, 51*, 631-664.

Hunter, J. (1986). Cognitive ability, cognitive aptitudes, job knowledge, and job performance. *Journal of Vocational Behavior, 29,* 340-362.

Hu, L. & Bentler, P. (1998). Fit indices in covariance structure modeling: Sensitivity to underparametrization model misspecification. *Psychological Methods, 3*, 424-453.

Ilgen, D., Major, D., Hollenbeck, J., & Sego, D. (1990). Team research in the 1990's. *Leadership theory and research: Perspectives and directions,* 245-270.

Irwin, T. & Browning, B. (1997). *Circuit Board Assembly Task*. Atlanta, GA. Copyright 1997 by Irwin & Browning. Adapted with permission.

Jackson, S. (1992). Team composition in organizational settings: Issues in managing an increasingly diverse workforce. In S. Worchel, W. Wood, & J. Simpson (Eds.). *Group process and productivity*, (pp. 138-173). Newbury Park, CT: Sage.

Jackson, S., May, K. & Whitney, K. (1995). Understanding the dynamics of diversity in decision-making teams. In R. Guzzo and E. Salas (Eds.). *Team effectiveness and decision making in organizations*, (pp. 204-261). Place: Jossey Bass.

James, L., Demaree, R. & Wolf, G. (1984). Estimating within-group interrater reliability with and without response bias. *Journal of Applied Psychology, 69*(1), 85-98.

Janssen, O & Van de Vliert, E. (1996). Concern for the other's goals: Key to (de-)escalation of conflict. *The International Journal of Conflict Management, 7*(2), 99-120.

Jehn, K. (1995). A multimethod examination of the benefits and detriments of intragroup conflict. *Administrative Science Quarterly, 40*, 256-282.

Jehn, K. (1997a). Affective and cognitive conflict in work groups: Increasing performance through value-based intragroup conflict. In C. DeDreu & E. Van de Vliert (Eds.). *Using conflict in organizations*. London, Sage.

Jehn, K. (1997b). A qualitative analyses of conflict types and dimensions in organizational groups. *Administrative Science Quarterly, 42*, 530-557.

Jehn, K, & Chatman, J. (2000). The influence of proportional and perceptual conflict composition on team performance. *The International Journal of Conflict Management*, *11*(1), 56-73.

Jensen, A. (1986). Major contributions g: Artifact or reality? *Journal of Vocational Behavior, 29*, 301-331.

Jeske, J., & Whitten, M. (1975). Motivational distortion of the sixteen personality factor questionnaire by persons in job applicants' roles. *Psychological Reports, 37*, 379-382.

Jones, R., Stevens, M. & Fischer, D. (2000). Selection in team contexts. In J. Kehoe (Ed.). *Managing selection in changing organizations*. San Francisco; Jossey-Bass.

Joreskog, K. & Sorbom, D. (1998). LISREL8.2 [Computer software]. Chicago IL: Scientific Software.

Kabanoff, B. & O'Brien, G. (1979a). The effects of task type and cooperation on group products and performance. *Organizational Behavior and Human Performance, 23*, 163-181.

Kabanoff, B. & O'Brien, G. (1979b). Cooperation structure and the relationship of leader and member ability to group performance. *Journal of Applied Psychology, 54* (5), 526-532.

Keppel, G. (1991). *Design and analysis: A researcher's handbook* (3rd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Keppel, J. & Zedech, S. (1989). *Data analysis for research designs: Analysis of variance and multiple regression/correlation approaches.* New York: W.H. Freeman and Company.

Keren, G. (1993). Between- or within-subjects design: A methodological dilemma. In G. Keren & C. Lewis (Eds.). *A handbook for data analysis in the behavioral sciences: Methodological issues*. Hillsdale, NJ; Lawrence Erlbaum.

Kichuck, S. (1996). *The effects of general cognitive ability, teamwork KSAs and the Big Five personality factors on the performance of engineering design teams: Implications for the selection of teams*. Unpublished doctoral dissertation, McMaster University, Hamilton, Ontario.

Kiggundu, M. (1983). Task interdependence and job design: Test of a theory. *Organizational Behaviors and Human Performance, 31*, 145-172.

Klein, H. & Mulvey, P. (1995). Two investigations of the relationships among group goals, goal commitment, cohesion, and performance. *Organizational Behavior and Human Decision Processes, 61*, 44-53.

Klein, K., Danssereau, F. & Hall, R. (1994). Levels issues in theory development, data collection, and data analysis. *Academy of Management Review, 19*(2), 195-229.

Klimoski, R. & Jones, R. (1995). Team effectiveness and decision making in organizations. In R. Guzzo and E. Salas (Eds.). *Team effectiveness and decision making in organizations*, (pp. 291-332). Place: Jossey Bass.

Klimoski, R. & Zukin, L. (1999). Selection and staffing for team effectiveness. In E. Sundstrom (Ed.). *Supporting work team effectiveness: Best management practices for fostering high performance*, (pp.63-91). San Francisco, Jossey-Bass.

Landy, F. (1985). *Psychology of work behavior*. Homewood, IL; The Dorsey Press.

Lawler, E. (1999). Employee involvement makes a difference. *The Journal for Quality and Participation, 22*(5), 18-20.

Leavitt, H. (1951). Some effects of certain communication patterns on group performance. *Journal of Abnormal and Social Psychology, 46*, 38-50.

LePine, J., Hollenbeck, J., Ilgen, D., & Hedlund, J. (1997). Effects of individual differences on the performance of hierarchical decision-making teams: Much more than *g*. *Journal of Applied Psychology, 82*, 803-811.

Levine, J. & Moreland, R. (1990). Progress in small group research. *Annual Review of Psychology, 41*, 585-634.

Lindell, M., Brandt, C. & Whitney, D. (1999). A revised index of interrater agreement for multi-item ratings of a single target. *Applied Psychological Measurement, 23*(2), 127-135.

Lindell, M., & Brandt, C. (2000). Climate quality and climate consensus as mediators of the relationship between organizational antecedents and outcomes. *Journal of Applied Psychology, 85*(3), 331-348.

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

Marsh, H., Balla, J., & McDonald, R. (1988). Goodness-of-fit indexes in confirmatory factory analysis: The effect of sample size. *Psychological Bulletim, 103*, 391-410.

Maxwell, S. & Delaney, H. (1993). Bivariate median splits and spurious statistical significance. *Psychological Bulletin, 113*, 181-190.

McGrath, J. (1964). *Social psychology: A brief introduction*. New York: Holt, Rinehart and Winston.

McGrath, J. (1984). *Groups: Interaction and performance.* Englewood Cliffs, NJ: Prentice-Hall.

McGrath, J. (1998). A view of group composition through a group-theoretic lens. *Research on Managing Group and Teams, Vol. 1*, p 255-272.

Mook, D. (1983). In defense of external validity. *American Psychologist, April*, 379-387.

Morgan, B. & Lassiter, D. (1992). Team composition and staffing. In T. W. Sweezy and E. Salas (Eds.). *Teams: Their training and performance*, (p.75-99). Norwood, NJ: Ablex Publishing

Mohammed, S., Mathieu, J., & Barlett, B. (April, 2000). *Individual differences, team effectiveness, and contextual performance: Considering the influence of teamwork and taskwork composition variables*. Paper presented at the XV Annual Meeting of the Society for Industrial/Organizational Psychology, New Orleans, LA.

Moreland, R. & Levine, J. (1998). The composition of small groups. *Research on Managing Group and Teams, Vol. 1*, p. 237-280.

Motowidlo, S. & Van Scotter, J. (1996). Evidence that task performance should be distinguished from contextual performance. *Journal of Applied Psychology, 79*(4), 475-480.

Mullen, B. & Copper, C. (1994). The relation between group cohesiveness and performance: An integration. *Psychological Bulletin, 115*(2), 210-227.

Neuman, G. & Wright, J. (1999). Team effectiveness: Beyond skills and cognitive ability. *Journal of Applied Psychology, 84* (3), 376-389.

Owen, J. (1999). Want a fast track job? Go to a fast track company. *Manufacturing Engineering, 122*(4), 60-69.

O'Brien, G. & Owens, A. (1969). Effects of organizational structure on the correlations between abilities and group productivity. *Journal of Applied Psychology, 53,* 525-530.

Owens, D., Mannix, E. & Neale, M. (1998). Strategic formation of groups: Issues in task performance and team member selection. In E. Gruenfeld (Ed.). *Research on managing groups and teams* (vol. 1, p. 149-165). Stamford, CT: JAI Press.

Parker, M. & Slaughter, J. (1988). Management by stress. *Technology Review, October*, 37-44.

Paulhus, D. (1984). Two component models of socially desirable responding. *Journal of Personality and Social Psychology, 45*, 598-609.

Paulhus, D. (1998). Manual for Balanced Inventory of Desirable Responding. Toronto: Multi-Health Systems.

Pedhazur, E. (1997). *Multiple regression in behavioral research: Explanation and prediction* (3rd ed.). Forth Worth, TX: Harcourt Brace.

Penner, L. & Craiger, J. (1992). The weakest link: The performance of individual members. In R. Swezey & E. Salas (Eds.). *Teams: Their training and performance* (pp. 57-74). Norwood, NJ: Ablex Publishing.

Pinkley, R. (1990). Dimensions of conflict frame: Disputant interpretations of conflict. *Journal of Applied Psychology, 75,* 117-126.

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

Putnam, L. & Wilson, C. (1982). Communicative strategies in organizational conflicts: Reliability and validity of a measurement scale. *Commitment Yearbook 6* (pp. 629-652). Newbury Park, CA: SAGE.

Rahim, M. (1983). A measure of styles of handling interpersonal conflict. *Academy of Management Journal, 26*(20), 368-376.

Rahim, M. (2001). *Managing conflict in organizations* (3rd ed.). Westport, CT; Quorun Books

Riggs, C. (1983). Dimensions of organizational conflict: A functional analysis of communication tactics. *Commitment Yearbook 7* (pp. 517-531). Newbury Park, CA: SAGE.

Roberts, K., Hulin, C. & Rousseau, D. (1978). Aggregation problems in organizational science. In K. Roberts, C. Hulin, & D. Rousseau (Eds.). *Developing an interdisciplinary science of organizations*. San Francisco: Jossey-Bass.

Rousseau, D. (1985). Issues of level in organizational research: Multi-level and cross-level perspectives. *Research in Organizational Behavior*, (vol.7, pp. 1-37). Stamford, CT: JAI Press.

Roznowski, M. & Hulin, C. (1992). The scientific merit of valid measures of general constructs with special reference to job satisfaction and job withdrawal. In J. Cranny, P. Smith, & E. Stone (Eds.). *Job satisfaction: How people fell about their jobs and how it affects their performance* (pp. 123-163). New York; Lexington Books.

Saavedra, R., Early, P. & VanDyne, L. (1993). Complex interdependence in task-performing groups. *Journal of Applied Psychology, 78,* 61-72.

Salas, E., Bowers, C. & Cannon-Bowers, J. (1995). Special issue: Team processes, training, and performance. *Military Psychology, 7*(2), 53-139.

Salas, E., Dickinson, T., Converse, S., & Tannenbaum, S. (1992). Toward and understanding of team performance and training. In R. Swezey & E. Salas (Eds.). *Teams: Their training and performance* (pp. 3-29). Norwood, NJ: Ablex Publishing.

Seers, A. (1989). Team-member exchange quality: A new construct for role-making research. *Organizational Behavior and Human Decision Process, 48*, 118-135.

Shaw, M. (1981). *Group dynamics: The psychology of small group behavior* (3rd ed.). New York: McGraw-Hill.

Schneider, B., Smith, D. & Sipe, W. 2000). Personnel selection psychology. In K. Klein & S. Kozlowski (Eds.). *Multilevel theory, research, and methods in organizations: Foundations, extensions and new directions* (91-120). San Francisco; Jossey-Bass.

Shepperd, J. (1993). Productivity loss in performance groups: A motivation analysis. *Psychological Bulletin, 113* (1), 67-81.

Simmons, T. & Peterson, R. (2000). Task conflict and relationship conflict in top management teams: The pivotal role of intergroup trust. *Journal of Applied Psychology, 85*, 102-111.

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

Stevens, M. & Campion, M. (1994). The knowledge, skill, and ability requirements for teamwork: Implications for human resources management. *Journal of Management, 20*, 503-530.

Stevens, M & Campion, M. (1998). *Teamwork-KSA test: Examiner's manual.* Minneapolis, MN: NCS.

Stevens, M. & Campion, M. (1999). Staffing work teams: Development and validations of a selection test for teamwork settings. *Journal of Management, 25*(2), 207-228.

Straus, S. & McGrath, J. (1994). Does the medium matter? The interaction of task type and technology on group performance and members reactions. *Journal of Applied Psychology, 73*, 337-358.

Sundstrom, E. (1999). The challenges of supporting work team effectiveness. In E. Sundstrom (Ed.). *Supporting work team effectiveness: Best management practices for fostering high performance*, (pp.3-23). San Francisco, Jossey-Bass.

Sundstrom, E., DeMeuse, K. & Futrell, D. (1990). Work teams: Applications and effectiveness. *American Psychologist, 45*(2), 120-133.

(Sundstrom, McIntyre, Halfkill, & Richards, 2000)

Swezey, R & Salas, E. (1992). Guidelines for use in team-training development. In R. Swezey & E. Salas (Eds.). *Teams: Their training and performance* (pp.153-175). Norwood, NJ: Ablex Publishing.

Tannenbaum, S., Salas, E. & Cannon-Bowers, J. (1996). Promoting team-effectiveness. In M. West (Ed.). *Handbook of work group psychology* (pp. 503-529). Sussex, England: Wiley.

Tesluk, P., Mathieu, J., Zaccarro, S., & Marks, M. (1997). Task and aggregation issues in the analysis and assessment of team performance. In M. T. Brannick, E. Salas, and C. Prince (Eds.). *Team performance assessment and measurement* (pp. 197-224). Mahwah, NJ: Erlbaum.

Thomas, K. (1992). Conflict and negotiation processes in organizations. In M. Dunnette & L. Hough (Eds.). *Handbook of industrial and organizational psychology,* Vol.3, 2nd ed. Palo Alto, CA: Consulting Psychologists Press.

Thompson, J. (1967). *Organizations in actions.* New York: McGraw-Hill.

Tjosvold, D. (1984). Cooperation theory and organizations. *Human Relations, 37* (9), 743-767.

Tjosvold, D. (1997). Conflict within interdependence: Its value for productivity and individuality. In C. DeDreu & E. Van de Vliert (Eds.). *Using conflict in organizations*. London, Sage.

Trist, E., Susman, G. & Brown, G. (1977). An experiment in autonomous working an American underground coal mine. *Human Relations, 30,* 201-236.

Tziner, A. (1988). Effects of team composition on ranked team effectiveness. *Small Group Behavior, 19*(3), 363-378.

Tziner, A & Eden, D. (1985). Effects of crew composition on crew performance: Does the whole equal the sum of its parts? *Journal of Applied Psychology, 70*(1), 85-93.

Van de Ven, A. & Delbec, A. (1976). Determinants of coordination modes within organizations. *American Sociological Review, 41*, 322-338.

Van de Ven, A. & Ferry, D. (1980). *Measuring and assessing organizations.* New York: Wiley.

Vandenberg, R. & Lance, C. (2000). A review and synthesis of the measurement invariance literature: Suggestions, practices, and recommendations for organizational research. *Organizational Research Methods, 3*(1), 4-69.

Wagner, J. (1986). Individualism-collectivism: Concept and measure. *Group and Organizational Studies, 11*(3), 280-304.

Wagner, J. (1995). Studies of individualism-collectivist: Effects on cooperation in groups. *Academy of Management Journal, 38*, 152-172.

Wageman, R. (1995). Interdependence and group effectiveness. *Administrative Science Quarterly, 40*, 145-180.

Wall, V., Galanes, G. & Love, S. (1987). Small task-oriented groups: Conflict, conflict management, satisfaction, and decision quality. *Small Group Behavior, 18*(1), 31-55.

Waung, M. & Thomas, B. (1998). The effects of conscientiousness and opportunity to caucus on group performance. *Small Group Research*, *29*(5), 624-234.

Watson, D., Clark, L., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scale. *Journal of Personality and Social Psychology, 54*(6), 1063-1070.

West, M & Anderson, N. (1996). Innovation in top management teams. *Journal of Applied Psychology, 81*, 680-693.

Whetten, D. & Cameron, K. (1998). *Developing management skills*. Reading, MA: Addison Wesley.

Wildt, A. & Ahtola, O. (1978). *Analysis of covariance*. Newbury Park, CA: SAGE.

Winer, B. (1971). *Statistical principals is experimental design* (2nd. ed.). New York: McGraw-Hill.

Zacarro, S. (1991). Nonequivalent associations between forms of cohesiveness and group-related outcomes: Evidence for multidimensionality. *The Journal of Social Psychology*, *131*(3), 387-399.

Zacarro, S. & Lowe, C. (1988). Cohesiveness and performance on an additive task: Evidence for multidimensionality. *The Journal of Social Psychology*, *128*(4), 547-558.

Zacarro, S., Gualtieri, J., & Minionis, D. (1995). Task cohesion as a facilitator of team decision making under temporal ungency. *Military Psychology, 7*(2), 77-93.

TABLES

Table 1

Normative Data for Task- and Team-related KSA Measures and Respective Cut-off Scores for Assigning Participants to Phase II

Measures	*M*	*SD*	*Min*	*Max*	1/3 *SD* <= *M* cut-off score	1/3 *SD* >= *M* cut-off score
Task-related KSAs Composite[a]	-.0002	2.13			-.71	.71
Inspection Test [b]	14.12	5.74	-4.00	29.00		
Pegboard Exercise [c]	27.99	3.19	16.25	33.75		
Manipulation Exercise [d]	2’20”	48”	1’09”	6’15”		
Team-related KSAs Composite[e]	22.83	3.86			21.54	24.12
Interpersonal KSAs[f]	15.24	2.93	6.00	21.00		
Self-Management KSAs[f]	7.57	1.73	3.00	10.00		

N = 100
[a] Scores on the task-related KSA measures were transformed into Z-scores. The Task-KSA Composite is an equal-weighted composite of scores on the Inspection Test and on the two manual dexterity exercises.
[b] Scores reflect number of correct answers minus incorrect ones.
[c] Scores reflect the average number of pegs inserted onto the board in two rounds of the exercise.
[d] Scores reflect the average number of seconds in two rounds of the exercise.
e The Team-KSA Composite is the total score on the Teamwork KSAs Test, which reflects Self-Management and Interpersonal KSAs.
[f] Scores reflect the number of correct answers.

Table 2

Descriptive Statistics – Phase I Sample

		Frequency	Percent
Gender	Male	348	27.1
	Female	886	69.1
Race	White/Non-Hispanic	1048	81.7
	African American	104	8.1
	Hispanic	15	1.2
	Asian American	46	3.6
	Other	21	1.6
Class standing	Freshman	512	39.9
	Sophomore	386	30.1
	Junior	217	16.9
	Senior	114	8.9
Work status	Work Full-Time	49	3.8
	Work Part-Time	469	36.6
	Do not work	708	55.2
Supervisory Experience	Yes	469	36.6
	No	730	56.9
Previous team work experience	Yes	1186	92.4
	No	45	3.5
Previous experience in manufacturing/production environment	Yes	152	11.8
	No	1074	83.7

N = 1,283

Note: Some percentages do not add to 100% due to missing data.

Table 3

Descriptive Statistics – Phase II Sample

		Frequency	Percent
Gender	Male	57	32.4
	Female	118	67.0
Race	White/Non-Hispanic	150	85.2
	African American	16	9.1
	Hispanic	3	1.7
	Asian American	3	1.7
	Other	3	1.7
Class standing	Freshman	88	50.0
	Sophomore	42	23.9
	Junior	32	18.2
	Senior	13	7.4
Work status	Work Full-Time	7	4.0
	Work Part-Time	57	32.4
	Do not work	109	61.9
Supervisory Experience	Yes	71	40.3
	No	104	59.1
Previous experience in manufacturing/production environment	Yes	19	10.8
	No	156	88.6

N = 176

Note: Some percentages do not add to 100% due to missing data.

Table 4

Gender Break Down per Experimental Condition - Phase II

				Male Group Composition		
Experimental Condition	Male	Female	0%	25%	50 %	75%
High Team KSA X High Task KSA	8 (18%)	36(82%)	16 (36%)	24 (55%)	4 (9%)	-
High Team KSA X Low Task KSA	19 (43%)	24 (55%)	4 (9%)	12 (27%)	16 (36%)	12 (27%)
Low Team KSA X High Task KSA	9 (20%)	35 (80%)	20 (46%)	12 (27%)	12 (27%)	-
Low Team KSA X Low Task KSA	19 (43%)	24 (55%)	4 (9%)	12 (27%)	16 (36%)	12(27%)

Note. Females = 175, Males = 57, and Missing Data = 1

Table 5

Descriptive Statistics for the Task- and Team-related KSA Measures – Phase I Sample

Measures	*M*	*SD*	*Min*	*Max*	*Skewness*	*Kurtosis*
Task-related KSAs Composite[a]	.20	2.03	-9.19	6.04	-.67	1.40
Inspection Test [b]	14.74	6.30	-23.00	39.00	-.90	4.33
Pegboard Exercise [c]	28.55	3.25	14.00	41.25	-.33	.68
Manipulation Exercise [d]	2’27”	39”	1’09”	6’53”	1.64	5.52
Team-related KSAs Composite[e]	23.01	3.81	7.00	32.00	-.49	.34
Interpersonal KSAs[f]	15.42	2.87	5.00	23.00	-.41	.22
Self-Management KSAs[f]	7.59	1.69	2.00	10.00	-.59	-.03

N = 1,283
[a] Scores on the task-related KSA measures were transformed into Z-scores. The Task-KSA Composite is an equal-weighted composite of scores on the Inspection Test and on the two manual dexterity exercises.
[b] Scores reflect number of correct answers minus incorrect ones.
[c] Scores reflect the average number of pegs inserted onto the board in two rounds of the exercise.
[d] Scores reflect the average number of seconds in two rounds of the exercise.
[e] The Team-KSA Composite is the total score on the Teamwork KSAs Test, which reflects Self-Management and Interpersonal KSAs.
[f] Scores reflect the number of correct answers.

Table 6

Correlations between Task- and Team-related KSA Measures and Composites – Phase I Sample

	1	2	3	4	5	6	7
1. Interpersonal KSAs	1.000						
2. Self-Management KSAs	.359***	1.000					
3. Team-related KSAs Composite[a]	.911***	.712***	1.000				
4. Inspection Test	.074**	.089***	.096***	1.000			
5. Pegboard Exercise	.155***	.068**	.147***	.084**	1.000		
6. Manipulation Exercise	.130***	.073**	.131***	.193***	.428***	1.000	
7. Task-related KSAs Composite[b]	.170***	.112***	.177***	.660***	.717***	.715***	1.000

N = 1,283
** $p < 0.01$, *** $p < 0.001$
[a] The Team-KSA Composite is the total score on the Teamwork KSAs Test, which reflects Self-Management and Interpersonal KSAs.
[b] The Task-KSA Composite is an equal-weighted composite of scores on the Inspection Test and on the two manual dexterity exercises.

Table 7

Gender Differences on the Task- and Team-related KSA Measures

	Male		Female				
	M	*SD*	*M*	*SD*	*t-test*[a]	*df*	*p-value*
Task-related KSAs Composite[b]	-.47	1.99	.47	1.97	-.7.50	1, 232	.00
Inspection Test [c]	14.64	6.29	14.80	6.34	-.42	1, 232	.68
Pegboard Exercise [d]	26.73	3.15	29.25	2.98	-13.51	1, 232	.00
Manipulation Exercise [e]	2’34”	38”	2’24”	39”	2.38	1, 232	.02
Team-related KSAs Composite[f]	22.55	4.29	23.19	3.63	-2.45	552	.02
Interpersonal KSAs[g]	15.02	3.25	15.57	2.71	-2.78	548	.00
Self-Management KSAs[g]	7.53	1.73	7.62	1.69	-.87	1, 232	.38

Males *N* = 348, Females *N* = 886, and Missing Data *N* = 49.
[a] Equal variances could not assumed in the *t*-Test for equality of means for Interpersonal KSAs and Team-related KSAs.
[b] Scores on the task-related KSA measures were transformed into Z-scores. The Task-KSA Composite is an equal-weighted composite of scores on the Inspection Test and on the two manual dexterity exercises.
[c] Scores reflect number of correct answers minus incorrect ones.
[d] Scores reflect the average number of pegs inserted onto the board in two rounds of the exercise.
[e] Scores reflect the average number of seconds in two rounds of the exercise.
[f] The Team-KSA Composite is the total score on the Teamwork KSAs Test, which reflects Self-Management and Interpersonal KSAs.
[g] Scores reflect the number of correct answers.

Table 8

Descriptive Statistics of Dependent Measures – Low Task Interdependence

Scale and Items	*M*	*SD*
Team viability (item-total correlations .32 - .52)		
I found it personally satisfying to be a member of this group.	3.4	1.0
I was proud to be a member of this team.	3.5	.91
Certain members of this group did not pull their weight. (R)	4.2	1.1
Everyone on this group did his or her share of the work.	4.0	1.0
Everyone on the group would choose to work together on future tasks.	3.6	.87
Task cohesion (item-total correlations .33 - .53)		
Our group was united in trying to reach its goals for performance.	3.8	.94
I'm unhappy with my group's level of commitment to the Circuit Board Assembly task. (R)	4.1	1.0
Our group members had conflicting aspirations for the team's performance (R)	4.3	.76
This group did not give me enough opportunities to improve my personal performance (R)	4.0	1.0
Communication (item-total correlations .44 - .72)		
Group members helped each other express their ideas.	3.0	1.1
Group members listened attentively to others' ideas.	3.3	.95
Group members paid attention when someone was talking.	3.8	.89
Group members pointed out positive aspects of other member's ideas.	3.1	.85
Group members responded to the non-verbal behaviors of other group members (e.g., posture, eye contact, fidgeting).	2.9	.96

Task Conflict (item-total correlations .36 - .54)		
How often did people in your group disagree about opinions regarding the work being done?	1.1	.31
How frequently was there conflict about ideas in your group?	1.1	.30
How much conflict about the work you did was there in your group?	1.2	.43
To what extent were there differences of opinion in your group?	1.2	.44
Conflict Management (item-total correlations .75 - .86)		
In our group, when conflict occurred…		
group members tried to work with each other for a proper understanding of the problem.	2.1	2.0
group members strove to thoroughly investigate the issue.	2.1	1.8
the group worked together to create solutions for the problem.	2.2	1.9
the group tried to use everyone's ideas to generate solutions to the problem.	1.8	1.7
group members suggested solutions that combined a variety of viewpoints.	1.9	1.7
the group tried to find solutions that were good for everyone.	2.0	1.9
Cooperation (item-total correlations .17 - .68)		
Other group members usually let me know what they expected from me.	2.8	.97
I normally checked with other group members before I did something that might affect them.	2.9	1.1
I usually let other group members know when I did something that affected their work.	3.3	1.1
Other group members usually let me know when I did something that affected their work.	3.0	1.0

Cooperation (cont.)		
I often made suggestions to other group members about better work methods	2.5	1.1
I had a clear understanding of the problems associated with the Circuit Board Assembly process and the needs of my group members during the production task.	4.0	.94
Other group members clearly understood my needs and problems related to the performance of the Circuit Board Assembly Task.	3.6	.98
I got constructive criticism from other group members.	2.4	1.1
I often helped other group members solve problems associated with the Circuit Board Assembly Task.	2.7	1.2
When I was busy, other group members often volunteered to help me out.	2.2	1.0
When other group members were busy, I often helped them out.	2.2	1.0
Other group members were flexible about switching responsibilities to make things easier for me.	2.4	1.1
I was willing to help finish work that had been given to other group members.	2.8	1.2
Other group members were willing to finish work that was assigned to me.	2.6	1.1

Note. Scales measured on Likert-type scales: Task Conflict scale: 1=Never, 2=Seldom, 3=Occasionally, 4=Frequently, 5=Always; Conflict Management Scale: 0=Not applicable, 1=Strongly disagree, 2=Disagree, 3=Neither agree nor disagree, 4=Agree, 5=Strongly agree; All other scales: 1=Strongly disagree, 2=Disagree, 3=Neither agree nor disagree, 4=Agree, 5=Strongly agree. (R) indicates reverse scored item.

Table 9

Descriptive Statistics of Dependent Measures – High Task Interdependence

Scale and Items	*M*	*SD*
Team viability (item-total correlations .53 - .64)		
I found it personally satisfying to be a member of this group.	3.8	.89
I was proud to be a member of this team.	3.8	.85
Certain members of this group did not pull their weight. (R)	4.2	.94
Everyone on this group did his or her share of the work.	4.3	.85
Everyone on the group would choose to work together on future tasks.	3.8	.86
Task cohesion (item-total correlations .38 - .58)		
Our group was united in trying to reach its goals for performance.	4.3	.74
I'm unhappy with my group's level of commitment to the Circuit Board Assembly task. (R)	4.2	1.1
Our group members had conflicting aspirations for the team's performance (R)	4.4	.74
This group did not give me enough opportunities to improve my personal performance (R)	4.2	.90
Communication (item-total correlations .41 - .70)		
Group members helped each other express their ideas.	3.5	.96
Group members listened attentively to others' ideas.	3.8	.88
Group members paid attention when someone was talking.	4.2	.66
Group members pointed out positive aspects of other member's ideas.	3.4	.87
Group members responded to the non-verbal behaviors of other group members (e.g., posture, eye contact, fidgeting).	3.3	.95

Task Conflict (item-total correlations .48 - .79)		
How often did people in your group disagree about opinions regarding the work being done?	1.3	.70
How frequently was there conflict about ideas in your group?	1.2	.40
How much conflict about the work you did was there in your group?	1.2	.53
To what extent were there differences of opinion in your group?	1.3	.50
Conflict Management (item-total correlations .76 - .88)		
In our group, when conflict occurred…		
group members tried to work with each other for a proper understanding of the problem.	2.9	2.0
group members strove to thoroughly investigate the issue.	2.8	1.8
the group worked together to create solutions for the problem.	3.0	1.9
the group tried to use everyone’s ideas to generate solutions to the problem.	2.6	1.9
group members suggested solutions that combined a variety of viewpoints.	2.5	1.8
the group tried to find solutions that were good for everyone.	2.9	1.9
Cooperation (item-total correlations .32 - .69)		
Other group members usually let me know what they expected from me.	3.1	.98
I normally checked with other group members before I did something that might affect them.	3.2	.99
I usually let other group members know when I did something that affected their work.	3.5	1.0
Other group members usually let me know when I did something that affected their work.	3.4	1.1

Cooperation (cont.)		
I often made suggestions to other group members about better work methods	3.0	1.1
I had a clear understanding of the problems associated with the Circuit Board Assembly process and the needs of my group members during the production task.	4.2	.86
Other group members clearly understood my needs and problems related to the performance of the Circuit Board Assembly Task.	4.0	.93
I got constructive criticism from other group members.	2.7	1.1
I often helped other group members solve problems associated with the Circuit Board Assembly Task.	3.3	1.1
When I was busy, other group members often volunteered to help me out.	3.5	1.2
When other group members were busy, I often helped them out.	3.4	1.3
Other group members were flexible about switching responsibilities to make things easier for me.	3.4	1.1
I was willing to help finish work that had been given to other group members.	3.8	1.1
Other group members were willing to finish work that was assigned to me.	3.5	1.1

Note. Scales measured on Likert-type scales: Task Conflict scale: 1=Never, 2=Seldom, 3=Occasionally, 4=Frequently, 5=Always; Conflict Management Scale: 0=Not applicable, 1=Strongly disagree, 2=Disagree, 3=Neither agree nor disagree, 4=Agree, 5=Strongly agree; All other scales: 1=Strongly disagree, 2=Disagree, 3=Neither agree nor disagree, 4=Agree, 5=Strongly agree. (R) indicates reverse scored item.

Table 10

Descriptive Statistics, Reliability Estimates and Correlations between Dependent Measures – Low Task Interdependence

	Number of items	*M*	*SD*	1	2	3	4	5	6	7
1. Team Viability	5	18.64	3.25	*.67*						
2. Task Cohesion	4	16.11	2.64	.56***	*.63*					
3. Communication	5	16.10	3.50	.38***	.33***	*.80*				
4. Cooperation	14	39.44	9.10	.35***	.22**	.62***	*.87*			
5. Task Conflict	4	4.60	1.04	-.05	-.10	.13	.14	*.64*		
6. Conflict Management	6	12.03	9.62	.19*	.08	.35***	.34***	.11	*.94*	
7. Social Desirability	40	10.68	4.77	.20**	.19*	.23**	.19*	-.08	-.04	*.70*

Note. Reliability estimates are displayed in the main diagonal

$N = 176$

* $p < 0.05$; ** $p < 0.01$, *** $p < 0.001$

Table 11

Descriptive Statistics, Reliability Estimates and Correlations between Dependent Measures – High Task Interdependence

	Number of items	*M*	*SD*	1	2	3	4	5	6	7
1. Team Viability	5	9.89	3.25	*.78*						
2. Task Cohesion	4	17.11	2.51	.56***	*.71*					
3. Communication	5	18.14	3.23	.59***	.27***	*.78*				
4. Cooperation	14	47.88	8.91	.51***	.25***	.64***	*.86*			
5. Task Conflict	4	4.96	1.64	-.23**	-.17*	-.02	.03	*.75*		
6. Conflict Management	6	16.62	9.92	.22**	.13	.41***	.39***	.18*	*.94*	
7. Social Desirability	40	10.68	4.77	.17*	.09	.32***	.17*	-.06	.09	*.70*

Note. Reliability estimates are displayed in the main diagonal

$N = 176$

* $p < 0.05$; ** $p < 0.01$, *** $p < 0.001$

Table 12

Team Viability and Task Cohesion Scales Dimensionality – Low Task Interdependence: Models' Goodness-of- Fit Indexes

							Versus target model	
	χ^2	*df*	SRMSR	TLI	CFI	RMSEA	$\Delta\chi^2$	Δdf
Target	148.93**	26	.13	.59	.70	.17	-	-
Φ Team Viability . Task Cohesion = 1.00	173.43**	27	.12	.53	.65	.19	24.5***	1
Null	451.72	36	-	-	-	-	-	-

Note. N = 176; χ^2 = Chi-square statistic; *df* = degrees of freedom; SRMR = standardized mean-square residual; TLI = Tucker-Lewis index; CFI = comparative fit index; RMSEA = root-mean-square of approximation; $\Delta\chi^2$ = change in Chi-square statistic; Δdf = change in degree of freedom
** $p < 0.01$; *** $p < 0.001$

Table 13

Communication and Cooperation Scales Dimensionality – Low Task Interdependence: Models' Goodness-of- Fit Indexes

							Versus target model	
	χ^2	*df*	SRMSR	TLI	CFI	RMSEA	$\Delta\chi^2$	Δdf
Target	599.99**	151	.12	.66	.70	.16	-	-
Φ Communication . Cooperation = 1.00	710.80**	152	.11	.58	.62	.18	110.81***	1
Null	1659.00	171	-	-	-	-	-	-

Note. N = 176; χ^2 = Chi-square statistic; *df* = degrees of freedom; SRMR = standardized mean-square residual; TLI = Tucker-Lewis index; CFI = comparative fit index; RMSEA = root-mean-square of approximation; $\Delta\chi^2$ = change in Chi-square statistic; Δdf = change in degree of freedom

** $p < 0.01$; *** $p < 0.001$

Table 14

Team Viability, Task Cohesion, Communication, and Communication Scales Dimensionality – High Task Interdependence: Models' Goodness-of- Fit Indexes

							Versus target model	
	χ^2	*df*	SRMSR	TLI	CFI	RMSEA	$\Delta\chi^2$	Δdf
Target	1083.49**	344	.10	.63	.67	.12	-	-
Φ Team Viability . Task Cohesion . Communication . Cooperation = 1.00	1390.28**	350	.11	.49	.53	.15	306.79***	6
Φ Team Viability . Task Cohesion . Communication = 1.00	1241.00**	347	.11	.56	.60	.14	157.51***	3
Φ Team Viability . Task Cohesion . Cooperation = 1.00	1390.28**	347	.11	.49	.53	.15	306.79***	3
Φ Team Viability . Communication . Cooperation. = 1.00	1390.28**	347	.11	.49	.55	.15	306.79***	3
Φ Task Cohesion . Communication . Cooperation. = 1.00	1287.19**	347	.11	.54	.58	.14	203.70***	3
Φ Team Viability . Task Cohesion and Communication . Cooperation = 1.00	1224.04**	346	.10	.57	.60	.13	140.55***	2
Φ Team Viability . Communication and Task Cohesion . Cooperation = 1.00	1299.81**	346	.11	.53	.57	.14	216.32***	2
Φ Team Viability . Cooperation and Task Cohesion . Communication = 1.00	1390.28**	346	.11	.49	.53	.15	306.79***	2
Φ Team Viability . Task Cohesion = 1.00	1228.94**	346	.11	.57	.60	.14	145.45***	2
Φ Team Viability . Communication = 1.00	1298.85**	346	.11	.53	.57	.13	215.36***	2
Φ Team Viability . Cooperation = 1.00	1357.69**	346	.11	.50	.54	.15	274.20***	2
Φ Task Cohesion . Communication = 1.00	1235.17**	346	.11	.56	.60	.14	151.68***	2
Φ Task Cohesion . Cooperation = 1.00	1324.54**	346	.12	.52	.56	.14	241.05***	2
Φ Communication . Cooperation = 1.00	1214.44**	346	.10	.57	.61	.13	130.95***	2
Null	2600.80**	378	-	-	-	-	-	-

Note. N = 176; χ^2 = Chi-square statistic; *df* = degrees of freedom; SRMR = standardized mean-square residual; TLI = Tucker-Lewis index; CFI = comparative fit index; RMSEA = root-mean-square of approximation; $\Delta\chi^2$ = change in Chi-square statistic; Δdf = change in degree of ** $p < 0.01$; *** $p < 0.001$

Table 15

Communication and Cooperation Scales Dimensionality – High Task Interdependence: Models' Goodness-of- Fit Indexes

							Versus target model	
	χ^2	*df*	SRMSR	TLI	CFI	RMSEA	$\Delta\chi^2$	Δdf
Target	641.81**	151	.10	.61	.66	.15	-	-
Φ Communication . Cooperation = 1.00	716.96**	152	.10	.56	.60	.16	75.15***	1
Null	1600.54	171	-	-	-	-	-	-

Note. $N = 176$; χ^2 = Chi-square statistic; *df* = degrees of freedom; SRMR = standardized mean-square residual; TLI = Tucker-Lewis index; CFI = comparative fit index; RMSEA = root-mean-square of approximation; $\Delta\chi^2$ = change in Chi-square statistic; Δdf = change in degree of freedom

** $p < 0.01$; *** $p < 0.001$

Table 16

Correlations between Potential Control Variables and Dependent Measures – Low Task Interdependence

	1	2	3	4	5	6	7	8	9	10
1. Gender Composition	1.000									
2. Mean Cognitive Ability	-.069	1.000								
3. Quantity of Output	-.227	.129	1.000							
4. Quality of Output	.335*	.147	-.369*	1.000						
5. Team Viability	-.134	-.357*	-.107	-.120	1.000					
6. Task Cohesion	-.153*	-.139	.002	-.129	.640***	1.000				
7. Communication	-.325*	-.166	.033	-.371*	.397**	.554***	1.000			
8. Cooperation	-.288	-.014	.217	-.291	.308*	.346*	.700***	1.000		
9. Task Conflict	.029	.132	-.162	.122	.006	.055	.195	.221	1.000	
10. Conflict Management	.013	-.049	-.142	.202	.319*	.175	.433**	.490**	.204	1.000

$N = 44$

* $p < 0.05$; ** $p < 0.01$, *** $p < 0.001$

Table 17

Correlations between Potential Control Variables and Dependent Measures – High Task Interdependence

	1	2	3	4	5	6	7	8	9	10
1. Gender Composition	1.000									
2. Cognitive Ability	-.069	1.000								
3. Quantity of Output	.118	.311*	1.000							
4. Quality of Output	.077	-.244	-.296*	1.000						
5. Team Viability	.148	-.212	.232	-.171	1.000					
6. Task Cohesion	-.013	-.098	.277	-.071	.639***	1.000				
7. Communication	-.002	-.159	.047	-.184	.652***	.254	1.000			
8. Cooperation	-.089	-.009	.085	.063	.569***	.228	.728***	1.000		
9. Task Conflict	-.109	.210	-.316*	.270	-.225	-.083	.022	.106	1.000	
10. Conflict Management	-.212	-.064	-.138	.134	.126	.142	.350*	.451**	.351*	1.000

$N = 44$

* $p < 0.05$; ** $p < 0.01$, *** $p < 0.001$

Table 18

Order Effects within Experimental Condition and Dependent Variable

Low Task Interdependence								
	Quantity of Output	Quality of Output	Team Viability	Task Cohesion	Communication	Cooperation	Task Conflict	Conflict Management
Experimental Condition								
High Team KSA X High Task KSA								
High Team KSA X Low Task KSA								
Low Team KSA X High Task KSA								
Low Team KSA X Low Task KSA			x	x	x			

High Task Interdependence								
	Quantity of Output	Quality of Output	Team Viability	Task Cohesion	Communication	Cooperation	Task Conflict	Conflict Management
Experimental Condition								
High Team KSA X High Task KSA	x							
High Team KSA X Low Task KSA		x						
Low Team KSA X High Task KSA					x	x		
Low Team KSA X Low Task KSA			x	x				x

Table 19

Measure of Within-Group Agreement

Dependent Variables	*M* $r^*_{wg\,(J)}$	*Minimum*	*Maximum*
Low Task Interdependence			
1. Team Viability	.59	.13	.95
2. Task Cohesion	.58	-.06	.94
3. Communication	.63	-.23	.92
4. Cooperation	.53	-.01	.85
5. Task Conflict	.96	.72	1.00
6. Conflict Management	-.06	-1.14	.94
High Task Interdependence			
1. Team Viability	.67	.07	.93
2. Task Cohesion	.66	.11	.97
3. Communication	.68	.03	.88
4. Cooperation	.50	.03	.85
5. Task Conflict	.88	.45	1.00
6. Conflict Management	-.15	-1.50	.84

Note: For scales 1 to 5, response options on a five-point Likert scale (1 to 5). Therefore, variance of the maximum variance distribution (S^2_{MV}) = 5.33, and lower bound $r^*_{wg\,(J)}$ = -1.0. For scale 6, response options on a six-point Likert scale (0 to 5). Thus, S^2_{MV} = 6.25, and lower bound $r^*_{wg\,(J)}$ = -1.143. Computation of $r^*_{wg\,(J)}$'s were carried out with variance of the uniform distribution equal to 2.0, in the case of five-point response scales, and 2.917, for six-point response scale, following guidelines by James et al., (1984).

S^2_{MV}'s were computed based on Lindell et al's (1999) formula (i.e., $S^2_{MV} = .5(X_U^2 + X_L^2) – [.5(X_U + X_L)]^2$, where X_U = upper and X_L = lower extremes of the response scales). However, results for maximum variance do not coincide when group members' response distribution is binomial, reflecting maximum dissensus (e.g., 1, 1, 5, 5 for the five-point Likert scale, and 0, 0, 5, 5 for the six-point Likert scale). This is the case is some groups answers to scale 6. Then, S^2_{MV} = 5.33 and 8.33, respectively. Therefore, $r^*_{wg\,(J)}$ lower bounds change to -1.665 and -4.413, respectively.

Table 20

One-Way Analyses of Variance for Dependent Measures – Low Task Interdependence

Dependent Variable	*Source*	*Sum of Squares*	*df*	*MS*	*F*
Team Viability	Model	782.23	43	18.19	2.25
	Error	1068.50	132	8.10	
	Total	1850.73	175		
Task Cohesion	Model	359.20	43	8.35	1.28
	Error	863.75	132	6.54	
	Total	1222.95	175		
Communication	Model	956.66	43	22.25	2.49
	Error	1181.50	132	8.95	
	Total	2138.16	175		
Cooperation	Model	7351.06	43	170.96	3.16
	Error	7146.25	132	54.14	
	Total	14497.31	175		
Task Conflict	Model	56.05	43	1.30	1.30
	Error	132.50	132	1.00	
	Total	188.55	175		
Conflict Management	Model	4828.11	43	112.28	1.30
	Error	11370.75	132	86.14	
	Total	16198.86	175		

N = 176

Table 21

One-Way Analyses of Variance for Dependent Measures – High Task Interdependence

Dependent Variable	*Source*	*Sum of Squares*	*df*	*MS*	*F*
Team Viability	Model	709.73	43	16.51	1.91
	Error	1138.00	132	8.62	
	Total	1847.73			
Task Cohesion	Model	364.73	43	8.48	1.51
	Error	741.00	132	5.61	
	Total	1105.73	175		
Communication	Model	786.23	43	18.28	2.32
	Error	1038.50	132	7.87	
	Total	1824.73	175		
Cooperation	Model	6822.24	43	158.66	2.96
	Error	7084.25	132	53.67	
	Total	13906.49	175		
Task Conflict	Model	179.97	43	4.19	1.91
	Error	288.75	132	2.19	
	Total	468.72	175		
Conflict Management	Model	5157.74	43	119.95	1.31
	Error	12053.75	132	91.32	
	Total	17211.49	175		

N = 176

Table 22

Summary of Propositions Tested and their Respective Control Variables

Propositions	Control Variables
# 1 - The relationship between task-related KSAs and task cohesion will be moderated by task interdependence.	Group gender composition and level of task interdependence order.
# 2 - The relationship between team-related KSAs and communication will be moderated by task interdependence.	Group gender composition and level of task interdependence order.
# 3 - The relationship between team-related KSAs and task conflict will be moderated by task interdependence.	-
# 5 – The relationship between task-related KSAs and quantity of output will be moderated by team-related KSAs.	Cognitive ability and level of task interdependence order.
# 5a - There will be mean differences in quantity of output between groups with similar task- and team-related KSAs as function of high and low task interdependence.	Cognitive ability and level of task interdependence order.
# 6 - Quality of output will be a function of task-, team-related KSAs, and task interdependence.	Group gender composition and level of task interdependence order.
# 7 - The relationship between task-related KSAs and team viability will be moderated by team-related KSAs.	Cognitive ability and level of task interdependence order.
# 7a - There will be mean differences in team viability between groups with similar task- and team-related KSAs as function of high and low task interdependence.	Cognitive ability and level of task interdependence order.

Table 23

Repeated Measures Analysis of Covariance for Task Cohesion with Group's Gender Composition and Task Interdependence Order as Covariates

Source	*Sum of Squares*	*df*	*MS*	*F*
Between subjects				
Group's gender composition	2.095	1	2.095	.68
Task interdependence order	.038	1	.378	.01
Task-related KSAs (A)	.857	1	.857	.28
S within-group error	123.57	40	3.089	
Within subjects				
Task interdependence (B)	.067	1	.067	.05
B x A	.092	1	.092	.07
B x S within-group error	52.717	40	1.318	

Note. S = subjects

N = 44

Table 24

Repeated Measures Analysis of Covariance for Communication with Group's Gender Composition and Task Interdependence Order as Covariates

Source	*Sum of Squares*	*df*	*MS*	*F*
Between subjects				
Group's gender composition	14.611	1	14.611	1.97
Task interdependence order	5.647	1	5.647	.76
Team-related KSAs (A)	4.041	1	4.041	.55
S within-group error	296.424	40	7.411	
Within subjects				
Task interdependence (B)	20.818	1	20.818	9.075**
B x A	.701	1	.701	.31
B x S within-group error	91.756	40	2.294	

Note. S = subjects

$N = 44$; ** $p < 0.01$

Table 25

Repeated Measures Analysis for Task Conflict

Source	*Sum of Squares*	*df*	*MS*	*F*
Between subjects				
Team-related KSAs (A)	.256	1	.256	.28
S within-group error	39.155	42	.932	
Within subjects				
Task interdependence (B)	3.001	1	3.001	6.56*
B x A	.376	1	.376	.82
B x S within-group error	19.217	42	.458	

Note. S = subjects

N = 44; * $p < 0.05$

Table 26

Repeated Measures Analysis of Covariance for Quantity of Output with Cognitive Ability and Group's Gender Composition as Covariates

Source	*Sum of Squares*	*df*	*MS*	*F*
Between subjects				
Cognitive ability	104.035	1	104.035	2.64
Group's gender composition	127.224	1	127.224	3.22
Task-related KSAs (A)	547.927	1	547.927	13.88***
Team-related KSAs (B)	5.594	1	5.594	.14
A x B	18.938	1	18.938	.48
S within-group error	1499.764	38	39.467	
Within subjects				
Task interdependence (C)	61.438	1	61.438	3.97*
C x A	47.383	1	47.383	3.06
C x B	56.249	1	56.249	3.64 (p = .06)
C x (A x B)	9.376	1	9.376	.61
C x S within-group error	587.969	38	15.473	

Note. S = subjects

N = 44; * $p < 0.05$, *** $p < 0.001$

Table 27

Paired Samples Test for Quantity of Output

	Low Task Interdependence	High Task Interdependence		
Experimental Condition	$_{Adj}M$ *(SD)*	$_{Adj}M$ *(SD)*	*df*	*t*
High Team KSA X High Task KSA	22.63 (.07)	22.45 (3.58)	10	.17
High Team KSA X Low Task KSA	17.73 (.08)	20.18 (2.66)	10	3.01**
Low Team KSA X High Task KSA	21.73 (.07)	22.27 (3.65)	10	.49
Low Team KSA X Low Task KSA	13.64 (.08)	18.55 (3.91)	10	4.12**

** $p < 0.01$

Table 28

Repeated Measures Analysis of Covariance for Quality of Output with Gender Composition and Task Interdependence Order as Covariates

Source	*Sum of Squares*	*df*	*MS*	*F*
Between subjects				
Group's gender composition	32.021	1	32.021	3.52
Task interdependence order	3.762	1	3.762	.42
Task-related KSAs (A)	3.826	1	3.826	.42
Team-related KSAs (B)	32.165	1	32.165	3.53 (p = .07)
A x B	.000	1	.000	.00
S within-group error	346.007	38	9.105	
Within subjects				
Task interdependence (C)	10.349	1	10.349	.79
C x A	3.259	1	3.259	.25
C x B	1.173	1	1.173	.09
C x (A x B)	2.227	1	2.227	.17
C x S within-group error	497.476	38	13.091	

Note. S = subjects

N = 44

Table 29

Repeated Measures Analysis of Covariance for Team Viability with Cognitive Ability and Task Interdependence Order as Covariates

Source	*Sum of Squares*	*df*	*MS*	*F*
Between subjects				
Cognitive ability	33.117	1	33.117	5.45*
Task interdependence order	6.448	1	6.448	1.06
Task-related KSAs (A)	1.711	1	1.711	.28
Team-related KSAs (B)	4.067	1	4.067	.67
A x B	.741	1	.741	.12
S within-group error	230.939	38	6.077	
Within subjects				
Task interdependence (C)	.313	1	.313	.13
C x A	.282	1	.282	.11
C x B	.222	1	.222	.09
C x (A x B)	.335	1	.335	.14
C x S within-group error	93.630	38	2.464	

Note. S = subjects

$N = 44$; $*p < 0.05$

Table 30

Results of Propositions Tested

Propositions	Evidence
# 1 - The relationship between task-related KSAs and task cohesion will be moderated by task interdependence.	Not supported
# 2 - The relationship between team-related KSAs and communication will be moderated by task interdependence.	Not supported
# 3 - The relationship between team-related KSAs and task conflict will be moderated by task interdependence.	Not supported
# 3a - Teams that are high on team-related KSAs will exhibit more constructive conflict management than teams that are low on team-related KSAs.	Not tested due to lack of within-group agreement
# 4 - The relationship between team-related KSAs and cooperation will be moderated by task interdependence.	Not tested due to lack of within-group agreement
# 5 – The relationship between task-related KSAs and quantity of output will be moderated by team-related KSAs.	Not supported
# 5a - There will be mean differences in quantity of output between groups with similar task- and team-related KSAs as function of high and low task interdependence.	Mean differences found for groups low on task-related KSAs
# 6 - Quality of output will be a function of task-, team-related KSAs, and task interdependence.	Not supported
# 7 - The relationship between task-related KSAs and team viability will be moderated by team-related KSAs.	Not supported
# 7a - There will be mean differences in team viability between groups with similar task- and team-related KSAs as function of high and low task interdependence.	Not tested due to lack of support for Proposition 7

Table 31

Correlations between Team Viability, Affectivity, Collectivism-Individualism (CI), Task- and Team-related KSAs

	1	2	3	4	5	6	7	8	9
1. Team viability – Low task interdependence	*.67*								
2. Team viability – High task interdependence	-.47***	*.78*							
3. Positive affectivity	**.15**	**.25**	*.80*						
4. Negative affectivity	-.08	-.20	-.22	*.78*					
5. CI Beliefs	**.00**	**.17**	.29	-.02	*.68*				
6. CI Values	**.13**	**.24**	-.01	.08	.08	*.72*			
7. CI Norms	**.19**	**.29***	.12	-.37*	-.03	-.14	*.68*		
8. Task-related KSAs Composite	**-.07**	**.03**	.06	-.24	.18	-.17	.24	-	
9. Team-related KSAs Composite	**-.20**	**-.06**	.06	-.35*	.31*	-.16	.02	.02	-

Note. Reliability estimates are displayed in the main diagonal when appropriate; Number of items: positive affectivity = 10, negative affectivity = 10; CI Beliefs = 3, CI Values = 3, CI Norms = 6; $N = 176$.

Correlations - $N = 44$; $*p < 0.05$, $***p < 0.001$

Table 32

Reliability Estimates for the Teamwork KSAs Test and its Subscales

Teamwork KSAs Test	Number of items	Reliability estimates[1]
Complete scale	35	.54
Interpersonal KSAs	25	.38
Conflict resolution KSAs	4	.13
Collaborative problem solving KSAs	9	.23
Communication KSAs	12	.22
Self-management KSAs	10	.43
Goal setting and performance management KSAs	5	.31
Planning and task coordination KSAs	5	.30

[1] Cronbach's alpha coefficient

N = 1,282

Table 33

Teamwork KSAs Test – Dimensionality of Scales

	χ^2	*df*	SRMSR	TLI	CFI	RMSEA	$\Delta\chi^2$	Δdf
1-Factor Model	874.41**	560	.03	.71	.73	.02	-	-
2-Factor Model	868.01**	559	.03	.72	.73	.02	6.40*	1
5-Factor Model	825.68**	550	.03	.74	.76	.02	48.73***	10
Null Model	1750.80**	595	-	-	-	-	-	-

Note. N = 1,282; χ^2 = Chi-square statistic; *df* = degrees of freedom; SRMR = standardized mean-square residual; TLI = Tucker-Lewis index; CFI = comparative fit index; RMSEA = root-mean-square of approximation; $\Delta\chi^2$ = change in Chi-square statistic; Δdf = change in degree of freedom
*$p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 34

Correlations between Task-related KSAs Measures and Quantity of Output for the Set-Up Operator in Conditions of Low and High Task Interdependence

	Low Task Interdependence					High Task Interdependence				
	1	2	3	4	5	1	2	3	4	5
1. Inspection Test	1.00					1.00				
2. Pegboard Exercise	-.06	1.00				.17	1.00			
3. Manipulation Exercise	.39**	.43**	1.00			.01	.48**	1.00		
4. Task-related KSAs Composite [a]	.71***	.63***	.75*	1.00		.55***	.82***	.70***	1.00	
5. Quantity of Output [b]	.35*	.45**	.45**	.59***	1.00	.34*	.15	.16	.30*	1.00

N = 42 and 42, low and high task interdependence, respectively
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[a] The Task-KSA Composite is an equal-weighted composite of scores on the Inspection Test and on the two manual dexterity exercises.
[b] Output from the Set-Up station is a board with a buzzer and leads inserted onto it

Table 35

Correlations between Task-related KSAs Measures and Quantity of Output for the Lighting Operator in Conditions of Low and High Task Interdependence

	Low Task Interdependence					High Task Interdependence				
	1	2	3	4	5	1	2	3	4	5
1. Inspection Test	1.00					1.00				
2. Pegboard Exercise	.20	1.00				-.10	1.00			
3. Manipulation Exercise	.09	.47**	1.00			.20	.28	1.00		
4. Task-related KSAs Composite [a]	.70***	.78***	.62***	1.00		.55***	.67***	.72***	1.00	
5. Quantity of Output [b]	.33*	.46**	.26	.51**	1.00	-.07	.20	.04	.10	1.00

N = 42 and 42, low and high task interdependence, respectively
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[a] The Task-KSA Composite is an equal-weighted composite of scores on the Inspection Test and on the two manual dexterity exercises.
[b] Output from the Lighting station is a board with a resistor and two diodes inserted onto it

Table 36

Correlations between Average Task-related KSAs Measures and Quantity of Output in Conditions of Low and High Task Interdependence

	Low Task Interdependence						High Task Interdependence					
	1	2	3	4	5	6	1	2	3	4	5	6
1. Inspection Test	1.00						1.00					
2. Pegboard Exercise	.43**	1.00					.43**	1.00				
3. Manipulation Exercise	.30*	.53***	1.00				.30*	.53***	1.00			
4. Task-related KSAs Composite [a]	.80***	.84***	.68***	1.00			.80***	.84***	.68***	1.00		
5. Quantity of Output [b]	.47***	.55***	.47***	.63***	1.00		.13	.22	.21	.23	1.00	
6. Quality of Output [c]	-.07	-.21	-.06	-.15	-.37*	1.00	.16	.02	.10	.12	-.30*	1.00

N = 44 groups
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[a] The Task-KSA Composite is an equal-weighted composite of scores on the Inspection Test and on the two manual dexterity exercises.
[b] Quantity of output reflects the number of circuit boards produced
[c] Quality of output reflects the number of defects in the circuit boards produced

APPENDICES

APPENDIX A

DIFFERENCES BETWEEN THE PRESENT STUDY AND THE ONE BY MOHAMMED ET AL. (2000)

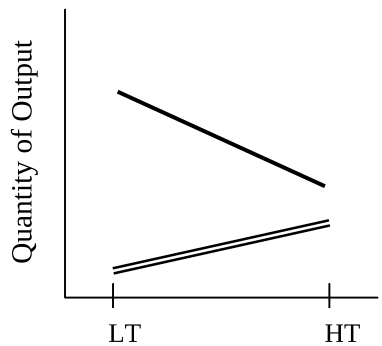
Mohammed and colleagues' (2000) study relates closely to this research in that both studies investigate how combinations of diverse individuals in a team influence team performance. However, there are important differences between the two studies. Mohammed and colleagues utilized one task composition variable specific to the task (i.e., mean levels of previous restaurant experience) and concentrated primarily on general task- and team-related composition variables (e.g., mean grade point average scores, mean levels of conscientiousness, extraversion, agreeableness, neuroticism, and previous team experience). However, this study employs specific task-related KSAs and general team-related KSAs due to characteristics of the experimental task.

Also, their research utilized an objective measure of task performance and one level of task interdependence. The present study employs both objective and subjective measures of team performance and two levels of task interdependence. In addition, their study assessed contextual performance with a seven-item scale covering aspects such as volunteering, cooperating, taking initiative, and working enthusiastically. This research investigates the impact of task- and team-related KSAs on specific group processes (i.e., communication, task conflict, task cohesion and cooperation). More importantly, while Mohammed and colleagues' study examined how the mix of taskwork and teamwork composition variables at the group-level of analysis impacts task and contextual performance, the present study investigates the nature of the relationship between task- and team-related KSAs at the group-level of analysis and its impact of team processes and outcomes.

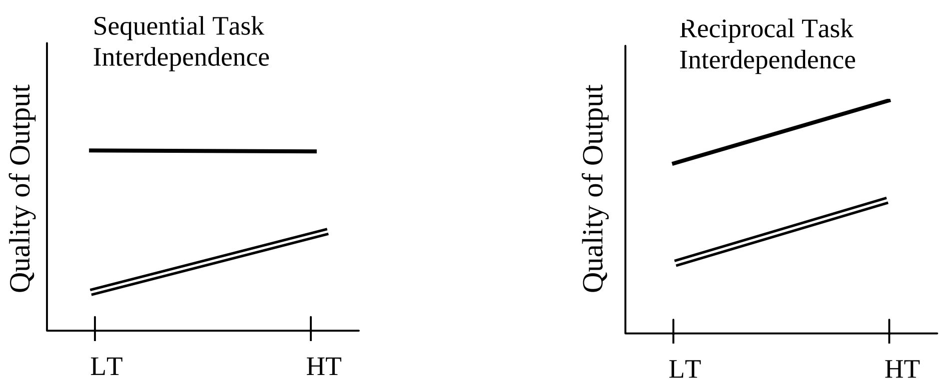
APPENDIX B

PICTORIAL DESCRIPTION OF PROPOSITIONS 5, 6, AND 7

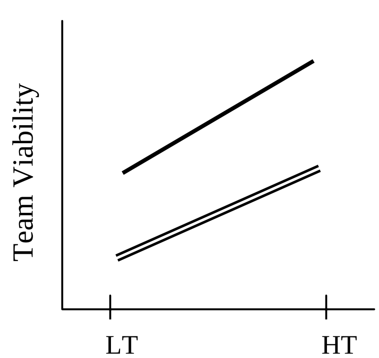
Propositions 5



Proposition 6



Propositions 7



Note:
LT = low team KSAs; HT = high team KSAs, ═══ = low task KSAs, ─── = high task KSAs

APPENDIX C

THE TEAMWORK KSA TEST ©[Note]

1. When you set work goals for yourself or your work team, what are the best goals to set?
   A. Set goals to "do your best."
   B. Set general and broad goals.
   C. Set specific and detailed goals.
   D. Set easy and simple goals.

2. How can members of a work team avoid wasting time in idle chit-chat?
   A. Only allow chit-chat during breaks or lunches.
   B. Develop an agreement among team members to avoid excessive chit-chat.
   C. Reward those who do not waste time in idle chit-chat by giving them an award.
   D. Chit-chat is important and should never be avoided, because it helps develop team spirit and strong relationships among team members.

3. Suppose you are on a team that decides for itself which team members perform its various duties and assignments. Which of the following should be used in making your decision?
   A. We should consider the match between each job's requirements and each employees' abilities.
   B. We should consider whether the workload is equally shared.
   C. We should consider the individual preferences of the team members.
   D. All of the above should be considered.

4. Which of the following is most likely to improve the <u>acceptance</u> of a team's goals by all of the team members?
   A. Giving a strong message from management that the goals are essential and must be reached.
   B. Involving all the team members in the process used to set the goals.
   C. Making sure the goals are easy enough to guarantee they are met.
   D. Monitoring progress and giving timely and accurate feedback.

5. A decision is being made about which people in a work area should be grouped together on a team. It is important to:
   A. always start by getting the supervisor's opinion first.
   B. have everyone vote on the final assignments.
   C. consider how each person's work relates to the work others do.
   D. try different combinations until you find the one that works best.

6. A team member is bothered about something. The best course of action for this person is to:
   A. hide his or her feelings and "deal with it," because this promotes the good of the group and maintains peace and harmony.
   B. talk privately to one or two team members who are sympathetic and willing to listen.
   C. constructively voice the concern and ask the group to consider ways to resolve it.
   D. pretend it doesn't exist and just go about his or her work.

7. You notice that another team member is pulling less than a full share of the team's load. You should:
   A. confront the person in a team meeting and ask for an explanation.
   B. talk to the team member privately and encourage the rest of the team to do the same.
   C. ignore it for now and wait to see if the team member will "come around," because confronting someone like this usually creates more problems.
   D. speak to a supervisor or manager in private and ask them to talk to the person.

<u>Note.</u> *The Teamwork-KSA Test*, by M. J. Stevens and M. A. Campion, 1993. Copyright by Authors. Used with permission.

8. Suppose that you find yourself in an argument with several co-workers about who should do a very disagreeable, but routine task. Which of the following would be the <u>most</u> effective way to resolve this situation?

A. Have your supervisor decide, because this would avoid any personal bias.
B. Arrange for a rotating schedule so everyone shares the chore.
C. Let the workers who show up earliest choose on a first-come, first-served basis.
D. Randomly assign a person to do the task and don't change it.

9. Your work team must develop a solution to a very difficult problem for your company. You want to generate a good solution. To make sure that the process runs as smoothly as possible, you should:

A. let those members with the greatest expertise on the problem develop the solution, because this would use your resources efficiently.
B. begin by encouraging everyone to share their ideas and suggestions in a noncritical atmosphere.
C. use a strategy where you evaluate ideas as they are presented, because this will speed up the process.
D. do all of the above.

10. Some experts suggest that work teams should involve all team members when making decisions by seeking advice and input from everyone. This is because greater involvement:

A. usually reduces the time required to come up with a good decision.
B. normally allows the team leader to shift the responsibility for the decision to others if things don't work out.
C. typically increases the breadth and diversity of available information.
D. helps keep pressures to conform to a minimum.

11. Suppose that you wanted to improve the effectiveness of your work team. Which of the following strategies is <u>most</u> likely to help?

A. Give the members more freedom to do their work by only setting general goals.
B. Set specific and challenging goals.
C. Set easy goals, to give a sense of accomplishment.
D. Criticize members with the lowest productivity record.

12. Suppose you are making copies of some training materials for your team. You need to make some decisions, such as what type of paper to use or whether to make single- or double-sided copies. Your team likes to involve everyone when making decisions on important matters. What should you do in this case?

A. Wait and bring it up at the next team meeting.
B. Try to contact as many team members as you can before you go ahead.
C. Try to contact at least one other team member before you go ahead.
D. Make the decision on the spot for the team and explain it later if asked.

13. You are running a team meeting. A lot of time seems to be wasted due to irrelevant conversations. You should:

A. prohibit any discussion not related to the purpose of the meeting.
B. have a meeting agenda and stick to it.
C. only let people speak who have something relevant to say.
D. limit the time for the meeting.

14. Some people communicate with others by using a tone that suggests they are very certain and unwavering in their views or positions. If you communicated this way with your team members, you would likely:

A. show that you are a confident decision maker.
B. find that others are reluctant to open up to you.
C. emerge as the informal leader of your work team.
D. end up hurting other team members' feelings.

15. You want to talk to the other members of your team about something important to you. However, you are worried that they might not react well to what you have to say. You should:

A. start by suggesting that the message is from your supervisor or a manager.
B. soften the message by saying up front that you are just stating your opinion, and that you are willing to change your mind.

C. say that you believe your message is important and that you would like the team to listen to your concern.
D. avoid bringing it up, because your concern may not be that important and may likely go away.

16. To listen more effectively to others, you should:
A. pay attention to things like facial expression, voice tone, etc.
B. ask questions to see if others have understood what you just said.
C. try to anticipate what the other person is going to say and where he or she is likely to head with the conversation.
D. focus more on the specific words the other person is using.

17. Your team members like to take some time to greet each other at the beginning of your shift, and make small talk with each other while working. This behavior:
A. suggests that your team is not spending enough time focused on its work.
B. can have positive benefits so long as it doesn't interfere with work.
C. can sometimes hurt good working relationships among members of your team.
D. both B and C are correct.

18. You have set a goal and started working on it. You should lower the goal:
A. only if things change so that it's now impossible to reach the goal.
B. if it turns out that the goal was set so high that reaching it will require a lot of effort.
C. if it looks like the goal might not be reached, because this way you can still reach the goal.
D. you should never lower the goal, because this would lower commitment to goals in the future.

19. Suppose you are presented with the following types of goals. You are asked to pick one for your team to work on. Which would you choose?
A. An easy goal so the team will be assured of reaching it, thus creating a feeling of success.
B. A goal of average difficulty so the team will be somewhat challenged, but successful without too much effort.
C. A difficult and challenging goal that will stretch the team to perform at a very high level, but attainable so that effort will not be seen as futile.
D. A very difficult, or even impossible goal so that even if the team falls short, it will at least have a very high target to aim for.

20. Your team has many activities that it must do. You must set some priorities to help you decide what to work on first. Which of the following questions would help you set these priorities?
A. Ask which activities are the greatest threat to the team's, or the company's survival if they are not done?
B. Ask what activities the company considers most important?
C. If there are several things that need to be done right away, ask which will likely result in failure if left unattended?
D. All of the above questions would help set priorities.

21. A successful work team must properly plan and coordinate all of its tasks and activities. Which of the following would most likely help a team do this planning and coordinating?
A. The team should look at how things have been done in the past and use that as its guide.
B. The team should consider the priorities, pacing, and sequencing of its tasks and activities.
C. The only way a team can know how to plan and coordinate things is by trial-and-error.
D. The team should do both A and C above.

22. Suppose that your work team is trying to develop a new strategy to improve the way it performs a certain task. Soon, your team has come up with several possible options. In order to choose the best new strategy, which of the following should your team consider?
A. Our team should consider which new strategy is the most imaginative, because they are almost always the best.
B. Our team should consider which members suggested each of the new strategies, because it should make sure that every team member has at least one suggestion adopted.

C. Our team should consider how it defines success, and whether it faces any obstacles that might keep the new strategies from working.
D. All of the above should be considered.

23. Suppose that you are having a problem with another member of your work team, and that the problem is based on a genuine disagreement (that is, it's not just a "miscommunication"). In the list below, which would be the most appropriate way to begin to resolve this situation?
A. Negotiate a solution that both of you are willing to accept.
B. Ask questions to try and understand each other's position and look for solutions that both of you like.
C. Offer to give something up to resolve the conflict if the other person is willing to do likewise.
D. Allow each person to try and persuade the other, so long as it is done fairly and without personally attacking anyone.

24. How can you tell if a co-worker is not really expressing his or her true feelings or opinions when talking to you about something?
A. By listening more attentively to what the person is saying.
B. By directly confronting the person with your suspicions.
C. By paying close attention to his or her body posture, facial expressions, and tone during the conversation.
D. By privately talking to other team members to see if they know what is going on.

25. Work teams can often face problems when making decisions about how something should be done or who should do what. Which of the following is an example of this type of decision making problem?
A. Important or powerful members of the team are usually too eager to go along with the rest of the team.
B. The concern over properly sharing the workload can dominate other concerns like how the team can best reach its objectives.
C. Members who are less assertive will usually reject a bad decision, even when other team members might accept it.
D. All of the above are examples of typical problems.

26. Your work team is facing a problem and the team is pressed for time. A member of the team has just presented a solution that appears to be workable. Your team should:
A. still take the time to evaluate the solution, even if it slows the process down.
B. carry out the solution at once, because the time is short.
C. vote on the solution and accept it only if it is approved by a majority of the team.
D. do none of the above.

27. Which of the following statements is true about decisions made in a group versus decisions made individually?
A. Groups tend to make less risky decisions than individuals.
B. Groups tend to make less cautious decisions than individuals.
C. Groups tend to make decisions that are either more risky or more cautious than individuals, depending on the circumstances.
D. Group decisions are no different from individual decisions in terms of risk or caution.

28. You are concerned about a poor level of quality in the decisions that your work team is making. Which of the following symptoms would lead you to believe that the problem is due to the team's strong desire for harmony and conformity?
A. The group seems to be too willing to listen to any new idea, no matter how odd it may be.
B. When objections are raised, they are taken much too seriously and prevent the team from acting.
C. Criticism is dismissed with ease and decisions are made without examining all the facts.
D. Members of the group seem to raise a lot of objections and concerns.

29. If left without direction or guidance, most group discussions tend to:
A. be a good way to spontaneously communicate new and unshared information.
B. improve the quality of the group's decisions.

C. bias individual group members into adopting decisions they would never adopt on their own.
D. only share information that the group members already have in common and that supports existing preferences.

30. Your team wants to conduct a "brainstorming" session to generate some new ideas. Which of the recommendation(s) below should it follow?
A. The process of generating ideas should be separated from the process of evaluating ideas, in order to encourage greater creativity.
B. Every new idea should be adopted, developed, and supported by one team member so that "ownership" results.
C. When the team meets in the "brainstorming" session, the meeting should not follow any sort of format or agenda.
D. All of the above should be followed.

31. What is the best kind of seating arrangement for a team meeting in order to encourage participation by all team members?
A. The team leader should sit at the head of the table, with the members along both sides.
B. Team members who have more to contribute should sit towards the front of the table.
C. Everyone should be seated with no special distinctions among members.
D. Seating arrangements really don't matter when it comes to meeting participation.

32. The ability of an individual to use an open and supportive communication style with others will be enhanced <u>most</u> by:
A. improving the quality of his or her personal relationships.
B. positioning oneself properly in the communication network.
C. learning the proper nonverbal communication techniques.
D. paying attention to things like social standing within the group.

33. When speaking to someone about a problem, supportive communication would tend to use messages that focus on:
A. the person.
B. the event.
C. the person's behavior.
D. both B and C are correct.

34. Your team wants to improve the quality and flow of the conversations among its members. Your team should:
A. set up a specific order for everyone to speak and then follow it.
B. use comments that build upon and connect to what others have already said.
C. let team members with more to say determine the direction and topic of conversation.
D. do all of the above.

35. To become better communicators, many people try to pay close attention to their own nonverbal messages (for example, use good eye contact, stand closer to the other person, etc.). Which of the following statements about these nonverbal messages is <u>most</u> correct?
A. To become a truly skilled communicator, you must learn to consciously control and manipulate your nonverbal messages.
B. If you strive to communicate openly and candidly with others, your nonverbal messages will take care of themselves.
C. Nonverbal messages communicate most of the meaning in a conversation, so you should constantly try to monitor them to be sure they are expressing what you want them to.
D. Nonverbal messages don't matter -- they are unimportant to becoming a better communicator.

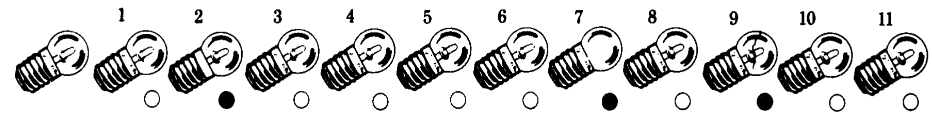
APPENDIX D

INSPECTION TEST © – FLANAGAN'S INDUSTRIAL TESTS BATTERY

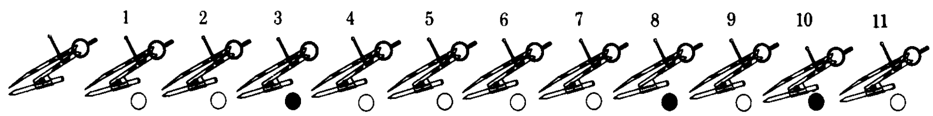
DIRECTIONS: This is a test of your ability to spot defects in small objects quickly and accurately.

Each line in this test shows a series of small parts like the ones below:

SAMPLE 1:



SAMPLE 2:

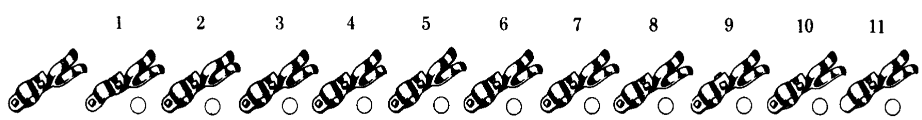


The parts in each line are supposed to be the same, but some were not made right. You are to find the ones that are faulty. In each line the first part is a perfect sample of the parts you are to inspect. Look carefully at this first part and then look closely at the other parts in the row. Fill in the circle under every part you find that is not made right. You will get a point for every faulty part you find, but you will lose points for incorrect responses.

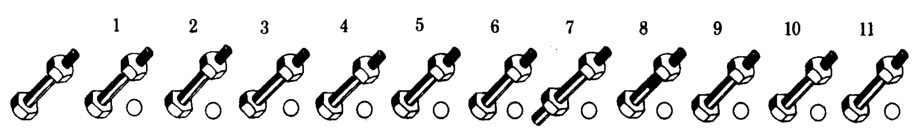
Study the two sample exercises above. Look carefully at the parts that have been marked *faulty* to see what is wrong with them. In Sample 1, for example, bulb 2 has no markings on the collar at the top of the threads; bulb 7 has no insides, and bulb 9 is cracked. In Sample 2, compass 3 has no top knob, compass 8 is missing a rivet in the hinge holding the pencil, and compass 10 has a side screw that is too short.

Now look at Samples 3 and 4 below. Fill in the circle below those parts that are not exactly like the first one in each series. Since there are different numbers of faulty parts in the lines, you should check each part.

SAMPLE 3:



SAMPLE 4:



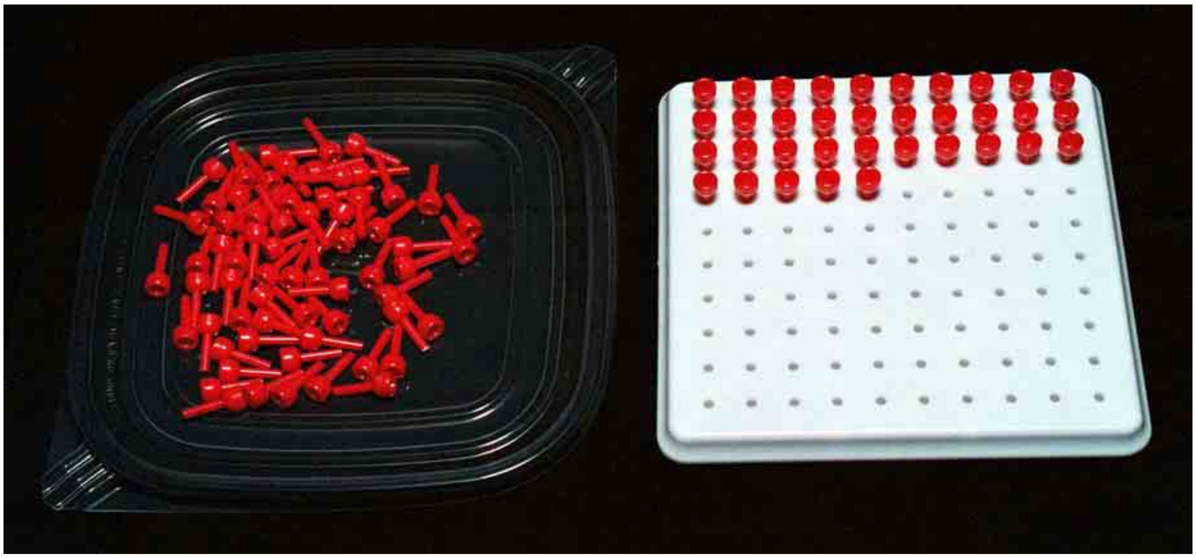
In Sample 3, you should have filled in the circles for parts 1, 2, 4, 9, and 11; in Sample 4, circles for parts 3, 7, and 8.

You will have five minutes for this test. Work as quickly and accurately as you can. Wait until the examiner tells you to begin.

APPENDIX E

FINGER DEXTERITY EXERCISES

Pegboard Exercise



Manipulation Exercise

APPENDIX F

POWER ANALYSIS

For Repeated Measurement and Matched Subjects Designs (Chapter 11, Cohen, 1988)

Desired Power = .80 by convention, p. 60 (Cohen, 1988)

Effect Size (f^2) = .30 by convention, p. 60 (Cohen, 1988)

Significance level = $p < .01$ by convention, p. 526 (Cohen, 1988)

L value = 11.68

(for desired power and number of conditions) by convention, p.526 (Cohen, 1988)

c = 2 (number of conditions → task types: sequential and reciprocal)

g = 4 (number of groups → team- and task-KSAs combinations)

To calculate the total number of subjects (teams) required (N):

$$n^* = \frac{L}{f^2\,(c-1)} + g$$

$$n^* = \frac{11.68}{.3\,(2-1)} + 4$$

TOTAL NUMBER OF SUBJECTS (TEAMS) REQUIRED = 43 total or 11 teams per cell.

Source: Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

APPENDIX G

GENERAL TASK TRAINING

“Before you work as a group, I am going to demonstrate how the product is assembled. First, you will be given time to observe what I do and you will practice individually.”

“Are there any questions at this point?”

“This is an assembled circuit board, the product that your group will assemble.”
- Show assembled circuit board.

“When the board is assembled correctly, the buzzers must buzz and the lights must light – both the red and the green.”
- Demonstrate working buzzers and lights.

“The materials needed to assemble a circuit board are nuts and bolts, boards, buzzers, red and green diodes, resistors, and batteries.”
- Show equipment as you name them.

“And this is how the circuit board is assembled:”
- Give instructions as you put the circuit board together.

“First, attach the buzzer to the board using a nut and bolt on each end of the buzzer.
You have to be careful when you insert the wires into the board. Otherwise, you may cut yourself.
Also, do not bend the wires more than absolutely necessary to properly install the parts.
Then, insert a red lead pin at space 16-H and a black lead pin at space 4-I.
Now, install the resistor in spaces 4-H and 7-H.
Install the red diode: long side in 11-F and short side in 7-G.
Install the green diode: long side in 16-F and short side in 11-G.
Insert battery red lead pin in space 16-J.
Insert battery black lead pin in space 4-J.
If both lights and buzzer work, your circuit board has been assembled correctly.”

“Now that you know what the final product looks like, in these boxes you will find the equipment necessary to assemble one circuit board. This is your opportunity to learn how to perform the task. However, do not worry if your board does not work properly the first time. I will give you some time to make adjustments. Also, do not worry about memorizing these steps. You will be given written instructions and schematics for assembling the circuit board once you move to the work stations.”

- Make sure that all participants have the materials ready and then begin giving out instructions.

“Let’s practice…
First, attach the buzzer to the board using a nut and bolt on each end of the buzzer.
You have to be careful when you insert the wires into the board. Otherwise, you may cut yourself.
Also, do not bend the wires more than absolutely necessary to properly install the parts.
Then, insert a red lead pin at space 16-H and a black lead pin at space 4-I.

Now, install the resistor in spaces 4-H and 7-H.
Install the red diode: long side in 11-F and short side in 7-G.
Install the green diode: long side in 16-F and short side in 11-G.
Insert battery red lead pin in space 16-J.
Insert battery black lead pin in space 4-J.
If both lights and buzzer work, your circuit board has been assembled correctly."

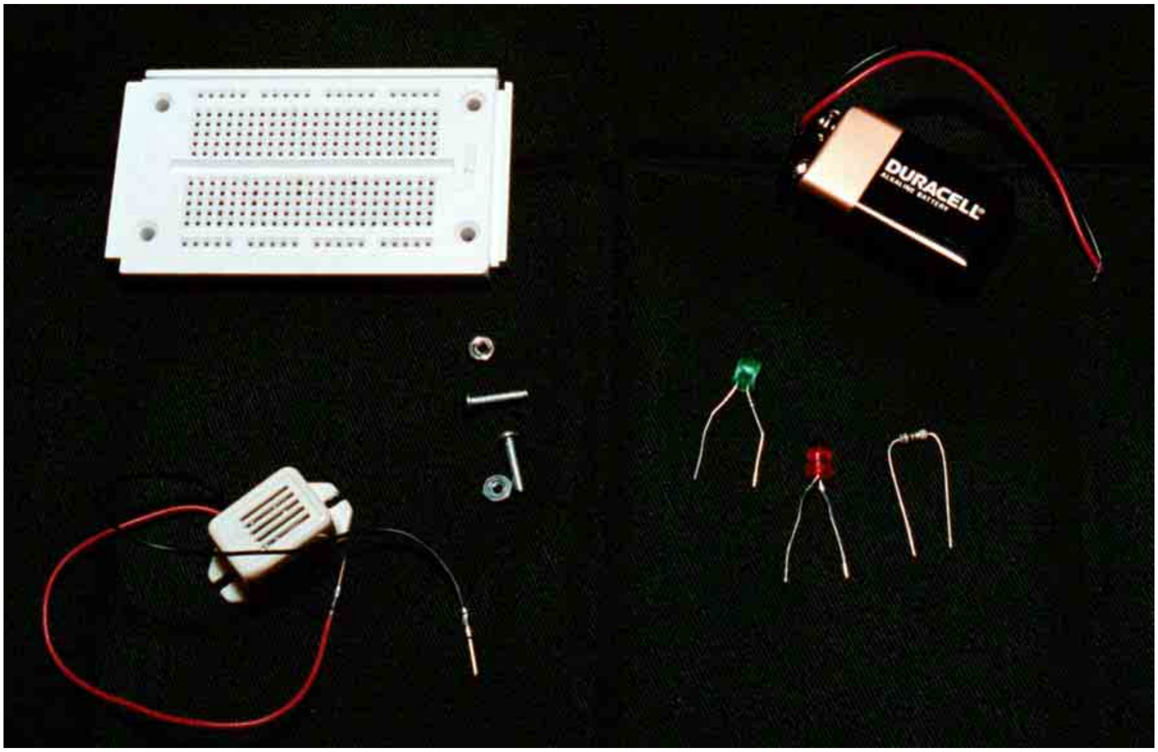
- Give time for participants to complete the previous step before moving along, but keep the group going.
- After the circuit board is completed, allow a few minutes for adjustments and questions.

"Now you are going to move to the work stations. Like I mentioned before, the task will be performed twice following the processes that the engineers devised. It is very important that the group follows the instructions that will be given."

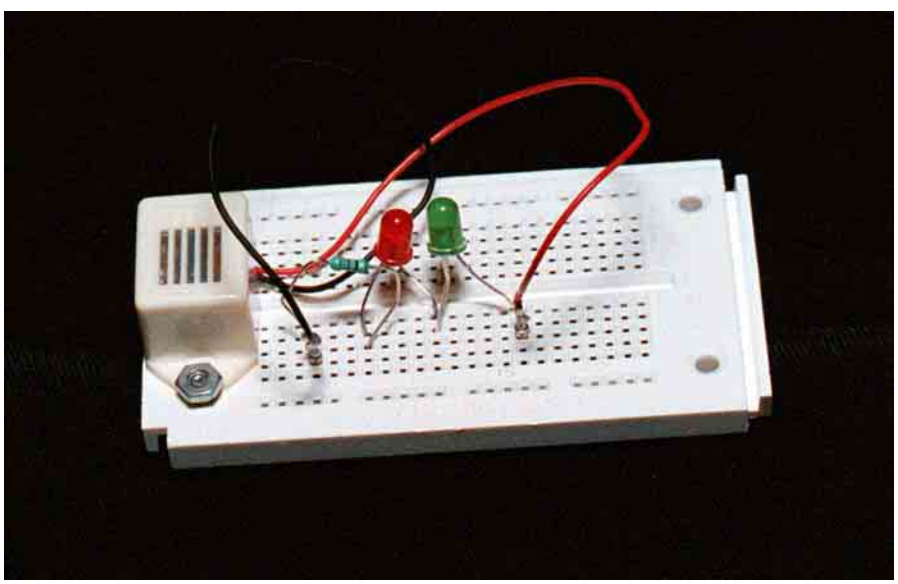
"In fact, try to imagine that for the next few minutes we produce an important product here at this plant – circuit boards. They are really in demand. Customers are lined up at the door to get this high-quality, high-tech product. Even though this does not look like a plant, please suspend your disbelief. During the next few minutes, we are a room of fully capable circuit board assemblers, doing high-tech, high quality work. For each production run, the group will have 20 minutes to produce as many circuit boards as possible."

APPENDIX H

CIRCUIT BOARD COMPONENTS



Assembled Circuit Board



APPENDIX I

JOB DESCRIPTIONS FOR THE SEQUENTIAL PROCESS

Set-Up Operator

Congratulations! You are a member of a proud manufacturing group. You have a critical role to play in the manufacture of electronic circuit boards. These boards are in incredible demand! It is crucial that production goes smoothly, and that lots of high quality circuit boards are completed during your 20 minute shift.

This is the area where each circuit board starts its life. This job is not that difficult, but you have to be exact in your placement of the wires and buzzer systems. You have repeatedly heard such warnings as, **"Don't drop the buzzers! Don't bend the wires! Don't slow down the next section by getting too few boards! Above all else, work safely!!**

Your job is to insert two loose wires and attach the buzzer to each board. **You must be exact in the placement of the wires because the remaining assembly steps are dependent on correct wire placement!** You are to insert the leads from the buzzer exactly as the diagram indicates. You are also responsible for keeping track of how many units you have sent to Lighting in the *Set-Up Daily Report* form.

You can only leave your work area to place boards with buzzers on the *Lighting Tray*. Raise you hand to contact the experimenter in case you need more material.

Equipment Needed:
- Nuts and Bolts
- Circuit Boards
- Buzzers
- Set-Up Schematic
- Set-Up Daily Report Form

Set-Up Instructions:
1. Attach buzzer to board using a nut and bolt on each end of the buzzer.
2. Insert red lead pin at space **16-H.**
3. Insert black lead pin at space **4-I.**
4. Place board with buzzer and pins on the *Lighting Tray*.

Lighting Operator

Congratulations! You are a member of a proud manufacturing group. You have a critical role to play in the manufacture of electronic circuit boards. These boards are in incredible demand! It is crucial that production goes smoothly, and that lots of high quality circuit boards are completed during your 20 minute shift.

Your job is to properly install one red diode, one green diode, and one resistor according to the schematic displayed below. Proper installation requires you to place them with correct polarity. Otherwise, they won't glow. In addition, you must install the resistor in the correct position as displayed in the schematic below. **Do not bend the wires more than is absolutely necessary to properly install the parts. Also, you have to be careful when you insert the wires into the board. Otherwise, you may cut yourself.** In addition, you are responsible for recording in the *Lighting Daily Report* form how many units you have sent to Quality Control.

You can only leave your work area to place boards with lights on the *Quality Control Tray*. Raise you hand to contact the experimenter in case you need more material.

Equipment Needed:
- Partially Completed Circuit Board
- Red Diodes
- Green Diodes
- Resistors
- Light Schematic
- Lighting Daily Report Form

Lighting Instructions:
1. Install resistor in spaces **4-H** and **7-H.**
2. Install red diode: long side in **11-F** and short side in **7-G.**
3. Install green diode: long side in **16-F** and short side in **11-G.**
4. Place board with lights and resistor on the *Quality Control Tray*.

Quality Control Operator

Congratulations! You are a member of a proud manufacturing group. You have a critical role to play in the manufacture of electronic circuit boards. These boards are in incredible demand! It is crucial that production goes smoothly, and that lots of high quality circuit boards are completed during your 20 minute shift.

What glows red and green and buzzes? A circuit board when the assembly areas have done their jobs.

Your job is to inspect each board that the Lighting Operator and the Reword Operator bring to Quality Control. You do this by first visually inspecting the board for all component parts. You then "power up" the board to make sure the buzzer works and the green and red diodes glow. **Place boards that work on the shipping table and those that do not on the Rework Tray.**

You are also responsible for keeping track of how many units you send to Rework and Shipping and of parts damaged during the inspection. In the *Quality Daily Report* form, record how many units were sent to Rework and Shipping and how many parts were damaged during inspection.

You can only leave your work area to place boards that do not work the Rework *Tray*.

Equipment Needed:

- 9-Volt DC Power Source
- Circuit Board Schematic
- Quality Daily Report Form

Instructions:

1. Insert battery red lead pin in space **16-J.**
2. Insert battery lead pin in space **4-J.**
3. If both lights and buzzer work, place the circuit board in the *Shipping Box*.
4. If one or more of the lights and/or the buzzer fail to work, place the circuit board on the *Rework Tray*.

Rework Operator

Congratulations! You are a member of a proud manufacturing group. You have a critical role to play in the manufacture of electronic circuit boards. These boards are in incredible demand! It is crucial that production goes smoothly, and that lots of high quality circuit boards are completed during your 20 minute shift.

Your job is to trouble-shoot each defective circuit board that arrives at your work station from Quality Control. You do this by first performing a visual inspection to ascertain that all parts are present, in the correct location, and all leads are connected. You then "power up" the boards and use the Trouble Shooting Guide to locate any problems. Most of the problems you have seen are the result of buzzer wires reversed, incorrect polarity diodes, and wires in the wrong place. Your work station maintains some spare parts for replacement, but this is limited due to the shortage and costs of incoming parts.

You are also responsible for keeping track of how many units you send back to Quality Control, and how many defects you find. Record these quantities in the *Rework Daily Report* form.

You can only leave your work area to place boards on the *Quality Control Tray*.

Equipment Needed:

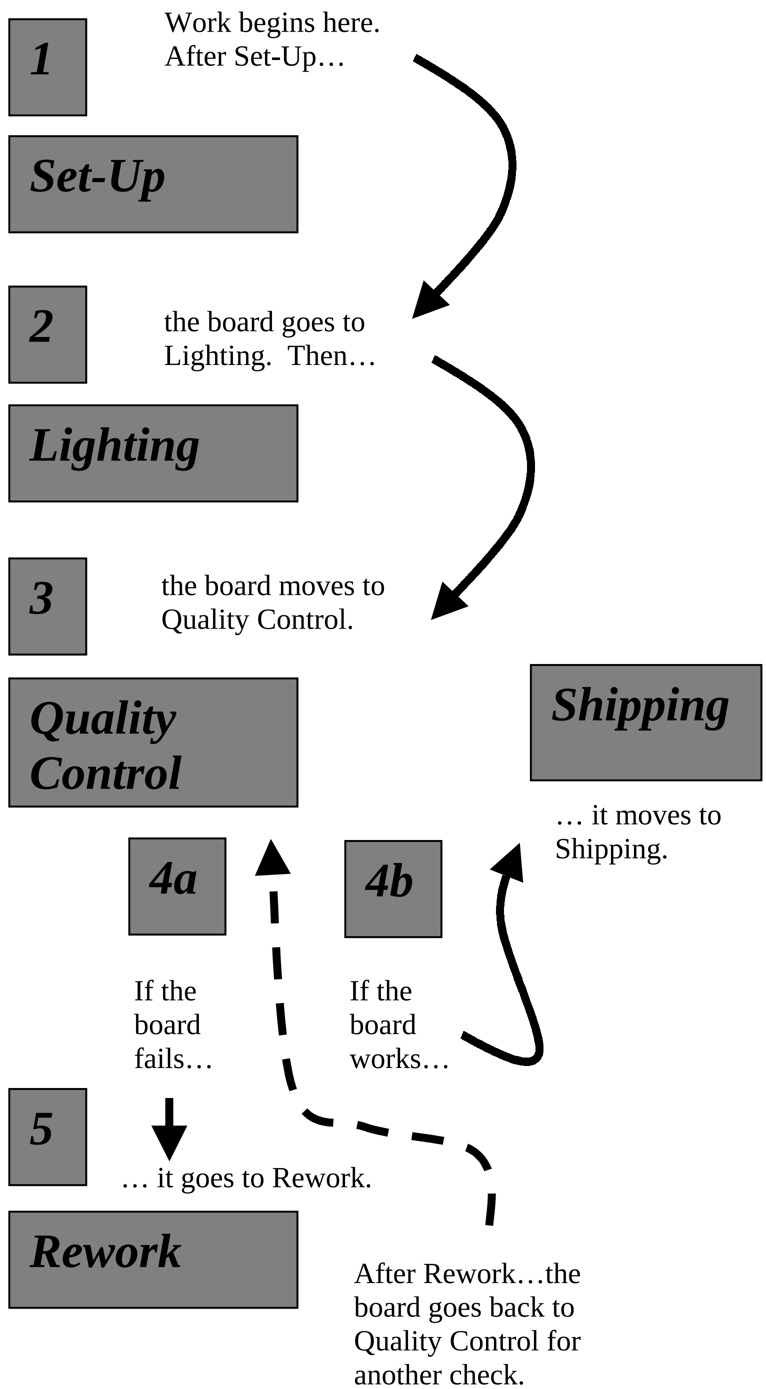
- 9-Volt DC Power Source
- Circuit Board Schematic
- Rework Daily Report Form
- Trouble Shooting Guide

Instructions:

1. Do a visual inspection of the board.
2. Insert battery red lead pin in space. **16-J.**
3. Insert battery black lead pin in space **4-J.**
4. Use the Trouble Shooting Guide to diagnose the problem.
5. Make necessary repairs.
6. Place repaired board on the *Quality Control Tray*.

APPENDIX J

SEQUENTIAL PROCESS



APPENDIX K

TRACKING FORMS FOR THE SEQUENTIAL PRODUCTION RUN

Set-Up Daily Report

Set-Up Department

Units sent to the Lighting Station: __________

Lighting Daily Report

Lighting Department

Units sent to Quality Control: __________

Quality Daily Report

Quality Control Department

Incoming units: __________ (number of units on the *Quality Control Tray)*

Units sent to the Rework Station: _________________ (count the number of times you send a unit to

Rework. It doesn't matter whether it is the same or a different unit)

Units sent to Shipping: ____________

Rework Daily Report

Reword Department

Units sent to Quality Control: _________

Total number of defects: _________

1 - each time you adjust a polarity either by changing it or adjusting the wiring, counts as one defect;

2 - each part you substitute counts as one defect.

APPENDIX L

JOB DESCRIPTIONS FOR THE RECIPROCAL PROCESS

Circuit Board Operator

Congratulations! You are a member of a proud manufacturing group. You have a critical role to play in the manufacture of electronic circuit boards. These boards are in incredible demand! It is crucial that production goes smoothly, and that lots of high quality circuit boards are completed during your 20 minute shift.

This is the area where each circuit board starts its life. This job is not that difficult, but you have to be exact in your placement of the wires and buzzer systems. You have repeatedly heard such warnings as, **"Don't drop the buzzers! Don't bend the wires! Don't slow down the next section by getting too few boards! Above all else, work safely!!**

Your job is to insert two loose wires and attach the buzzer to each board. **You must be exact in the placement of the wires because the remaining assembly steps are dependent on correct wire placement!** You are to insert the leads from the buzzer exactly as the diagram indicates.

You are also responsible for repairing wires and buzzers of boards sent back to you from Quality Control.

Equipment Needed:
- Nuts and Bolts
- Circuit Boards
- Buzzers
- Set-Up Schematic

Set-Up Instructions:
1. Attach buzzer to board using a nut and bolt on each end of the buzzer.
2. Insert red lead pin at space **16-H.**
3. Insert black lead pin at space **4-I.**
4. Place board with buzzer and pins on the *Set-Up Quality Control Tray*.

Circuit Board Operator

Congratulations! You are a member of a proud manufacturing group. You have a critical role to play in the manufacture of electronic circuit boards. These boards are in incredible demand! It is crucial that production goes smoothly, and that lots of high quality circuit boards are completed during your 20 minute shift.

Your job is to properly install one red diode, one green diode, and one resistor according to the schematic displayed below. Proper installation requires you to place them with correct polarity. Otherwise, they won't glow. In addition, you must install the resistor in the correct position as displayed in the schematic below. **Do not bend the wires more than is absolutely necessary to properly install the parts. You have to be careful when you insert the wires into the board. Otherwise, you may cut yourself.**

You are also responsible for repairing the diodes and resistors of boards sent back to you from Quality Control.

Equipment Needed:

- Partially Completed Circuit Board
- Red Diodes
- Green Diodes
- Resistors
- Light Schematic

Lighting Instructions:

1. Install resistor in spaces **4-H** and **7-H.**
2. Install red diode: long side in **11-F** and short side in **7-G.**
3. Install green diode: long side in **16-F** and short side in **11-G.**
4. Place board with resistor and diodes on the *Lighting Quality Control Tray*.

Circuit Board Operator

Congratulations! You are a member of a proud manufacturing group. You have a critical role to play in the manufacture of electronic circuit boards. These boards are in incredible demand! It is crucial that production goes smoothly, and that lots of high quality circuit boards are completed during your 20 minute shift.

What glows red and green and buzzes? A circuit board when the assembly areas have done their jobs. Your job is to inspect each board that the Set-Up Operator and the Lighting Operator place on the Quality Control Trays. Your work has two components:

Component 1 - You visually inspect the placement of wires and buzzers of boards on the Set-Up Quality Control Tray. Then, you "power up" the boards to make sure that the buzzer works. **If the buzzer works, place the board on the Lighting Tray. If the buzzer does not work, place the board on the Set-Up Rework Tray.**

Component 2 – You visually inspect the placement of resistor and diodes of boards on the Lighting Quality Control Tray. Then, you "power up" the boards to make sure the lights light. **If the lights work, place the board on the Shipping Table. If the lights do not work, place the board on the Lighting Rework Tray.**

Be sure to inform the Set-Up and the Lighting Operators what kind of problems were found in the boards that you send back for rework.

Equipment Needed:
- 9-Volt DC Power Source
- Circuit Board Schematic
- Trouble Shooting Guide

Instructions:
1. Insert battery red lead pin in space **16-J.**
2. Insert battery lead pin in space **4-J.**
3. If buzzer works, place circuit board on the *Lighting Tray*. If buzzer doesn't work, place board on the *Set-Up Rework Tray*.

1. Insert battery red lead pin in space **16-J.**
2. Insert battery lead pin in space **4-J.**
3. If lights work, place circuit board on the *Shipping Table*. If lights don't work, place board on the *Lighting Rework Tray*.

Circuit Board Operator

Congratulations! You are a member of a proud manufacturing group. You have a critical role to play in the manufacture of electronic circuit boards. These boards are in incredible demand! It is crucial that production goes smoothly, and that lots of high quality circuit boards are completed during your 20 minute shift.

Your job has three components.

1 - You will record the number of defects in the units sent for Set-Up Rework and Lighting Rework. Please check the Daily Report Form for instruction on how to record the number of defects. **It is very important that you are accurate in recording this information.** In addition, you will record the total number of units sent to Shipping. Be sure to coordinate with the other group members in order to obtain all the necessary information.

2 - You are responsible for keeping the group informed about its productivity every few minutes.

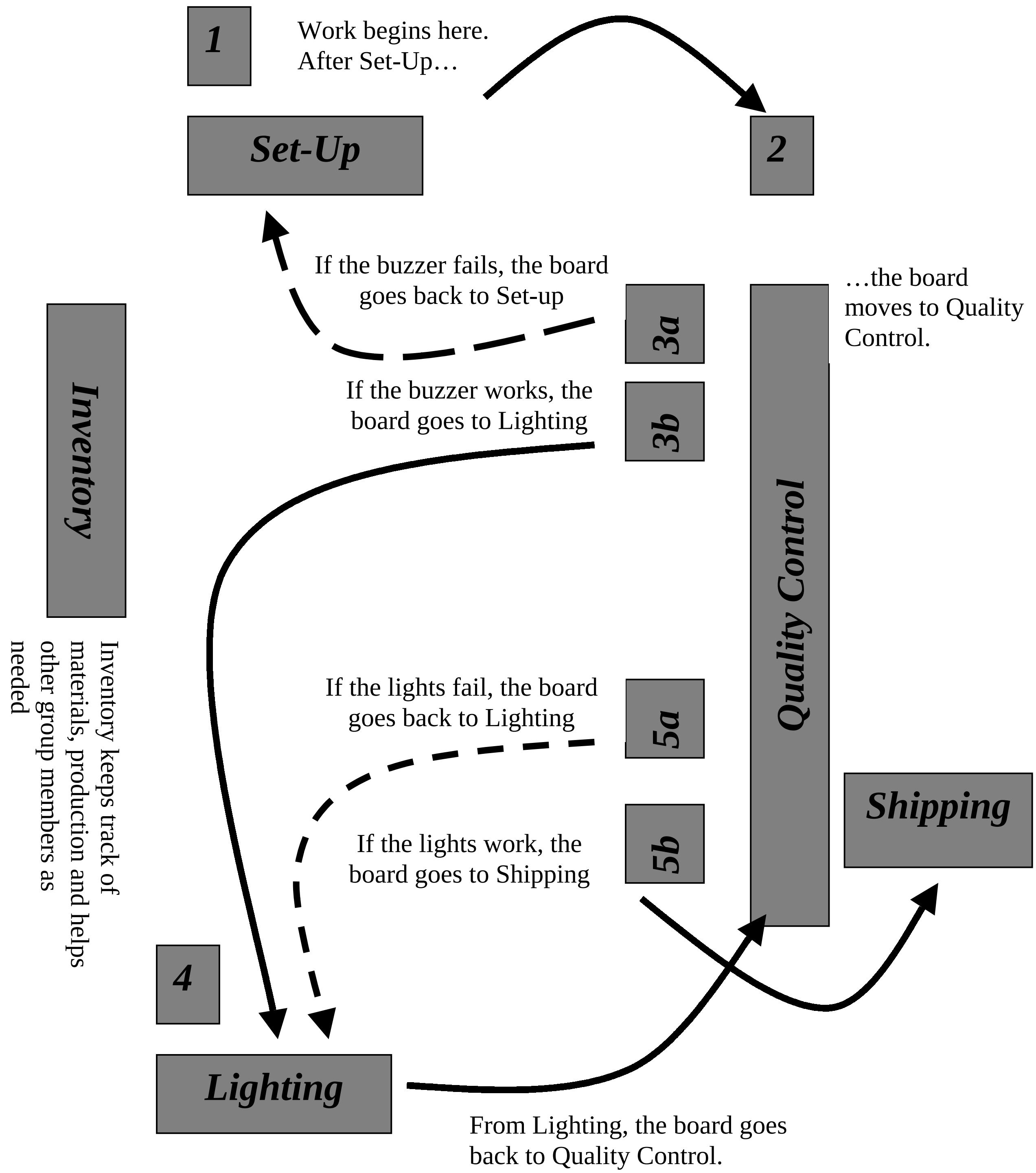
3 - You are responsible for helping the other group members as needed.

Equipment Needed:

- Daily Report Form

APPENDIX M

RECIPROCAL PROCESS



APPENDIX N

TRACKING FORMS FOR THE RECIPROCAL PRODUCTION RUN

Daily Report

Inventory Department

Production:

Units produced by Set-Up: ____________

Units produced by Lighting: ___________

Total Units sent to Shipping: __________

Rework:

By Set-Up

Total number of defects: __________

1 - each time a polarity is adjusted either by changing it or adjusting the wiring, counts as one defect

2 - each part that is substituted counts as one defect.

By Lighting

Total number of defects: __________

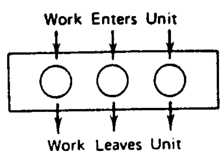
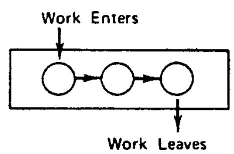
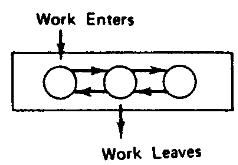
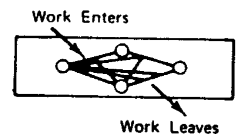
1 - each time a polarity is adjusted either by changing it or adjusting the wiring, counts as one defect

2 - each part that is substituted counts as one defect.

APPENDIX O

MANIPULATION CHECK SCALES

Work flow description - Van de Ven & Ferry, 1980

A	B	C	D
Independent Work Flow – each group member independently contributes to the task without direct interaction with the other team members.	Sequential Work Flow – each group member has a different role and performs different parts of the task. Work and activities flow between team members but mostly in one direction.	Reciprocal Work Flow – each group member has a different role. However, over a period of time, work and activities flow back and forth between group members.	Team Work Flow – group members jointly diagnose, problem-solve, and collaborate at the same time to complete a task.
			

Task Interdependence Scale – Campion et al., 1993

1. I worked closely with others in doing my work.
2. I frequently coordinated my efforts with others.
3. My own performance was dependent on receiving accurate information or materials from others.
4. The way I performed my job had a significant impact on others.
5. My work required me to consult with others fairly frequently.
6. I could have not accomplished my tasks without information or materials from other members of my team.
7. Other members of my team depended on me for information or materials needed to perform their tasks.
8. Within the team, jobs performed by team members were related to one another.

Note. Scales measured on Likert-type scale: 1=Strongly disagree, 2=Disagree, 3=Neither agree nor disagree, 4=Agree, 5=Strongly agree.

APPENDIX P

PILOT STUDIES

Measures of Task- and Team-related KSAs

Pilot data on the task- and team-related KSA measures were used to obtain preliminary information on the measures such as characteristics of score distributions and possible performance differences on the measures due to gender. The pilot of measures also provided information about the clarity of test instructions, adequacy of times allotted to the dexterity exercises, and served as a training setting for two researcher assistants who will help in the main study. Undergraduate students from the same population as those participating in the main study were administered the task- and team-related KSA measures and received research credit for participating in the pilot of the study.

Inspection Test and Dexterity Exercises

Twenty-eight participants (11 male and 17 female) performed the Inspection test from the Flanagan's Industrial Tests battery and the manual dexterity exercises. Although this is a small sample for inferential statistical analysis, descriptive statistics were computed for male and female groups on the different exercises.

Correct responses on the Inspection test were slightly higher for males than for females (M = 17.7, SD = 5.5 and M = 16.7, SD = 3.8, respectively), but wrong answers was about the same for both groups (M = 1.9, SD = 2.5 and M =1.8, SD = 2.4, respectively). Across groups, the mean of correct responses was higher than the one presented in the examiner's manual (M = 17.1, SD = 4.8 and M = 12.6, SD = 5.5, respectively). Nevertheless, it is important to take into account the different sample sizes when considering these values (N = 28 in the pilot sample and N = 490 in the manual; Flanagan, 1975).

Over two trials, on average females inserted more pegs onto the pegboard with the dominant hand than did males (M = 29.9, SD = 3.4 and M = 25.9, SD = 3.0, respectively). However, with the non-dominant hand both groups inserted about the same number of pegs onto the pegboard (M = 25.0, SD = 2.6, for males and M = 24.9, SD = 2.5, for females). Average time to complete five units in the manipulation exercise was higher for male than female groups (*M* = 2 min 5 s, *SD* = 25 s and *M* = 1 min 44 s, *SD* = 33 s, respectively).

Teamwork KSA Test

A total of 93 (35 male and 57 female) participants answered the Teamwork KSA test in mixed sex sessions of 5-10 people. Even though 42% of them reported some type of supervisory experience, only 16% indicated that they were holding middle management or entry-level manager positions at the time of the study. Preliminary analysis of the Teamwork KSAs data indicated lower internal consistency reliability (α = .52) than reported in the examiner's manual (i.e., α = .80; Stevens & Campion, 1998). Results also suggested there were no mean score differences between male and female groups (*M* = 23.7, *SD* = 3.6, t (88) = .785, *n.s.*). Across groups, the mean and standard deviation for the total score on the Teamwork KSAs instrument approach that presented in the examiner's manual (*M* = 23.7, *SD* = 3.6, *N* = 91 in the pilot sample and *M* = 22.4, *SD* = 5.3, N = 388 in the manual; Stevens & Campion, 1998).

Production Task

In order to ascertain the efficacy of the task type manipulation and possible context effects (e.g., practice effects), six groups of four participants performed the Circuit Board Assembly Task ©. Participants received general training on how to assemble a circuit board and after the individual training, they worked on the task as a group. There were two sets of instructions for the group work: sequential and reciprocal (Appendix Q). Three groups worked first on the sequential format, followed by the reciprocal format, and format order was reversed for the other three groups. This was necessary because the main study will has a within-subjects components and it was important to observe whether or not the order in which the instructions were given affected groups' interactions and outcomes.

In the sequential condition, the researcher explained how the sequential process unfolded. Then, participants were randomly assigned specific roles and worked independently as they assembled Circuit Boards. After five minutes of practice working together, the group had 15 minutes to produce as many circuit boards as possible. Following the 15 minutes, participants were asked to fill out a questionnaire about their experience carrying out the task in the sequential format (Appendix R).

Similarly, in the reciprocal instructions, the researcher explained how the reciprocal process worked. Participants were randomly assigned specific roles, but they were also required to coordinate their activities. Likewise, after five minutes of practice working together, the group had 15 minutes to produce as many circuit boards as possible. Then, participants were asked to fill out a questionnaire about their experience carrying out the task in the reciprocal format and some background information.

Participants' responses about their experiences carrying out the task suggested that verbal and written instructions were clear, time for individual and group practice was sufficient, report forms and schematics were easy to use, and the general training was useful. In addition, the task was considered enjoyable and interesting. The answers also indicated that although it was difficult not to use on the second production round what had been learned about the task on the first round, the two production processes were very different. In fact, participants were able to differentiate between the sequential and reciprocal work processes. The sequential condition was described as one in which the group had low levels of interdependence by 91% of participants, and 74% of them described the reciprocal condition as one where moderate to high levels of group interdependence were present.

Groups that participated in the pilot of the task were also videotaped. This was necessary because the researcher needed to ensure that the groups were able to distinguish the two sets of task instructions and that the degree of task interdependence under the two sets of instructions could be differentiated. Five graduate students who were blind to the purpose of the study watched the videotapes. They were instructed to carefully observe group members' exchanges of materials and information and rate the group's work flow as independent, sequential, reciprocal, or team.

Out of 30 ratings for the groups performing the task under the sequential set of instructions, 28 characterized the work flow as a sequential. That is, group members had different roles and performed different parts of the task while work and activities flowed mostly in one direction. For the reciprocal set of instructions, out of 30 ratings, 20 reflected a reciprocal work flow and 10 a team work flow. Thus, under the reciprocal set of instructions, the work flow was primarily perceived as one in which group members had specific roles but activities flowed back and forth between members or one in which group members jointly collaborated to complete the task. These ratings, combined with participants' responses evaluating the task, suggest that the two sets of instructions for the experimental task are indeed different and reflect conditions of less (i.e., the sequential work flow) and more (i.e., the reciprocal work flow) task interdependence.

APPENDIX Q

INSTRUCTIONS FOR THE GROUP WORK

- Sequential Production Run Instructions

If this is the first production run…

"Please have a seat. It does not matter where – any of the four tables is fine. You will be working as a group but each of you has a very specific role to perform during the 20 minute production run. You know which of the four roles you will perform by the sign on your work station. These are set-up, lighting, quality control, and rework. It is VERY IMPORTANT that you follow your job description."

If this is the second production run…

"Please have a seat at a station different from the one you worked before. You will be working as a group but each of you has a very specific role to perform during the 20 minute production run. This time your stations and roles will be different from the previous production run. You know which of the four roles you will perform by the sign on your work station. These are set-up, lighting, quality control, and rework. It is VERY IMPORTANT that you follow your job description."

- Guide participants to the sequential assembly room.
- Give them time to get settled.

" And this is how the work should flow."

- Use picture on flip-char to explain the work flow
- Also, point to the various trays on the table as you explain where things go.

"The process begins here at the Set-Up station. Then the product is sent to Lighting. Once lighting is done, you have a complete circuit board. The complete board is sent to Quality Control to be checked. If the board meets the quality standards, it moves to Shipping. If the board fails, it goes to Rework to be repaired. Once rework repairs it, it goes back to Quality Control for another check. Ultimately, Shipping sends our quality product to the customers."

"Do you have any questions at this point?"
"We have two quality standards:
1) The buzzers must buzz.
2) The lights must light – both the red and the green."

"When you finish your part in the assembly of the circuit board, place the work in progress only on the designated trays. If you need more materials, raise your hand and I will bring them to you. It is very important that you follow the production process as it was designed by the engineers. That is, set-up, then lighting, quality control, rework if the board fails, shipping if the board meets standards, and back to quality control after rework."

“Let me distribute your job descriptions, instructions for your role in assembling the circuit board, schematics, and necessary tracking forms.”

- Go from station to station distributing the appropriate forms:
- Quality Control – job description, tracking form, and full schematic.
- Rework – job description, tracking form, troubleshooting guide, and full schematic
- Set-Up – job description and tracking form
- Lighting – job description and tracking form
- Remember to review the materials handling information sheet to prevent the distribution of wrong materials to the various stations.

“You have 5 minutes to review your job descriptions. If you have any questions about your forms, please ask me before the group begins its work.”

- Give participants time to review the various forms.

“The group will have 5 minutes for practice and 20 minutes for the first/second Production Run. Do you remember what our quality standards are? (Buzzers buzz, lights light). Okay, during the practice run you do not need to use the tracking forms. I will time your 3 minute practice.”

- Allow 5 minutes for practice.

“Okay, time is up. Please clear your trays of any work in progress. Okay. You have 20 minutes.

Good luck!”

- Allow 20 minutes of work

“Okay, time is up. Please place all your tracking forms in this envelope.”

“Before you move to the next work station, please fill out this questionnaire. Once you have finished answering the questionnaire, please disassemble all work-in-progress that is left in your station and all the circuit boards completed by your group.”

- Take the participants to the next station as soon as all members of the group finish disassembling the boards.

OR if this is the second production run…

“Please fill out this questionnaire. Once you have finished answering the questionnaire, please disassemble all work-in-progress that is left in your station and all the circuit boards completed by your group.”

- Give participants time to answer the questionnaire and disassemble the boards.
- Debrief participants.

- Reciprocal Production Run Instructions

If this is the first production run…

“Please have a seat. It does not matter where – any of the four chairs is fine. Three of you will perform the task and the fourth group member will support the group’s activities.”

If this is the second production run…

““Please have a seat at a station different from the one you worked before. This time your stations and roles will be different from the previous production run.”

“ This is how the work should flow.”

- Use picture on flip-char to explain the work flow (see next page)
- Also, point to the various trays on the table as you explain where things go.

“The process begins with setting-up the buzzer on the circuit board. From **Set-Up**, the board goes through its first phase of quality control: it goes to the tray labeled *Set-up Quality Control tray*. If the buzz works, the board moves to the next production step, **Lighting**, or the board is placed on the *Lighting tray*. If the buzz does not work, the board goes back to set-up: it is placed on the *Set-up Rework tray*. Once the problem with the board is corrected, it goes through the quality check again.”

“When the product is sent to Lighting, lights are added and the circuit board is complete. Then, the complete board is sent to the second phase of quality control. The board is placed on the *Lighting Quality Control tray*. If the lights light, the board meets the quality standards and it is moved to **Shipping**. If the lights do not light, the board goes back to Lighting: it is placed on the *Lighting Rework tray*. Once the board is repaired, it goes through quality control one more time.”

“The fourth member of the group will be responsible for keeping the group informed about its productivity every few minutes, and for helping the other group members as needed. Ultimately, Shipping sends our quality product to the customers.”

“Do you have any questions at this point?”
“We have two quality standards:
1) The buzzers must buzz.
2) The lights must light – both the red and the green.”

“When you finish your part in the assembly of the circuit board, place the work in progress only on the designated trays. It is very important that you follow the production process as it was designed by the engineers. That is set-up, then quality control, rework if the board fails, lighting if the board is okay. Then, quality control again, rework if the lights fail, and shipping if the board meets standards.”
“Let me distribute your job descriptions, instructions for your role in assembling the circuit board, schematics, and tracking forms.”

- Go around the table distributing the appropriate forms:
- Circuit Board Operator – job description (quality control), full schematic, and troubleshooting guide.
- Circuit Board Operator – job description (inventory), tracking forms, full schematic
- Circuit Board Operator – job description (set-up) and troubleshooting guide
- Circuit Board Operator – job description (lighting) and troubleshooting guide

“You have 5 minutes to review your job descriptions and discuss the production process amongst yourselves. If you have any questions about your forms, please ask me before the group begins its work.”

- Give time for participants to review the various forms.

“The group will have 3 minutes for practice and 20 minutes for the first/second Production Run. Do you remember what our quality standards are? (Buzzers buzz, lights light). Okay, during the practice run you do not need to use the tracking forms. I will time your 3 minute practice.”

- Allow 3 minutes for practice.

"Okay, time is up. Please clear your trays of any work in progress. Okay. You have 20 minutes. Good luck!"

- Allow 20 minutes of work

"Okay, time is up. Please place all your tracking forms in this envelope."

"Before you move to the next work station, please fill out this questionnaire. Once you have finished answering the questionnaire, please disassemble all work-in-progress that is left in your station and all the circuit boards completed by your group."

- Take the participants to the next station as soon as all members of the group finish disassembling the boards.

  OR if this is the second production run…

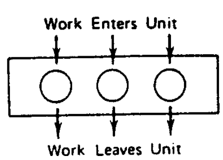
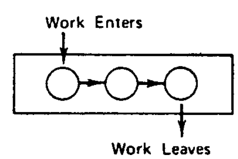
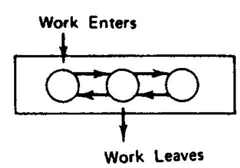
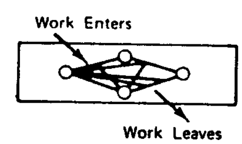
"Please fill out this questionnaire. Once you have finished answering the questionnaire, please disassemble all work-in-progress that is left in your station and all the circuit boards completed by your group."

- Give participants time to answer the questionnaire and disassemble the boards.
- Debrief participants.

APPENDIX R

QUESTIONNAIRE USED DURING THE PILOT STUDY TO EVALUATE THE CIRCUIT BOARD ASSEMBLY TASK ©

Teams can work together in a variety of ways. Some teams rely on input and information from all team members at every stage of the task. Other teams complete their tasks separately and then combine these into a larger team task. These different ways of completing a team task are referred to as a team's work flow. For the Circuit Board Assembly Task © you have just completed, how would describe your team's work flow? Please choose one of the following four options.

A	B	C	D
Independent Work Flow – each group member independently contributes to the task without direct interaction with the other team members. 	Sequential Work Flow – each group member has a different role and performs different parts of the task. Work and activities flow between team members but mostly in one direction. 	Reciprocal Work Flow – each group member has a different role. However, over a period of time, work and activities flow back and forth between group members. 	Team Work Flow – group members jointly diagnose, problem-solve, and collaborate at the same time to complete a task. 

This section asks questions about your assessment of your own contribution while **working on the task you have just completed**. Read each question carefully and indicate how much you agree with each statement using the following scale:

1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree

9. I worked closely with others in doing my work.
10. I frequently coordinated my efforts with others.
11. My own performance was dependent on receiving accurate information or materials from others.
12. The way I performed my job had a significant impact on others.
13. My work required me to consult with others fairly frequently.
14. I could have not accomplished my tasks without information or materials from other members of my team.
15. Other members of my team depended on me for information or materials needed to perform their tasks.
16. Within the team, jobs performed by team members were related to one another.

This section asks questions about your evaluation of various components of the task you just performed. Please indicate how much you agree with each statement using the following scale:
1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree

1. The verbal instructions about the production process were easy to understand.
2. The written instructions about the production process were easy to understand.
3. Five minutes were sufficient for the group to become comfortable with the production process.
4. The work stations and trays were clearly marked.
5. After reading the job description, I had a clear understanding of what I was supposed to do.
6. The report forms were easy to understand.

The following questions refer to your assessment of the Circuit Board Assembly Task ©. Thinking about the entire experimental session you have just gone through, use the scale below to respond to the statements.
1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree

1. It was difficult to assemble the Circuit Board.
2. Any undergraduate student can assemble the Circuit Board.
3. The schematics and written instructions were easy to understand.
4. I had difficulties meeting the time constraints of the Circuit Board Assembly Task ©.
5. It was easy to know whether I did my work correctly.
6. The training at the beginning of the session was useful.
7. It was difficult not to use on the second round what I had learned about the task on the first one.
8. The two production rounds are very different.
9. I enjoyed the Circuit Board Assembly Task ©.
10. The Circuit Board Assembly Task © is interesting.
11. During an experiment, I would rather assemble Circuit Boards than answer questionnaires.
12. I believe that my group members enjoyed the Circuit Board task.
13. I think that the Circuit Board Assembly Task © is appropriate to observe team interactions.

APPENDIX S

DEXTERITY EXERCISES - INSTRUCTIONS

- **Pegboard Exercise**

"You will perform two dexterity exercises: the pegboard exercise and the manipulation exercise. First, you will complete the pegboard exercise.

- Distribute cloths and other materials.
- Before giving out instructions for the Pegboard Exercise, make sure that all participants are comfortably seated, no personal belongings are present on their tables, and all participants have the necessary materials for the exercise (i.e., peg board, box with pegs, pen or pencil, and record form).

"Please… cover the table with the cloth, place the pegboard in front of you, and the box with the pegs on the left side of the board. If you are left-handed, place the box on the right side of the board."

"You will need a pen or pencil and the record form at a later time to record your own scores. For the time being, you can leave the form and the pen on the floor or on the table. If you leave them on the table, just make sure that they are not on the way."

- Check to see that participants have all the materials needed for the exercise.

"This exercise was designed to assess how quickly you can work with your hands. You will be scoring your own performance. Thus, I ask you to be conscientious as you record your scores because these results impact future phases of this study. "

"You will perform four rounds of this exercise. Your goal is to place as many pegs onto the board as possible in a time limit of 1minute. First, you will start placing the pegs at the upper left corner of the board and move along the row to the right. After you complete the first row, start again at the left side of the second row moving to the right. Keep moving down the rows from left to right until time is up. If you are left-handed, start from the upper right corner of the board and move along the row to the left.

"A few details: you can only use one hand, you can only pick one peg at a time, and you cannot switch hands once you start working. I am going to give you a few minutes for practice. Please start placing the pegs from the upper left corner (or from the right one if you are left-handed). Try to work as quickly as you can."

- Give about 1 minute for practice.
-

"Now, remove all the pegs from the board and place them back in the boxes."

- Give time for participants to remove all pegs from the board and place them in the boxes.

"When I say "Start!", place as many pegs on the board, always moving from left to right (those who are left handed will move from the right). Remember that you can only use one hand, pick only one peg at a time, and cannot switch hands. You will have1 minute to place as many pegs as you can on the board. Any questions?"

- Respond to questions if there is any.
- Check to see if everyone is ready.

"Are you ready? Start!"
- Wait 1 minute then…

"Stop! Now, count how many pegs you have placed on the board. There are ten pegs in each full row. That should help you count. Record your score in the record form, and after you have recorded your score, return the pegs to their box."
- Check that everyone has the pegs back in the boxes.

"You will perform this exercise one more time. When I say "Start!", place as many pegs on the board, always moving from left to right (those who are left-handed will move from the right). Remember that you can only use one hand, pick only one peg at a time, and cannot switch hands. Again, you will have1 minute to place as many pegs as you can on the board."
- Check to see if everyone is ready.

"Are you ready? Start!"
- Wait 1 minute then…

"Stop! Now, count how many pegs you have placed on the board and record your score in the record form. After you have recorded your score, return the pegs to their box."

"You will perform the exercise again, but the instructions are going to change. If you were using the right hand before, from now on you are going to use the left one, and if you were using the left hand, from now on you will use the right one. You still have the same goal: place as many pegs onto the board as possible in a time limit of 1 minute."

"First, switch the box with the pegs to the opposite side of the board. You will start placing the pegs at the upper right corner of the board and move along the row to the left. After you complete the first row, start again at the right side of the second row moving to the left. Keep moving down the rows from right to left until time is up, using your left hand. If you are left-handed, start from the upper left corner of the board and move along the row to the right using your right hand. Again, you can only use one hand, you can only pick one peg at a time, and you cannot switch hands once you start working."

"I am going to give you a few minutes for practice. Please start placing the pegs from the upper left corner (or from the right one if you are left-handed). Try to work as quickly as you can."
- Give about 1 minute for practice.

"Now, remove all the pegs from the board and place them back in the box."
- Give time for participants to remove all pegs from the board and place them in the box.

"When I say "Start", place as many pegs on the board, always moving from right to left (those who are left handed will move from the left). Remember that you can only use one hand, pick only one peg at a time, and cannot switch hands. You will have1 minute to place as many pegs as you can on the board. Any questions?"
- Respond to questions if there is any.
- Check to see if everyone is ready.

"Are you ready? Start!"

- Wait 1 minute then…

"Stop! Now, count how many pegs you have placed on the board. There are ten pegs in each full row. That should help you count. Record your score in the record form."

"After you have recorded your score, return the pegs to their box."
- Check that everyone has the pegs back in the boxes.

"You will perform this exercise one more time. When I say start, place as many pegs on the board, always moving from right to left (those who are left-handed will move from the left). Remember that you can only use one hand, pick only one peg at a time, and cannot switch hands. Again, you will have 1 minute to place as many pegs as you can on the board."
- Check to see if everyone is ready.

"Are you ready? Start!"
- Wait 1minute then…

"Stop! Now, count how many pegs you have placed on the board and record your score in the record form."

"After you have recorded your score, please place the pegs back in their boxes and return them to me."

- **Manipulation Exercise**

"Now you are going to perform the second dexterity exercise: The manipulation exercise. This exercise was designed to assess how quickly you can manipulate small screws without the assistance of tools."

"In these bags, you will find magnetic clasps and two boxes with fasteners. Please cover the table with the cloth, place the clasps and the two boxes with fasteners in front of you like this:"
- Show the diagram and make sure all tables are properly set.

"Now, carefully pour the content of the boxed onto their lids. Still, maintain the materials in the same order you had before."
- Make sure that all tables are properly set.

"Your job is to fasten two screws on each clasp. Please come closer as I demonstrate how you are going to fasten the screws."
- Wait until everyone is close to you.

"You will hold the clasp with one hand, placing your thumb on the upper part of the clasp and the other fingers at the bottom. Then, you will insert a screw from the bottom up and place the fastener onto it from the top all the way to the bottom. You do not need to tighten the fastener, but it needs to go all the way to the bottom. Like this…"
- Demonstrate.

"Once you finish one side, go to the next. Again, insert a screw from the bottom up and place the fastener onto it from the top. Like this…"
- Demonstrate.

"Please go back to your seats and practice for a few minutes. For this exercise, you can choose which hand you will use to hold the clasp."

- Give about 2 minutes for practice.

"In the next two rounds, you will work as quickly as you can to complete 5 units. Your neighbor will record how long you took to complete the 5 units. When your neighbor says "Go!" you should start working as quickly as you can to complete 5 units. For these two rounds, you can also choose which hand you will use to hold the clasp."

"Once you have finished, your neighbor will record how much time you took to complete the 5 units in your record form. Then, you will start 5 more units. Again, your neighbor will record how long you take to complete the 5 units. Keep in mind that people will finish at different times. However, it is very important that the time is recorded accurately and that you keep quite so others can finish their work."

"I will let you know when everyone finishes. Then, it will be time for the ones who were timing the performance to complete their 5 units. Any questions?"

- Respond to questions if there is any.
- Distribute stop watches.
- Let participants be comfortable with the timers.

"Are you ready? You can start."

- Wait until all participants have finished.

"Please disassemble the units and place all the parts in their original lids."

"Now it is time for the ones who were recording the time to complete their 5 units. Please hand the stop watch to your neighbor and get ready."

"In the next two rounds, you will work as quickly as you can to complete 5 units. Your neighbor will record how long you took to complete the 5 units. When your neighbor says "Go!" you should start working as quickly as you can to complete 5 units. For these two rounds, you can also choose which hand you will use to hold the clasp."

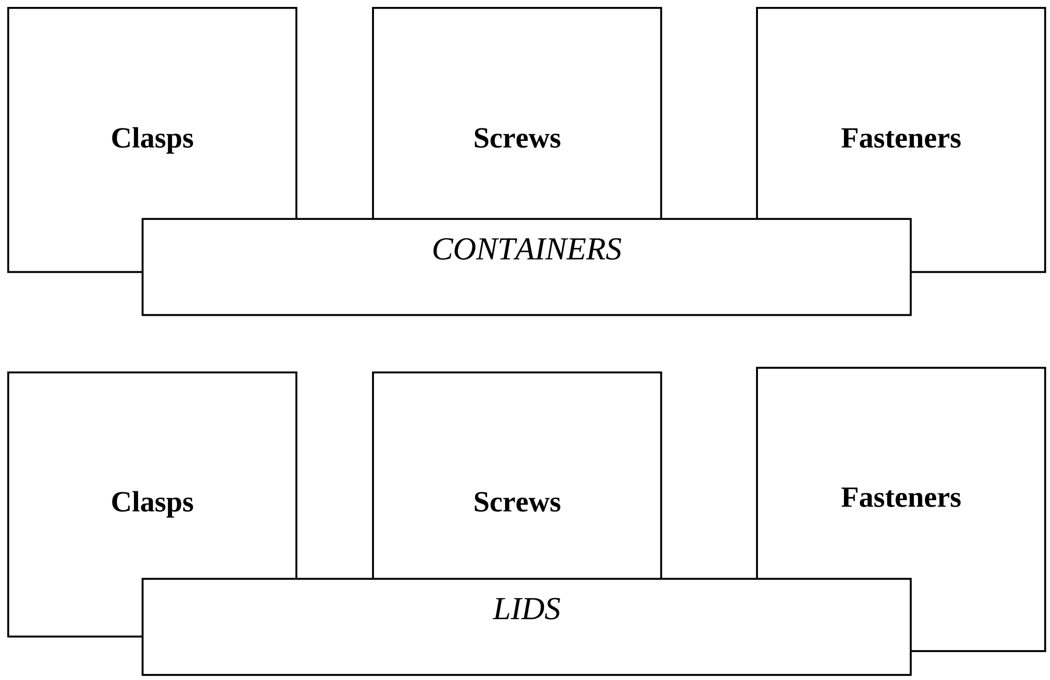
"Once you have finished, your neighbor will record how much time you took to complete the 5 units in your record form. Then, you will start 5 more units. Again, your neighbor will record how long you take to complete the 5 units. Keep in mind that people will finish at different times. However, it is very important that the time is recorded accurately and that you keep quite so others can finish their work."

"Are you ready? You can start."

- Wait until all participants have finished.

"Please disassemble the units and place all the parts in their original lids."

- **Manipulation Exercise – Instructions for positioning exercise materials**



Dexterity Assessment – Record Form

Pegboard Exercise

- Dominant Hand
  First round - ______________ pegs
  Second round - ____________ pegs

- Non-dominant Hand
  First round - ______________ pegs
  Second round - ____________ pegs

Manipulation Exercise

- Time to complete 5 units
  First round - _____minutes and ______seconds
  Second round - _____minutes and ______seconds

APPENDIX T

BACKGROUND QUESTIONNAIRE

While your confidentiality will be maintained, it is important for us to obtain some general background information on the participants of this activity. Please check or write the appropriate response to the following questions.

- Age: ___________
- Gender: □ Male □ Female
- Race: □ White/Non-Hispanic □ African American □ Hispanic □ Asian American
  □ Other________________________
- Major: ___________________________________ (If undecided, please indicate so)
- Class standing: □ freshman □ sophomore □ junior □ senior
- SAT: ___________Verbal ___________Math
- Overall Grade Point Average: _____________
- Work status: □ Work full time (30+ hours/week) □ Work part-time □ Do not work
- Do you have supervisory experience? □ Yes □ No
- Have you ever worked in a team project or worked in a group before? □ Yes □ No
- Have you ever worked in a manufacturing/production environment? □ Yes □ No
    - If your answer was yes, for how long?
      ____
    - What kind (s) of product(s) did you work with?
      ____
- Do you have any hobbies that require the use of your hands and fingers (e.g., fishing, embroidering, knitting, building car or airplane miniatures, etc.)? □ Yes □ No
- Do you have any experience assembling small devices (e.g., radio, watches, jewelry)? □ Yes □ No
    - If your answer was yes, please explain what kind of devices.
      ____