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The Effects of Team-Member Attributes on Team Performance: a Model of Individual Contribution to Team Performance.

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THE EFFECTS OF TEAM-MEMBER ATTRIBUTES ON TEAM PERFORMANCE:
A MODEL OF INDIVIDUAL CONTRIBUTION TO TEAM PERFORMANCE

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Psychology

by

Joe J. Yum
B. B. A., University of Hawaii at Manoa, 1992
M. A., Louisiana State University, 1997
August, 1999

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DEDICATION

The values that my parents have instilled in me have guided me in all of my endeavors, including this one. My mother, Hwa Kang Yum, has taught me the importance of patience and kindness. Through her love and support, she has made me feel like I could accomplish anything. My father, Jeewon Yum, has taught me the value of hard work. He showed me that anything is possible with hard work and dedication. For blessing me with their love and illuminating me with their wisdom, I humbly dedicate this dissertation to my mother and father.
ACKNOWLEDGMENTS

This dissertation would not have been possible without the support of various individuals. First and foremost, I would like to thank my advisor, Dr. Timothy Buckley. He has been a constant source of encouragement and support throughout this project. He has stood by me through some tough times, and I can’t even begin to thank him in words how much I appreciate all that he has done for me. I would also like to thank my committee members, Dr. Gary Greguras, Dr. Irving Lane, Dr. Brian Bornstein, and Dr. Betsy Garrison for their valuable advice. I especially thank Dr. Gary Greguras for reviewing various drafts of my dissertation and for giving me encouragement and advice throughout this project. In addition, I would like to thank Dr. Trey Maxham for listening to my lofty ideas and for helping me with various technical issues on structural equation modeling. He has been a true friend not only during this process but throughout my graduate school career. I would also like to thank Rick Carter of New Orleans Civil Service for playing an instrumental role in helping me obtain the data for this study. He has served as a liaison between myself and the New Orleans Fire Department and his knowledge of the employee selection process and the organization of the fire department has contributed tremendously to the success of this project. Furthermore, this project would not have been possible without the support of Chief Terry Tullier and Walter Dupeire of the New Orleans Fire Department. I would like to thank them for their support of this project and all of their efforts to coordinate with others in the department to make this project run smoothly as possible. In addition, I would like to thank Paula Adams, Scott Braud, Matthew Guidry, Michelle Hawthorne, Jennifer Kaufman, Jim
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ABSTRACT

Although team composition is one of the most frequently studied topics in team research, much remains unknown regarding what attributes to look for when selecting team-members and how these attributes affect team performance. The purpose of this study was to present and to test a theoretical model that depicts how individual attributes affect team-member performance and how team-member performance ultimately affects team performance. The proposed model is based on the integration of research on team and individual performance. From a practical standpoint, understanding the relationships among the variables in the proposed model may be important for the selection of employees in team-based organizations.

In general, the results did not support the proposed model. However, further examination of the data showed that task knowledge and skills is a separate construct from teamwork knowledge and skills, task motivation is a separate construct from teamwork motivation, and task experience is a separate construct from teamwork experience. One implication of these findings is that assessing knowledge, skills, motivation, and experience for several appropriate job performance dimensions may be useful for selecting employees who may perform well on their job specific tasks and work well with others in a team environment.

Furthermore, the data suggest that the use of peer ratings in a team setting may be problematic due to the close personal relationships among team-members. These results seem to be consistent with various studies that found that ratings in a team setting may be affected by contextual factors (e.g., Grey & Kipnis, 1976; Liden & Mitchell, 1983;
Mitchell & Liden, 1982). In addition, the problems encountered with peer ratings seem to have been magnified by the political context of the organization examined in the present study. Implications of these results are discussed.
INTRODUCTION

Utilization of work teams has become a popular trend in a variety of organizations (Bassi, Benson, & Cheney, 1996; Kristof-Brown, & Stevens, 1996; Rentsch, Heffner, & Duffy, 1994). As team-based organizations become more prevalent, it is important to understand how to select team-members (Borman, Hanson, & Hedge, 1997). Toward this end, researchers (e.g., Barry, & Stewart, 1997; Hogan, Raza, & Driskell, 1988; LePine, Hollenbeck, Ilgen, & Hedlund, 1997; Thoms, Moore, & Scott, 1996) have identified various individual attributes (e.g., Conscientiousness and Extraversion) that may be important for team performance. However, much remains unknown regarding what attributes to look for when selecting team-members, and how these attributes affect team performance (Borman et al., 1997; Landy, Shankster, & Kohler, 1994). The purpose of this study is to present and to test a theoretical model that depicts how individual attributes affect team-member performance, and how team-member performance ultimately affects team performance.

First, definitional issues regarding work team and team performance will be addressed. Second, existing models of team performance will be reviewed and critiqued. Third, a model depicting the relationships between various individual attributes and team performance will be proposed. Finally, support for the proposed model will be established.
LITERATURE REVIEW

Definitional Issues

Work Team. Borman et al. (1997) defined a work team as two or more individuals with a common goal, who work interdependently on specific tasks. Similarly, Brannick and Prince (1997) defined a work team as two or more individuals with different tasks, who work together to accomplish common goals. These researchers also emphasized coordination as the common element in work teams. Guzzo and Dickson (1996) defined a work team as individuals who are recognized as a social entity, who work interdependently on common tasks, who are embedded in a larger social system, and who perform tasks that are important to others.

Adopting the major elements of the definitions given above, a work team can be described as: 1) two or more individuals who are aware that they are a social entity, 2) embedded in a larger social system (e.g., the organization), 3) coordinating activities on differentiated tasks, 4) working toward common goals, and 5) conducting work that has an impact on people external to the team.

Team Performance. In general, team performance has been defined in terms of process criteria or outcome criteria (Miller, Burke, & Glick, 1996). Process criteria refer to the procedures that a team uses to meet its goals. Specifically, Nieva, Fleishman, and Rieck (1978) defined team performance as goal directed behaviors of the team in performing the team task. Fleishman and Zaccaro (1992) developed a taxonomy of team performance functions (see Appendix A). The performance dimensions in this taxonomy include: 1) orientation functions, 2) resource distribution functions, 3) timing or activity
pacing functions, 4) response coordination functions, 5) motivational functions, 6) system monitoring functions, and 7) procedural maintenance. McIntyre and Salas (1995) developed a team performance appraisal system with the following performance dimensions: 1) communication, 2) adaptability, 3) cooperation, 4) acceptance of suggestions or criticism, 5) giving suggestions, 6) team spirit and morale, and 7) coordination. Although there are some differences in the performance dimensions developed by these researchers, there is general agreement that communication, coordination, providing feedback, responding to feedback, and motivation are important team performance dimensions.

Outcome criteria refer to the extent to which a team is able to meet its goals. Specifically, Guzzo and Dickson (1996) defined team performance as outputs produced by the team, team-member consequences (i.e., team-member satisfaction, turnover, commitment, and trust), and/or the team’s ability to perform effectively in the future. Outcome measures have generally consisted of objective and subjective measures of team output, and team-member attitude questionnaires.

Existing Models of Team Performance

Several researchers have developed models to explain how various factors affect team performance (e.g., Cohen, Ledford, & Spretzer, 1996; Gladstein, 1984; Klimoski & Jones, 1995; Nieva et al., 1978). Although these models were not specifically developed to depict the relationships between team-member attributes and team performance, they do depict team-member attributes as one of several factors affecting team performance. In this section, a general description of these models will be given. In addition, specific
relationships between team-member attributes and team performance depicted in these models will be discussed.

Nieva et al. (1978) proposed a model of team performance that depicts the relationships among four antecedent conditions and team performance. According to their model, the relationship between external conditions imposed on the team and team performance is mediated by three variables: 1) member resources such as, knowledge, skills, abilities, and other team-member attributes; 2) team characteristics such as team size and cohesion; and 3) task characteristics and demands. Specific to individual attributes, this model suggests that the selection procedures and training programs adopted by the organization (i.e., external conditions imposed on the team) directly affect team-member KSAO’s (i.e., team-member attributes). In turn, these team-member attributes have a direct effect on team performance.

According to Gladstein’s (1984) model of group performance, input variables at the organizational and group level affect group effectiveness in two ways. First, these input variables have a direct effect on group effectiveness. Second, the relationship between input variables and group effectiveness is mediated by group process and moderated by the group task. Specific to individual attributes, this model depicts group member attributes such as, skills and tenure as having a direct effect on group effectiveness. In addition, group member attributes directly affect group processes such as, communication, supportiveness, conflict, weighing of individual inputs, and boundary management. In turn, group process directly affects group effectiveness. However, the
relationship between group process and group effectiveness is moderated by the group task.

Klimoski and Jones (1995) adapted a group performance model developed by Hackman (1987). Klimoski and Jones’s model depicts input variables as having an indirect effect on group outcomes through group process variables. In addition, environmental demands and resources have direct effects on input, process, and outcome variables. Specific to individual attributes, this model depicts individual differences in KSAO’s as having a direct effect on process variables such as, use of skills, strategies, effort level and coordination, potency, and compatibility. In turn, these process variables have a direct effect on team outcomes. In addition, environmental demands and resources have direct and indirect effects on group member attributes, group processes, and group outcomes.

Cohen et al. (1996) described a model of team effectiveness with four predictor and four outcome variables. Predictors include team task design, encouraging supervisory behaviors, team characteristics, and employee involvement context. Outcome variables are employee ratings of performance, managerial ratings of performance, quality of work life, and withdrawal behaviors. Specific to individual attributes, this model depicts knowledge and skills of the team-members as having a direct effect on effectiveness outcomes. An empirical test of the model showed that team-member attributes were significantly related to employee rating of performance and quality of work life (Cohen et al., 1996).
In general, the existing models of team performance show that team-member attributes are important for team performance. However, the relationships depicted in these models are not particularly useful for selecting team-members. First, none of the models reviewed here show which individual attributes are important for team performance. These models simply show that appropriate KSAO's are important for team performance. Second, there is a relatively weak conceptualization of how individual attributes affect team performance in some of the models. For example, Cohen et al.'s (1996) model shows that team-member attributes have an effect on effectiveness outcomes. However, it does not explain how these attributes affect team effectiveness. Third, the relationships depicted in these models are somewhat contradictory. For example, Nieva et al.'s (1978) model shows a direct relationship between team-member attributes and team performance while Klimoski and Jones's (1995) model shows that the relationship between team-member attributes and team performance is moderated by process variables.

Model of Individual Contribution to Team Performance

The model proposed in this paper builds upon the general idea of the existing team performance models that team-member attributes affect team performance. However, the proposed model differs from these models in an important way. Instead of depicting an all-encompassing model of team performance, the proposed model specifically focuses on how team-member attributes affect team performance. Due to the lack of specificity and inconsistencies regarding the relationships between individual attributes and team performance in the team performance models, the proposed model
will be largely based on models of individual performance (e.g., Borman, White, Pulakos, & Oppler, 1991; Hunter, 1983; McCloy et al., 1994).

According to the proposed model, individual performance components that significantly contribute to team performance are, task performance and teamwork performance. Each performance component is directly affected by the interaction between knowledge and skills, and motivation. Specifically, the relationship between task knowledge and skills (task-KS) and task performance is moderated by task motivation. Similarly, the relationship between teamwork knowledge and skills (teamwork-KS) and teamwork performance is moderated by teamwork motivation. The proposed model also depicts various indirect determinants of performance. First, task experience affects task performance through task-KS. Second, cognitive ability affects task and teamwork performance through task-KS and teamwork-KS respectively. Third, Conscientiousness affects task and teamwork performance through task and teamwork motivation respectively. Fourth, teamwork experience affects teamwork performance through teamwork-KS. Fifth, Extraversion affects teamwork performance through teamwork motivation. Finally, Agreeableness affects teamwork performance through teamwork motivation (see Figure 1). In the following sections, detailed explanation of the relationships depicted in the proposed model will be given and research supporting these relationships will be discussed.

**Individual Task and Teamwork Performance as Determinants of Team Performance.**

According to Porras and Robertson (1992), organizational performance is dependent upon the behavior of individuals within the organization. Applying this
argument to the team level, team performance is dependent upon the individual behavior or performance of team-members. In this section, components of individual performance that may be important for team performance will be identified.

Figure 1

Model of Individual Contribution to Team Performance
Researchers have provided various conceptualizations of individual performance (e.g., Campbell, McCloy, Oppler, & Sager, 1993; Dubois, Sackett, Zedeck, & Fogli, 1993; Motowidlo & Van Scotter, 1994). The prevalent view is that job performance consists of multiple performance components (Borman et al., 1997). Consistent with this view, Stout, Salas, and Carson, (1994) named two components of individual performance that are especially important for team performance: task proficiency and team process behavior. The present paper will refer to these performance components as task performance and teamwork performance.

According to Campbell et al. (1993), job-specific task proficiency (i.e., task performance) is the individual’s performance of specific tasks that are central to the job. This component of job performance consists of behaviors that are specific to the core technical aspects of the job. For example, task performance of a gunner in a tank crew may consist of an individual’s proficiency in acquiring appropriate targets, accurately engaging them, and destroying these targets in a timely manner. Whether one works individually or as part of a team, task performance is essential for all jobs. Therefore, the level of team-member task performance should contribute significantly to team performance.

However, team performance is not a simple aggregation of individual performance, but it is also determined by the synchronized actions of individuals within the team (e.g., Fleishman & Zaccaro, 1992; LePine et al., 1997). For example, high levels of team-member task performance may have little or no effect on team performance if the
actions of the team-members are not properly synchronized or coordinated with the actions of others.

In support of the argument that synchronization of individual behavior is important for team performance, researchers (e.g., Barry & Stewart, 1997; Driskell & Salas, 1992; Stout et al., 1994) have found that effective group process behaviors have a positive effect on team performance. McClough and Rogelberg (1998) referred to this class of behaviors as teamwork performance.

Teamwork performance is the individual's performance in coordinating their activities with other team-members (Fleishman & Zaccaro, 1992). For example, teamwork performance of a gunner in a tank crew may consist of coordinating with the driver so that the tank is located in the optimal place to acquire and engage targets and communicating with the loader so that the correct projectile is loaded for the appropriate target. Campbell et al. (1993) argued that this particular component of job performance has no relevance to individuals who work alone. However, it is an important component of job performance for individuals working in teams.

To date, only one empirical study has examined the effects of both individual task and teamwork performance on team performance. Stout et al. (1994) examined how these two individual performance components affect team performance in a flight simulation task. The team consisted of two members: pilot and copilot. Task performance was operationalized as the pilot's proficiency in operating the joy stick (i.e., flying the simulator) and the copilot's proficiency in operating the keyboard (i.e., destroying...
targets). Teamwork performance was operationalized as important process behaviors such as coordination, planning, providing feedback, asking for input, and helping other team-member. Results of this study showed that both task and teamwork performance of individual team-members have significant effects on team performance (i.e., total number of targets destroyed by the team).

As reviewed in this section, theoretical arguments and empirical evidence show that both task and teamwork performance of individual team-members should have significantly positive effects on team performance. Therefore,

**Hypothesis 1**: Task and teamwork performance of individual team-members will be positively related to team performance.

**Knowledge and Skills, and Motivation as Direct Determinants of Performance**

In the proposed model, task-KS and task motivation are depicted as direct determinants of task performance, and teamwork-KS and teamwork motivation are depicted as direct determinants of teamwork performance. All other individual attributes are depicted as indirect determinants of the two performance components. These relationships are consistent with Campbell et al.'s (1993) theory of performance and various models of individual performance (e.g., Borman, et al., 1991; Hunter, 1983; McCloy et al., 1994).

According to Campbell and his colleagues (i.e., Campbell et al., 1993; Campbell, Gasser, & Oswald, 1996; McCloy, Campbell, & Cudeck, 1994), there are only three direct determinants of performance: declarative knowledge, procedural knowledge and
skills, and motivation. McCloy, et al. represented this function in the following formula:

\[ PC = f(DK, PKS, M) \]

- **PC** = Job performance component (e.g., task performance, & teamwork performance).
- **DK** = Declarative knowledge: Knowledge of facts, rules, principles, and procedures (Anderson, 1985).
- **PKS** = Procedural knowledge and skills: Knowledge of how to perform and the skills to perform.
- **M** = Motivation: The combined effects of three choice behaviors: choice to expend effort, choice to exert a certain level of effort, and choice to persist.

These authors argued that all other determinants indirectly affect performance through these direct determinants. For example, individual differences in ability, personality, and experience affect performance through one or more of the three direct determinants. Similarly, organizational interventions such as training, rewards, and leadership also affect performance through one or more of the three direct determinants (Campbell et al., 1996). Therefore, any predictor variable other than DK, PKS, and M, is an indirect determinant of performance.

A growing body of research supports Campbell’s theory of performance and the idea of knowledge, skills, and motivation as direct determinants of performance. First, a
widely cited meta-analysis by Hunter (1983) found that job knowledge and work sample tests have direct paths to supervisor ratings of performance. Furthermore, the effect of general cognitive ability on supervisory rating of performance is mediated by job knowledge and work sample tests. In other words, job knowledge and skills have a direct effect on performance, and ability has an indirect effect on performance through knowledge and skills. Although the purpose of Hunter's model was to explain the validity of supervisory ratings as a measure of performance, the empirical results of this study support Campbell et al.'s (1993) theory of performance.

Second, further analysis of the same data set by Schmidt, Hunter, and Outerbridge (1986) replicated the paths found in the previous study. In addition, job experience was added to the model as an exogenous variable. In general, job experience was found to have an indirect effect on supervisory ratings of performance through job knowledge and job skills. Therefore, the model represented in this study found that knowledge and skills are directly related to performance and that general cognitive ability and job experience affect performance through job knowledge and skills.

Third, Borman, Hanson, Oppler, Pulakos, and White (1993) replicated the paths found in the Schmidt et al. (1986) study with a sample of first-line supervisors. Thus, this study showed further support that job knowledge and skills are direct determinants of performance where as cognitive ability and job experience are indirect determinants.

Fourth, Borman et al. (1991) found that the relationship between ability and supervisory rating of job performance is mediated by job knowledge and task proficiency (i.e., skills). In addition to the measures of ability, job knowledge, and job skills, these
researchers included two personality factors (i.e., achievement orientation & dependability) and two indirect measures of motivation (i.e., awards & disciplinary actions) to the model. In general, they found direct paths from the two personality factors to job performance, and the two motivational factors to job performance. However, stronger paths showing that the relationship between achievement orientation and performance is mediated by awards, and the relationship between dependability and performance is mediated by disciplinary actions emerged. In other words, although personality was directly related to performance, a stronger relationship emerged when motivation was a mediating factor. The paths found in this study generally support Campbell et al.'s (1993) conceptualization of the three direct performance determinants. However, the small but significant direct links between the two personality measures and performance are inconsistent with Campbell et al.'s (1993) theory. Campbell et al. (1996) argued that the direct paths from the two personality measures and performance may have resulted from the relatively weak conceptualization of motivation in this study.

Fifth, Barrick, Mount, and Strauss (1993) found that the relationship between two personality measures (i.e., Extraversion & Conscientiousness) and two measures of performance (i.e., sales volume & supervisory ratings of performance) were mediated by autonomous goal setting and goal commitment (i.e., motivation). This study showed additional support that motivation mediates the relationship between personality and job performance.

Sixth, Gellatly (1996) found that the effect of Conscientiousness on performance was mediated by expectancy, valence, and personal goals (i.e., motivational components).
This study also showed that motivation mediates the relationship between personality and job performance.

Seventh, Borman, White, and Dorsey (1995) found that job knowledge and technical proficiency mediated the relationship between ability and two measures of job performance: supervisory ratings and peer ratings. This study further supports the notion that job knowledge and skills mediate the effects of individual attributes on job performance.

Finally, in a confirmatory test of Campbell et al.'s (1993) model of performance determinants, McCloy et al. (1994) examined the mediating effects of DK, PKS, and M on the relationship between multiple measures of individual attributes and multiple measures of job performance for eight different job classifications in the army. Covariance structure analysis showed that Campbell et al.'s (1993) model of performance determinants was consistently supported across a wide variety of jobs in the army.

In summary, the models reviewed above support the idea that job knowledge, skills, and motivation are direct determinants of performance, and all other individual attributes are indirect determinants. However, it is still unclear whether there are three distinct direct determinants of performance (i.e., DK, PKS, & M) as Campbell and his colleagues (e.g., Campbell et al, 1993) have claimed. According to Campbell et al. (1996) written tests indicate DK, work sample tests indicate PKS, and measures of choice behaviors indicate M. Although it can be argued that choice behaviors indicate a construct that is distinct from written and work sample tests, it may be inaccurate to state that written tests only indicate DK and work sample tests only indicate PKS. For
example, most written job knowledge tests are designed to measure both declarative and procedural knowledge. Furthermore, written tests may also be used to test job skills for a variety of jobs that require writing skills and/or abstract thinking (e.g., accounting, engineering, research, managerial, and clerical). In addition, for individuals to perform on a work sample test, they need to have declarative knowledge, procedural knowledge, and skills. Therefore, the distinction between DK and PKS cannot be made simply by examining the method of measurement.

In the present study, knowledge and skills will be examined as a single construct. Although there may be theoretical differences between job knowledge and job skills, there is not enough evidence to determine if they are indeed separate constructs. Furthermore, most employment tests are designed to assess both knowledge and skills. Therefore, it is difficult to make such a distinction in an applied setting.

The relationships depicted in the proposed model are consistent with the idea that knowledge and skills, and motivation are direct determinants of performance. However, unlike some of the previous models that have characterized these determinants as having an additive effect on performance (e.g., Borman et al., 1991; McCloy et al., 1994), the proposed model depicts an interaction effect between motivation, and job knowledge and skills.

Support for the Interaction Between Knowledge and Skills, and Motivation

Various researchers (e.g., Maier, 1958; Kanfer & Ackerman, 1989) have conceptualized performance as consisting of an interaction between ability and motivation (i.e., $P = f(A \times M)$). In other words, an individual should have the capability (e.g.,
possess job-relevant knowledge and skills) and the motivation to perform to be successful on the job. However, studies in this area have shown conflicting results with only a few supporting an interaction effect. Kanfer and Ackerman (1989) argued that it is difficult to draw any definitive conclusions from many of these studies. First, measurement of ability may have been confounded with motivation in several studies. Second, the conceptualization of motivation widely varies from study to study.

In a more recent conceptualization of this interaction effect, Hollenbeck and Whitener (1988) argued that personality affects motivation, and the interaction between motivation and ability affects performance. In other words, the relationship between personality and performance is mediated by motivation and the relationship between motivation and performance is moderated by ability.

Hollenbeck, Brief, Whitener, and Pauli (1988) argued that personality traits indicate individual differences in values, needs, and beliefs. Thus, personality is a strong indicator of an individual's motivation to perform. In other words, personal values, needs, and beliefs will most likely affect one's choice to engage in a particular behavior, the intensity in which a person engages in that behavior, and the individual's choice to persist at that behavior for a given amount of time. However, these choice behaviors will affect performance only if the individual has the ability to perform.

In a two-part study, Hollenbeck et al. (1988) examined the interaction effects of personality and ability on performance. With a sample of college students, they found that the interaction between students' Scholastic Aptitude Test (SAT) scores and their level of Locus of Control was significantly related to Grade Point Average (GPA). With a
sample of insurance sales people, they found that the interaction between the sales person’s Aptitude Index Battery (i.e., a test of an individual’s aptitude in insurance sales) scores and their level of self-esteem was significantly related to the amount of sales commission received. Wright, Kacmar, McMahan, and Deleeuw (1995) found further support for Hollenbeck and Whitener’s (1988) model. These authors found that Achievement Need and cognitive ability had a significant interaction effect on the performance of warehouse employees. In general, these two studies showed that performance is affected by the interaction between one’s capacity to perform and personality (i.e., an indicator of motivation to perform).

In addition to the empirical support, an interactive model seems to be more logical than an additive model. For example, in an additive model, an individual with a high level of knowledge and skills but no motivation would perform at a relatively high level. Even more implausible, an individual with a high level of motivation but no knowledge and skills would also perform at a relatively high level (McCloy et al., 1994). It seems more logical to state that at least a certain amount of motivation needs to be present along with a high level of knowledge and skills for an individual to perform at a high level. Furthermore, it would also be logical for an individual to possess a minimal level of knowledge and skills along with a high level of motivation to perform at a relatively high level. Therefore, the proposed model predicts that the interaction between task-KS and task motivation will affect task performance and the interaction between teamwork-KS and teamwork motivation will affect teamwork performance.
Hypothesis 2: The interaction between task-KS and task motivation will affect task performance such that the relationship between task-KS and task performance will only hold when a minimal level of task motivation is present and vice versa.

Hypothesis 3: The interaction between teamwork-KS and teamwork motivation will affect teamwork performance such that the relationship between teamwork-KS and teamwork performance will only hold when a minimal level of teamwork motivation is present and vice versa.

Indirect Determinants of Performance

In the proposed model, cognitive ability, job experience (i.e., task experience and teamwork experience) and personality factors (i.e., Conscientiousness, Extraversion, and Agreeableness) are depicted as indirect determinants of performance. These individual attributes were included in the proposed model for several reasons. First, these individual attributes have been identified as valid predictors of job performance in various studies. Second, these attributes were included in other causal models of job performance. Third, all selection measures (excluding job knowledge and work sample tests that are designed to measure specific job knowledge and skills) are designed to measure an aspect of one or more of these individual attributes.

Ability as an Indirect Determinant of Performance. Cognitive ability has been shown to be a valid predictor of job performance and training success across many jobs. First, a meta-analytic study conducted by Hunter and Hunter (1984) showed that
cognitive ability has a validity coefficient of .54 with training success and a validity coefficient of .45 with job performance.

Second, results of a validation study with Project-A data showed that, of six predictor measures, general cognitive ability had the highest validity coefficients with two measures of job performance. General cognitive ability correlated .63 with core technical proficiency and .65 with general task proficiency (Campbell, 1990).

Third, 25 validation studies have shown that scores on the Wonderlic Personnel Test, a test of general cognitive ability, are related to various measures of job performance across numerous jobs (Wonderlic Personnel Test, Inc., 1992). These validity coefficients ranged from .22 for female hourly blue collar workers to .67 for supervisors.

Fourth, a meta-analytic study conducted by the National Research Council demonstrated that the General Aptitude Test Battery (GATB), a battery of cognitive ability tests, is valid across a wide variety of jobs. Across 755 studies, the validity coefficient for the GATB ranged from .20 to .40 with an average validity of .30 (Wigdor & Sackett, 1993).

Fifth, Ree, Earles, and Teachout (1994) found that although specific ability measures added a statistically significant incremental validity to a general cognitive ability measure, the increase in validity by adding these specific measures was practically negligible. Across seven job classifications in the air force, general cognitive ability showed an average validity coefficient of .44, where as both general cognitive ability and
specific abilities combined resulted in a validity coefficient of .46. The authors concluded that general cognitive ability is the single best predictor of job performance.

Finally, a study conducted by Schmidt, Hunter, Outerbridge, and Goff (1988) demonstrated that the relationship between cognitive ability and job performance is stable across individuals with different number of years on the job. More specifically, the results of this study showed that although job performance generally increases as individuals work longer on the job, individuals with high ability consistently perform higher than individuals with low ability. Furthermore, the relative difference in the performance of high ability and low ability individuals was found to be consistent across individuals with different amounts of time on the job. Although this was a cross-sectional study, it nevertheless demonstrated that the relationship between ability and job performance is stable over time.

Taken together, the results of various studies show that general cognitive ability is a valid predictor of job performance across a large number of jobs. However, these results are simply empirical correlations and they do not explain how cognitive ability affects performance (McCloy et al., 1994).

Campbell et al.’s (1993) theory of performance provides an explanation of how cognitive ability and other individual attributes affect performance. For example, cognitive ability affects job performance through job knowledge and skills. Empirical tests of this relationship show that job knowledge and skills mediate the relationship between cognitive ability and performance (e.g., Barrick et al., 1993; Borman et al., 1991; Borman et al., 1993; Borman et al., 1995; Hunter, 1983; McCloy et al., 1994;
Schmidt et al., 1986). The relationships between cognitive ability, job knowledge and skills, and job performance depicted in these studies seem to make sense. For example, an individual with high ability should be able to easily learn knowledge and skills that are important for the job. In turn, having knowledge and skills that are important for the job should contribute to job performance. This logic is further supported by research that shows that the relationship between cognitive ability and training performance is higher than the relationship between cognitive ability and job performance (e.g., Hunter & Hunter, 1984). In other words, cognitive ability is a better predictor of an individual’s capacity to acquire knowledge and skills that are necessary for job performance than job performance itself.

**Hypothesis 4:** Cognitive ability will be directly related to task-KS.

**Hypothesis 5:** Cognitive ability will be directly related to teamwork-KS.

**Hypothesis 6:** The relationship between cognitive ability and task performance will be mediated by task-KS.

**Hypothesis 7:** The relationship between cognitive ability and teamwork performance will be mediated by teamwork-KS.

**Experience as an Indirect Determinant of Performance.** According to Owens (1968), the best predictor of future behavior is past behavior. Thus, an individual’s job experience should be a good indicator of how he or she will perform in similar jobs. However, unlike cognitive ability, studies examining the relationship between experience and job performance are not common in the research literature. This may partly be because many selection tests include some measures of experience but experience is
usually confounded with other individual attributes. For example, interviews may include questions regarding job experience, but may also tap verbal ability and certain personality traits.

Nevertheless, there is some empirical evidence that experience is related to job performance. For example, Schmidt et al. (1988) found that number of years on the job is positively related to job performance for both low and high ability individuals. In addition, a meta-analysis of training and experience evaluation forms (i.e., a type of application form specifically designed to measure previous experience, training, and education that are relevant to the job) found that these measures are valid predictors of job performance across many jobs (McDaniel, Schmidt, & Hunter, 1988).

Consistent with Campbell et al.'s (1993) theory of performance, the proposed model depicts previous experience regarding the task (i.e., task experience) as having an effect on task performance through task-KS. Similarly, the proposed model depicts experience with teamwork (i.e., teamwork experience) as having an effect on teamwork performance through teamwork-KS. Empirical tests of causal models of job performance generally support the notion that the relationship between experience and performance is mediated by job knowledge and skills (e.g., Borman et al., 1993; Schmidt et al., 1986). It can be explained that individuals with job experience have gained job knowledge and skills that may be applied to similar jobs in the future.

**Hypothesis 8:** Task experience will be directly related to task-KS.

**Hypothesis 9:** Teamwork experience will be directly related to teamwork-KS.
**Hypothesis 10:** The relationship between task experience and task performance will be mediated by task-KS.

**Hypothesis 11:** The relationship between teamwork experience and teamwork performance will be mediated by teamwork-KS.

**Personality as an Indirect Determinant of Performance.** In the past, personality measures were regarded as having little value in predicting job success. Researchers and practitioners alike dismissed personality tests for being easily faked and having low validity (Hogan, Hogan, & Roberts, 1996). This view was supported by numerous studies that showed low validity coefficients between personality measures and job performance.

Part of the problem with using personality measures for employee selection has been that some personality tests were designed to measure abnormal patterns of personality. For example, the Minnesota Multiphasic Personality Inventory (MMPI) was mainly designed for assessment of personality in clinical settings. Furthermore, there are numerous conceptualizations of personality dimensions and even worse, different names given to dimensions that are conceptually similar. Hogan et al. (1996) called this confusion in terminology a “professional embarrassment.”

One major advancement in personality research has come from the identification of the Big-Five personality dimensions (Hogan et al., 1996). Although there is some disagreement among researchers regarding the names of some of the dimensions, the following labels have been typically used: 1) Surgency or Extraversion, 2) Agreeableness, 3) Conscientiousness, 4) Emotional stability or Neuroticism, and 5) Openness to
experience or Intellectance (Schmit & Ryan, 1993). Various studies (e.g., Hogan & Hogan, 1992) have shown the five-factor model of personality to be consistent. Although the debate regarding the appropriate dimensions of personality goes on, the Big-Five seems to provide a unifying framework for examining personality in research and personnel selection.

Hogan et al. (1996) argued that a well-constructed personality test designed to measure normal personality can be a valid predictor of job performance. In support of this argument, recent research on personality have shown moderate relationships between personality measures and job performance. For example, in a meta-analytic study, Tett, Jackson, and Rothstein (1991) found that the corrected mean validity coefficient for personality measures across 494 studies was .29. Specific to the Big-Five, these researchers found the following corrected mean validity coefficients: Conscientiousness ($\rho = .18$), Extraversion ($\rho = .16$), Agreeableness ($\rho = .33$), Openness to experience ($\rho = .27$), and Neuroticism ($\rho = -.22$). Furthermore, in a meta analysis of the Big-Five personality factors, Barrick and Mount (1991) found that Conscientiousness was a valid predictor of job performance across all occupational types ($\rho = .23$), while Extraversion was a valid predictor of performance for jobs that involve interpersonal skills ($\rho = .18$ for managerial jobs & $\rho = .15$ for sales jobs).

Although research specifically examining personality in a team setting is limited, two recent studies show some evidence that personality may be important for team-member and team performance. Thoms et al. (1996) examined the relationship between the Big-Five and self-efficacy for participating in team work. These researchers argued
that due to the positive relationship between self-efficacy and performance (Gist & Mitchell, 1992), the relationship between self-efficacy for teamwork and personality will provide initial evidence of the potential relationship between personality and team-member performance. The results of this study showed that Conscientiousness, Extraversion, Agreeableness, and Neuroticism were significantly related to self-efficacy for teamwork.

Furthermore, Barry and Stewart (1997) examined the effects of the Big-Five on team-member behavior and team performance. In general, the results of this study showed that Extraversion was significantly related to socioemotional inputs (i.e., teamwork performance) and task inputs (i.e., task performance). In turn, both socioemotional inputs and task inputs had significant effects on team performance.

In the proposed model, three personality factors from the Big-Five (i.e., Conscientiousness, Extraversion, and Agreeableness) are included. Conscientiousness is depicted as an indirect determinant of task and teamwork performance through task and teamwork motivation respectively. As mentioned previously, Conscientiousness has been found to be a valid predictor of performance across a large number of jobs (Barrick & Mount, 1991). More specific to work teams, Thoms et al. (1996) found that of the Big-Five personality factors, Conscientiousness has the highest correlation with self-efficacy for teamwork.

According to Dunn, Mount, Barrick, and Ones (1995), Conscientiousness reflects one's sense of purpose, obligation, and persistence. These qualities are important for job performance across all job tasks (Barrick & Mount, 1991). Thus, conscientious team-
members should be self-motivated to be focused on the task (Barry & Stewart, 1997). In turn, the team-members task-focus (i.e., task motivation) should be related to task performance.

**Hypothesis 12:** Conscientiousness will be directly related to task motivation.

**Hypothesis 13:** The relationship between Conscientiousness and task performance will be mediated by task motivation.

Barry and Stewart (1997) argued that conscientious team-members should also contribute to important team process behavior. These individuals may not only have a sense of purpose and obligation toward the task, but they also may have a sense of purpose and obligation toward teamwork. Thus, conscientious team-members may be motivated to perform important team process behavior (i.e., teamwork performance).

**Hypothesis 14:** Conscientiousness will be directly related to teamwork motivation.

**Hypothesis 15:** The relationship between Conscientiousness and teamwork performance will be mediated by teamwork motivation.

In the proposed model, Extraversion is depicted as an indirect determinant of teamwork performance through teamwork motivation. As mentioned previously, Extraversion has been found to be a valid predictor of performance for jobs involving social interaction (Barrick & Mount, 1991). More specific to work teams, Thoms et al. (1996) found that Extraversion is related to self-efficacy for teamwork. Furthermore, Barry and Stewart (1997) found that Extraversion has a significant effect on team process behaviors, which in turn has a significant effect on team performance.
According to Costa and McCrae (1992), extraverts are predisposed to be outgoing, confident, assertive, and talkative. Thus, extraverts should be motivated to engage in important team process behavior (i.e., teamwork performance) such as communicating freely with other team-members without the fear of intimidation (Barry & Stewart, 1997), seeking and providing feedback, and motivating other team-members.

**Hypothesis 16:** Extraversion will be directly related to teamwork motivation.

**Hypothesis 17:** The relationship between Extraversion and teamwork performance will be mediated by teamwork motivation.

According to the proposed model, Agreeableness is depicted as an indirect determinant of teamwork performance through teamwork motivation. Although the results of the two meta-analyses on personality measures (e.g., Barrick & Mount, 1991; Tett et al., 1991) are conflicting in respect to the relationship between Agreeableness and job performance, research on work teams have shown that Agreeableness may be an important predictor of an individual’s motivation to perform teamwork. Specifically, Thoms et al, (1996) found that Agreeableness is related to self-efficacy for teamwork.

According to Costa and McCrae (1992) an agreeable person is altruistic, sympathetic, and is eager to help others. This personality trait may not be helpful in jobs where one has to look out for one’s own self interest. However, Agreeableness may be important in a team environment where one is required to interact with others. Thus, agreeable individuals should be motivated to engage in important team process behavior (i.e., teamwork performance) such as resolving conflicts, helping others, accepting
suggestions, working with others to solve problems, and considering others' ideas (Thoms et al., 1996).

**Hypothesis 18:** Agreeableness will be directly related to teamwork motivation.

**Hypothesis 19:** The relationship between Agreeableness and teamwork performance will be mediated by teamwork motivation.

Various researchers have argued that personality tests should be used in conjunction with ability tests (e.g., Dunn et al., 1995; Wright et al., 1995). Wright et al. argued that the relatively low relationship between personality and job performance may be the result of the failure to examine ability in conjunction with personality. Personality may have no effect on performance if an individual does not have the ability to perform. Therefore, the examination of personality in conjunction with ability and experience in the proposed model may provide a clearer idea of how these variables affect performance.

Various models of performance determinants have supported the idea that the relationship between personality and performance is mediated by motivation (e.g., Barrick et al., 1993; Borman et al., 1991; Gellatly, 1996; Hollenbeck & Whitener, 1998). The relationships depicted in the proposed model are consistent with these existing models.
METHOD

Participants

The participants consisted of firefighters from a large metropolitan fire department in the Southeastern United States. Firefighters were an ideal group to examine for the present study because firefighting is an activity that teamwork is required. The fire department examined in this study is divided into three platoons or shifts where each platoon is on-duty for a period of 24 hours and off-duty for a period of 48 hours. Furthermore, each platoon is divided into six districts where each district is assigned to a certain geographic area. Within each district there are several fire stations where one or more firefighting teams called fire companies operate from. There are three to seven members in each fire company consisting of one fire captain, one operator, and one or more firefighters. The fire captain plays the role of a team leader, the operator is mainly responsible for operating the fire engine/apparatus, and the firefighters are mainly responsible for conducting basic firefighting operations.

To obtain a representative sample of firefighters and fire companies, a systematic sampling procedure was used. Firefighters from three fire companies from each district and from each platoon were scheduled to participate. However, several fire companies were not able to participate due to various reasons. The data used in the present study consist of information collected from 135 firefighters representing 45 fire companies. All participants were male with a mean age of 37.67 years (SD = 8.58). The participants were 68% Caucasian and 22% African American.
In the present study, tenure was measured in two ways. First, the participants were asked how long they served in their present fire company. Second, they were asked how long they served in their present job position (i.e., firefighter, operator, fire captain). The participants' mean tenure in their present fire company was 4.30 years (SD = 5.20), and their mean tenure in their current position was 6.30 years (SD = 5.9). For both measures of tenure, the distribution was positively skewed with most company members serving in their current company and position for several years and a few serving in their current company for up to 21 years and in their current position for up to 30 years.

For the aggregated team level data, intact teams were required. However, information regarding individual team-members were missing from several fire companies. This missing information was due to firefighters being absent, on vacation, attending training, or exercising their right not to participate in this study. Therefore, fire companies with more than one member missing from the study were omitted from the group level analysis. Although individual level data were collected from 45 fire companies, only 37 of those companies were examined at the group level. Each district in each platoon was represented by at least one fire company.

**Measures**

**General Cognitive Ability.** General cognitive ability, also referred to as *cognitive ability*, *general intelligence* or *g*, is an individual’s ability to learn, understand, and solve problems (Wonderlic Personnel Test Inc., 1992). In the present study, cognitive ability was assessed via the Wonderlic Personnel Test. The Wonderlic is a test of general cognitive ability that is widely used in industrial settings. It is a 50 item test that consists
of verbal, mathematical, and analytical questions. For example, a mathematical item in the Wonderlic asks, “Wire is 12.5 cents a foot. How many feet can you buy for a dollar?” (see Appendix B for more sample items from the Wonderlic). The respondents were given 12 minutes to complete as many of the 50 items as possible. Studies have shown that the Wonderlic has high reliability and validity (Murphy, 1990). Internal consistency and alternate forms reliability have generally been in the .90 range, and validity coefficients have ranged from .22 to .67, with a mean of .39. Complete information regarding the psychometric properties of the Wonderlic can be found in the Wonderlic User’s Manual (Wonderlic Personnel Test Inc., 1992). In the present study, the reliability of the Wonderlic was $\alpha = .79$.

**Task and Teamwork Experience.** Task experience is an individual’s experience in performing tasks that are central to the core technical aspects of the job of a firefighter. In the present study, task experience was assessed by asking team-members about their level of experience in firefighting. The participants were instructed to consider all of their experiences as a firefighter including volunteer work, training, experiences at fire and rescue scenes, and experiences from their current and all previous jobs as a firefighter.

Teamwork experience is an individual’s experience in coordinating his or her activities with others to accomplish common goals. Teamwork experience was also assessed by asking team-members about their level of experience in teamwork. The participants were instructed to consider all of their experiences in teamwork including sports and other extracurricular activities, and all job-related teamwork experiences from their current and all previous jobs.
Task and teamwork experience were each measured by three items. One item from the task experience measure was, “Working as a fire fighter.”, and one item from the teamwork experience measure was, “Performing various activities requiring teamwork.” (see Appendix C for the complete task and teamwork experience measures). The responses for these items were on a 5-point scale ranging from “1” indicating “Little experience” to “5” indicating “Extensive experience”. The first two items from each scale were adopted from Greguras (1998). Greguras used three items to measure supervisory ratings of job experience. In the current study, these items were revised as a self-report measure. Furthermore, these items were modified to assess experiences that are specific to task and teamwork. The third item in each scale was developed for the present study. The content of these items is similar to the other items in their respective scales. In the present study, the reliability of the task experience measure was $\alpha = .96$, and the reliability of the teamwork experience measure was $\alpha = .94$.

Conscientiousness, Extraversion and Agreeableness. Conscientiousness is a personality trait that reflects an individual’s sense of purpose, obligation, and persistence (Dunn et al., 1995). Extraversion is an individual’s tendency to be outgoing, assertive, confident, and talkative (Costa & McCrae, 1992). Agreeableness is an individual’s tendency to be altruistic, sympathetic, and eager to help others. Conscientiousness, Extraversion, and Agreeableness were assessed via NEO-FFI. (Costa & McCrae, 1992). The NEO-FFI is a 60-item personality assessment designed to measure the Big-Five personality dimensions. This test is one of the most widely used measures of the Big-Five (Schmit & Ryan, 1993). In the NEO-FFI, 12-items assess each personality dimension.
One item from the Conscientiousness facet was, "I work hard to accomplish my goals.", one item from the Extraversion facet was, "I like to have a lot of people around me.", and one item from the Agreeableness facet was, "I try to be courteous to everyone I meet." (see Appendix D for more sample items from the NEO-FFI). The responses for each item were on a 5-point scale ranging from “Strongly Disagree” to “Strongly Agree”.

This measure was chosen because of its relatively high internal consistency and good factor structure (Thoms et al., 1996). For example, Costa and McCrae (1992) found that the internal consistency of the Extraversion, Conscientiousness, and Agreeableness scales were .79, .83, and .75 respectively, and Mooradian and Nezlek (1996) found an acceptable five factor solution with loadings that were consistent with the design of the instrument. Detailed information regarding the psychometric properties of the Neo-FFI can be found in Costa and McCrae (1992), Mooradian and Nezlek (1996), and in Schmit and Ryan (1993). In the present study, the reliability of the Extraversion, Conscientiousness, and Agreeableness scales were $\alpha = .74, .86, \text{ and } .75$ respectively.

**Task-KS and Teamwork-KS.** Task-KS is an individual’s knowledge and skills in tasks that are central to the core technical aspects of the job of a firefighter. Each team-member was asked to assess the task-KS of the other team-members. This measure consisted of three items. One item from this measure was, "This individual possesses the technical knowledge and skills required to be a firefighter." (see Appendix E for the complete task-KS measure). The responses for these items were on a 5-point scale ranging from “1” indicating “Strongly Disagree” to “5” indicating “Strongly Agree”. The
items for task-KS were adopted from Greguras (1998). Greguras used three items to measure supervisory ratings of job knowledge. In the current study, these items were revised as a peer rating of job knowledge. Furthermore, these items were modified to assess knowledge and skills that are specific to job specific tasks. In the present study, the reliability of the task-KS measure was $\alpha = .97$.

Teamwork-KS is an individual’s knowledge and skills in coordinating his or her activities with others in accomplishing common goals. Teamwork-KS was measured by asking each team-member to assess the teamwork-KS of the other team-members. The format of this measure is similar to the task-KS measure described previously. However, the items were specifically designed to tap an individual’s knowledge and skills in teamwork. One item from this measure was, “This individual possesses the knowledge and skills required to be a team player.” (see Appendix F for the complete teamwork-KS measure). In the present study, the reliability of the teamwork-KS measure was $\alpha = .97$.

Task and Teamwork Motivation. Motivation is the combined effect of three choice behaviors: direction of behavior, the intensity of behavior, and persistence (Kanfer, 1990; McCloy et al., 1994). Thus, task motivation is an individual’s choice to perform the job specific tasks of a firefighter, and the intensity and persistence of his or her performance of these tasks. Teamwork motivation is an individual’s choice to perform teamwork behaviors, and the intensity and persistence of these behaviors. Each team-member was asked to assess the task and teamwork motivation of the other team-members.
Task and teamwork motivation were each measured by four items. One item from the task motivation measure was, “If given the choice, this individual is likely to work as a firefighter rather than any other job.”, and one item from the teamwork motivation measure was, “This individual cooperates and coordinates activities with other company members.” (see Appendix G for the complete task and teamwork motivation measures). The responses for these items were on a 5-point scale ranging from “1” indicating “Strongly Disagree” to “5” indicating “Strongly Agree”. These items were developed based on the operational definitions of task and teamwork motivation given above. In the present study, the reliability of the task motivation measure was $\alpha = .83$, and the reliability of the teamwork motivation measure was $\alpha = .85$.

**Task and Teamwork Performance.** Task performance is an individual’s performance on the core technical aspects of the job of a firefighter. Teamwork performance is an individual’s performance in coordinating activities with others to accomplish common goals. Each team-member was asked to assess the task and teamwork performance of the other team-members. Items for the task performance dimension were developed by examining available job analysis information. Items for the teamwork performance dimension were developed by examining the literature (e.g., Stevens & Campion, 1994; Stout et al., 1994) on team-member process behavior and teamwork proficiency. These items were then pilot tested with a group of 21 district fire chiefs and were further modified. The task performance measure consisted of 7 items and the teamwork performance measure consisted of 9 items. One item from the task performance measure was, “Proficiency in applying tactical procedures.”, and one item
from the teamwork performance measure was, “Being involved in tactical planning and contributing to team decisions.” (see Appendix H for the complete task and teamwork performance measures). The responses for these items were on a 5-point scale ranging from “1” indicating “Inadequate” to “5” indicating “Superior”. In the present study, the reliability for both the task performance and teamwork performance measures was $\alpha = .97$.

**Team Performance.** Team performance was measured in two ways. First, the team-members assessed the performance of their company. Second, the district fire chiefs (i.e. supervisors in charge of several fire companies) assessed the performance of the fire companies under their command. The team performance measure was developed by examining available job analysis data and appropriately applying this information to performance at the team level. The team performance measure used in the present study consists of 10 items and the format of this measure is similar to the individual performance measures. One item from the team performance measure was, “Extinguishing and controlling the intensity of fires.” (see Appendix I for the complete team performance measure). In the present study, the reliability of the supervisory rating of team performance was $\alpha = .95$, and the reliability of the team-member assessment of team performance was $\alpha = .96$.

**Procedures**

Several researchers administered the measures to the firefighters at a predesignated fire station in each of the six districts. The measures were administered to the firefighters assigned to the predesignated fire stations and firefighters from additional
fire companies within the district. To equally represent all three platoons (i.e., shifts), the measures were administered on three consecutive days in each district. Supervisory ratings of team performance were obtained from the district fire chiefs at the fire department headquarters.

The participants were informed that their participation in this study was entirely voluntary and that this project was for research purposes only. Furthermore, they were told that all responses would be confidential and that no one in their chain of command would have access to their individual responses. All information provided to the fire department was summarized so that individual responses were not revealed.

The measures were administered to each participant in a session that lasted approximately one hour. Because the Wonderlic test may be cognitively taxing, this measure was administered first. Next, the NEO-FFI and the measure of task and teamwork experience were administered. Finally, assessment of team-member knowledge, skills, motivation, and performance, and team performance was conducted. However, the order of peer ratings was counterbalanced to determine the effects of performance assessment on the assessment of knowledge, skills, and motivation and vice versa. For one group, the measures were administered in the following order: 1) Wonderlic, 2) NEO-FFI, 3) experience measure, 4) team-member performance measure, 5) motivation, knowledge, and skill measures, and 6) team performance measure. For another group, the measures were administered in the following order: 1) Wonderlic, 2) NEO-FFI, 3) experience measure, 4) motivation, knowledge, and skill measures, 5) team-member performance measure, and 6) team performance measure.
As mentioned previously, each team-member rated the task-KS, teamwork-KS, task motivation, teamwork motivation, task performance, and teamwork performance of the other team-members. Thus, each team-member received ratings from multiple sources (i.e., team-members). Ratings from these multiple sources were aggregated for each item in all subsequent analyses (i.e., arithmetic mean of ratings from all sources were used).

During several sessions, some of the participants were interrupted from completing the measures and were required to respond to a fire alarm. However, these calls were false alarms and all participants returned within a few minutes to complete the measures.
RESULTS

Overview

The model proposed in the present study depicts complex relationships across levels of analysis. Therefore, a simultaneous test of all of the relationships depicted in the proposed model was not possible. When appropriate, a structural equation modeling (SEM) approach was used to simultaneously test as many of the relationships depicted in the model as possible. Relationships in the model that were not amenable to SEM were tested using regression. Specifically, the following analyses were conducted in the present study. First, possible order effects between team-member ratings of performance, and knowledge, skills, and motivation were tested using multiple t-tests. Second, confirmatory factor analysis (CFA) was conducted to test the measurement model of measures used in the present study. Third, relationships among variables at the group level of analysis were tested using multiple regression. Fourth, moderated regressions were used to test the interaction effects among variables at the individual level of analysis. Finally, a structural model depicting all direct and indirect relationships among variables at the individual level of analysis was tested.

Test for Order Effects

Multiple t-tests were conducted to determine whether ratings of performance affected the ratings of knowledge, skills, and motivation and vice versa. Specifically, the ratings of task and teamwork performance, knowledge and skills, and motivation given by the two counterbalanced groups were compared. The results showed no significant differences between these groups: \( t(125) = -1.66, p > .05 \) for task performance; \( t(125) \)
=.87, p > .05 for teamwork performance; t (125) = -1.82, p > .05 for task-KS; t (125) = -.94, p > .05 for teamwork-KS; t (125) = -1.50, p > .05 for task motivation; and t (125) = -.76, p > .05 for teamwork motivation. Therefore, the data from the two groups were collapsed in all subsequent analyses.

Test of the Measurement Model

Before testing the relationship between any set of constructs, it is important to determine whether the instruments used to measure the constructs are valid. In line with this view, James, Mulaik, & Brett (1982) proposed a two-step approach to model testing. In the first step, a measurement model is tested to determine whether the indicators of the constructs in question are actually measuring these constructs. In the second step, a structural model is tested to determine the relationships among constructs (Fornell, & Yi, 1992). In other words, a measurement model provides information regarding convergent and discriminant validity, and the structural model provides information regarding predictive validity (Anderson, & Gerbing, 1988). According to Joreskog and Sorbom (1993b), testing of any theory is meaningless unless the validity of the measures is first established by testing a specified measurement model. In line with this view, the two-step approach was taken in the present study. In this section, testing of the measurement model will be discussed.

CFA was conducted to assess the measurement model of all measures that were developed for the present study. However, CFA was not conducted on the Wonderlic and the personality factors measured via NEO-FFI. This approach was taken for two reasons. First, the main concern for convergent and discriminant validity was with the
measures that were specifically developed for the present study. Unlike the NEO-FFI and the Wonderlic, the validity of these measures has not been examined in previous studies. Furthermore, all measures could not be tested in a single measurement model due to the relatively large number of parameters in such a model considering the sample size that was available in the present study.

Evaluation of Model Fit. Before presenting the results of the CFA some discussion regarding the evaluation of model fit in SEM is needed. In SEM an overall fit of the model or goodness-of-fit (GOF) can be tested. Furthermore, relationships among individual parameters (i.e., component fit) can be tested (Bollen, 1989). Researchers (e.g., Bollen, 1989; Schumacker, & Lomax, 1996) have suggested that examination of both overall model fit and component fit is important to assess the validity of a given model.

Numerous GOF measures are available in SEM. In general, there are three types of GOF measures or indexes: absolute fit indexes, incremental fit indexes, and parsimony-based fit indexes (Schumacker, & Lomax, 1996). Absolute fit indexes test the observed covariance matrix against the hypothesized covariance matrix. Incremental fit indexes test the hypothesized model against a null model. Parsimony-based fit indexes are similar to absolute fit indexes with the number of parameters required to achieve a given value of Chi-square taken into account.

Assessment of GOF is not a straightforward process (Schumacker, & Lomax, 1996). For example, the distributional properties of most GOF measures are not known (Bagozzi, & Yi, 1988). Furthermore, Chi-square statistic and the Root Mean Square
Error of Approximation (RMSEA) are the only GOF measures with an associated test of significance that identifies a correct model given a set of data (Schumacker, & Lomax, 1996). Most other GOF measures are simply assessed by a general rule-of-thumb. In addition, Monte Carlo studies have shown that various GOF measures (e.g., Chi-square statistic, Normed Fit Index, & Goodness of Fit Index) are affected by sample size (Gerbing & Anderson, 1992). Finally, studies have shown that some GOF measures (e.g., Goodness of fit index) can be increased by simply freeing additional parameters in the model.

Due to the problems discussed above, researchers (e.g., Bagozzi, & Yi, 1988) have suggested examining several GOF measures when assessing model fit. In general, it is common practice to assess at least one index from each of the three types of GOF measures (Schumacker, & Lomax, 1996). In the present study, Chi-square statistic, Goodness of Fit Index (GFI), RMSEA, Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), and Parsimony Normed Fit Index (PNFI) were examined. Chi-square, GFI, and RMSEA are absolute fit indexes, TLI and CFI are incremental fit indexes, and PNFI is a parsimony-based fit index.

A significant Chi-square value relative to degree of freedom indicates that the hypothesized covariance matrix is significantly different from the observed covariance matrix. Therefore, a non significant Chi-square value indicates good model fit. GFI, TLI, CFI, and PNFI are on a scale ranging from “0” to “1”, with higher values indicating better fit. As a general rule-of-thumb, a value close to “.90” indicates good fit (Schumacker, & Lomax, 1996). RMSEA has a minimum value of “0”, with lower values
indicating better fit. As a general rule-of-thumb, an RMSEA of "0" indicates perfect fit, "0.05" or lower indicates good fit, "0.08" or lower indicates reasonable fit, and greater than "0.10" indicates poor fit.

CFA of All Developed Measures. In the present study, LISREL 8.2 (Joreskog, Sorbom, 1993a) was used to test the measurement and structural models. The results of the CFA with all measures that were developed for the present study (i.e., task performance, teamwork performance, task-KS, teamwork K-S, task motivation, teamwork motivation, task experience, teamwork experience) showed that the overall fit of the measurement model is marginal at best (see Table 1). However, examination of component fit showed that all items in the model loaded significantly on their appropriate constructs (see Table 2).

Table 1

GOF Measures for the Measurement Model

<table>
<thead>
<tr>
<th>Model</th>
<th>$\chi^2$</th>
<th>df</th>
<th>$p$</th>
<th>GFI</th>
<th>TLI</th>
<th>CFI</th>
<th>PNFI</th>
<th>RMSEA</th>
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<tr>
<td>Eight-Factor. 36 items</td>
<td>1486.50</td>
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<td>.85</td>
<td>.86</td>
<td>.72</td>
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<td>Two-Factor. 36 items</td>
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<td>593</td>
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<td>.46</td>
<td>.68</td>
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<td>.61</td>
<td>.16</td>
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Note: The Eight-Factor measurement model is the hypothesized measurement model and the Two-Factor measurement model is the model representing method bias.
Table 2

Factor Loading of Items in the Measurement Model

<table>
<thead>
<tr>
<th>Constructs/Items</th>
<th>TKP</th>
<th>TWP</th>
<th>TKKS</th>
<th>TKM</th>
<th>TWKS</th>
<th>TWM</th>
<th>TKEX</th>
<th>TWEX</th>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>0.90</td>
</tr>
</tbody>
</table>

Note: All items loaded significantly on their respective factors, p < .05. TKP = task performance; TWP = teamwork performance; TKKS = task-KS; TKM = task motivation; TWKS = teamwork-KS; TWM = teamwork motivation; TKEX = task experience; TWEX = teamwork experience.
One, possible reason for the poor fit of the measurement model in the present study is that the hypothesized factors may be inconsistent with the factors that are inherent in the data. For example, the data may have been affected by method bias such that the factors that are inherent in the data may reflect the method in which the measures were administered instead of the hypothesized constructs. Therefore, the hypothesized model was compared to a two-factor model (one factor indicating peer ratings and another factor indicating self report). Results showed that the hypothesized measurement model fit the data significantly better than the two-factor model, $\Delta \chi^2 (27) = 1102, p < .05$ (see Table 1).

It is also possible that the factor structure inherent in the data may represent the inability of the measures to distinguish between constructs dealing with task and teamwork. For example, task and teamwork performance may reflect a single construct (i.e., performance), and task and teamwork motivation may reflect a single construct (i.e., motivation). Therefore, nested models representing task and teamwork as one construct were compared to nested models representing task and teamwork as separate constructs. Results showed that a model representing task and teamwork performance as separate constructs fit significantly better than a model representing task and teamwork performance as a single construct, $\Delta \chi^2 (1) = 169, p < .05$ (see Table 3). Results also showed that a model representing task and teamwork-KS as separate constructs fit significantly better than a model representing task and teamwork-KS as a single construct, $\Delta \chi^2 (1) = 182, p < .05$ (see Table 3). Furthermore, results showed that a model representing task and teamwork motivation as separate constructs fit significantly
better than a model representing task and teamwork motivation as a single construct, $\Delta \chi^2 (1) = 41, p < .05$ (see Table 3). Finally, results showed that a model representing task and teamwork experience as separate constructs fit significantly better than a model representing task and teamwork experience as a single construct, $\Delta \chi^2 (1) = 324, p < .05$ (see Table 3). Taken together these results confirmed that task and teamwork items represent two separate constructs.

Table 3

GOF Measures for the Nested Models

<table>
<thead>
<tr>
<th>Model</th>
<th>$\chi^2$</th>
<th>df</th>
<th>p</th>
<th>GFI</th>
<th>TLI</th>
<th>CFI</th>
<th>PNFI</th>
<th>RMSEA</th>
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<tr>
<td>Performance as 1 Factor</td>
<td>763.93</td>
<td>104</td>
<td>.00</td>
<td>.54</td>
<td>.77</td>
<td>.80</td>
<td>.67</td>
<td>.21</td>
</tr>
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<td>Performance as 2 Factors</td>
<td>567.88</td>
<td>103</td>
<td>.00</td>
<td>.64</td>
<td>.83</td>
<td>.85</td>
<td>.71</td>
<td>.18</td>
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<tr>
<td>KS as 1 Factor</td>
<td>198.75</td>
<td>9</td>
<td>.00</td>
<td>.61</td>
<td>.75</td>
<td>.85</td>
<td>.51</td>
<td>.40</td>
</tr>
<tr>
<td>KS as 2 Factors</td>
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<td>8</td>
<td>.00</td>
<td>.96</td>
<td>.99</td>
<td>.99</td>
<td>.53</td>
<td>.09</td>
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<tr>
<td>Motivation as 1 Factor</td>
<td>101.11</td>
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<td>.00</td>
<td>.82</td>
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<td>.86</td>
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<td>Motivation as 2 Factors</td>
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<td>.89</td>
<td>.89</td>
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<td>Experience as 1 Factor</td>
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<td>.53</td>
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<tr>
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<td>.05</td>
<td>.96</td>
<td>.98</td>
<td>.99</td>
<td>.52</td>
<td>.08</td>
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</tbody>
</table>

Note: All two-factor models fit significantly better than the one-factor models.

Another possible reason for the poor fit of the measurement model in the present study is that some of the items may have been problematic. To identify problems with specific items in a measurement model, the residual matrix can be examined. A residual
matrix indicates the difference between the observed covariance matrix and the hypothesized covariance matrix (Joreskog, Sorbom, 1996). In other words, a residual matrix is a covariance matrix of error terms. Thus, lower residuals in the residual matrix indicate good items, while higher residuals indicate poor items.

In the present study, there were high residuals among several items (see table 4). In an attempt to improve the fit of the measurement model, some of these items were removed. Specifically, item 6 from the task performance measure was removed and the measurement model was reexamined. Although the removal of this item resulted in a significant improvement in model fit, $\Delta \chi^2 (34) = 143, p < .05$, the fit of the measurement model remained marginal at best (see Table 5). Therefore, this process was repeated with item 5 from the task performance measure removed. Removal of this item resulted in a significant improvement in model fit, $\Delta \chi^2 (33) = 84, p < .05$, but the fit of the measurement model was still marginal at best (see Table 5). This process was again repeated with item 3 from the task performance measure removed, item 2 from the task performance measure removed, and item 2 from the teamwork performance measure removed. However, removal of these items reduced the content validity of these measures and did not result in an acceptable fit of the measurement model (see Table 5).

In a more drastic attempt to improve the fit of the measurement model, all items from the task performance and teamwork performance measures were removed and the measurement model was reexamined. Since the items from these measures had the highest residuals (see table 4), it seemed that these measures may have been the biggest
contributors to the poor fit of the measurement model. This approach resulted in an acceptable fit of the measurement model (see Table 6).

One possible reason for the poor fit of the performance measures is that these measures may have been modeled incorrectly. In the present study, task performance and teamwork performance were modeled as separate but correlated constructs. This model is consistent with Campbell, et al.'s (1993) theory that job performance is not a unitary construct. Furthermore, the results of the present study seem to support this view. For example, a nested model representing task and teamwork performance as two factors fit significantly better than a single-factor model (see Table 3). However, it is possible that task and teamwork performance are subcomponents of an overall job performance construct. To test this theory, a higher-order factor analysis was conducted with task and teamwork performance representing two subcomponents of overall job performance. The results showed that there was no difference in fit between the two-factor model and the higher-order model, $\Delta \chi^2 (1) = 0.00$, $p > .05$ (see Table 7). According to Marsh and Hocevar (1985), GOF of a higher-order model can never be better than the corresponding first-order model. In other words, the upper limit of GOF of the higher-order model is restricted by the GOF of the corresponding first-order model. In the present study, the fit of the higher-order model was identical to the fit of the first-order model (i.e., the two-factor model). Therefore, it is plausible that task and teamwork performance may be subcomponents of overall job performance.
Table 4

Largest Standardized Residuals Among Items

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<th>Items</th>
<th>Standardized Residuals</th>
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</thead>
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</tr>
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<tr>
<td>TWKS 3 &amp; TWP 1</td>
<td>2.72</td>
</tr>
<tr>
<td>TKKS 2 &amp; TKP 3</td>
<td>2.71</td>
</tr>
<tr>
<td>TWEX 2 &amp; TKM 1</td>
<td>2.68</td>
</tr>
</tbody>
</table>

Note: TKP= task performance; TWP= teamwork performance; TKKS= task-KS; TKM= task motivation; TWKS= teamwork-KS; TWM= teamwork motivation; TKEX= task experience; TWEX= teamwork. Residuals greater than 2.57 indicate significant correlated measurement error.
### Table 5

**GOF Measures of the Measurement Model with Poor Items Removed**

<table>
<thead>
<tr>
<th>Model</th>
<th>$\chi^2$</th>
<th>df</th>
<th>$p$</th>
<th>GFI</th>
<th>TLI</th>
<th>CFI</th>
<th>PNFI</th>
<th>RMSEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>TKP 6 removed</td>
<td>1343.08</td>
<td>532</td>
<td>0.00</td>
<td>.65</td>
<td>.86</td>
<td>.87</td>
<td>.72</td>
<td>.11</td>
</tr>
<tr>
<td>TKP 6 &amp; TKP 5 removed</td>
<td>1259.01</td>
<td>499</td>
<td>0.00</td>
<td>.66</td>
<td>.86</td>
<td>.87</td>
<td>.72</td>
<td>.11</td>
</tr>
<tr>
<td>TKP 6, TKP 5, &amp; TKP 3 removed</td>
<td>1147.42</td>
<td>467</td>
<td>0.00</td>
<td>.67</td>
<td>.87</td>
<td>.88</td>
<td>.72</td>
<td>.10</td>
</tr>
<tr>
<td>TKP 6, TKP 5, TKP 3, &amp; TKP 2 removed</td>
<td>1060.55</td>
<td>436</td>
<td>0.00</td>
<td>.68</td>
<td>.87</td>
<td>.89</td>
<td>.72</td>
<td>.10</td>
</tr>
<tr>
<td>TKP 6, TKP 5, TKP 3, TKP 2, &amp; TWP 2 removed</td>
<td>961.93</td>
<td>406</td>
<td>0.00</td>
<td>.69</td>
<td>.88</td>
<td>.89</td>
<td>.73</td>
<td>.10</td>
</tr>
</tbody>
</table>

*Note: TKP= task performance; TWP= teamwork performance*

### Table 6

**GOF Measures of the Measurement Model with the Performance Measures Removed**

<table>
<thead>
<tr>
<th>Model</th>
<th>$\chi^2$</th>
<th>df</th>
<th>$p$</th>
<th>GFI</th>
<th>TLI</th>
<th>CFI</th>
<th>PNFI</th>
<th>RMSEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task and Teamwork Performance removed</td>
<td>316.17</td>
<td>155</td>
<td>0.00</td>
<td>.81</td>
<td>.93</td>
<td>.95</td>
<td>.73</td>
<td>.09</td>
</tr>
</tbody>
</table>
Table 7

GOF Measures for the Two-factor and the Higher-Order Models of Performance

<table>
<thead>
<tr>
<th>Model</th>
<th>$\chi^2$</th>
<th>df</th>
<th>p</th>
<th>GFI</th>
<th>TLI</th>
<th>CFI</th>
<th>PNFI</th>
<th>RMSEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Factor Model</td>
<td>567.88</td>
<td>103</td>
<td>.00</td>
<td>.64</td>
<td>.83</td>
<td>.85</td>
<td>.71</td>
<td>.18</td>
</tr>
<tr>
<td>Higher-order Model</td>
<td>567.88</td>
<td>102</td>
<td>.00</td>
<td>.64</td>
<td>.83</td>
<td>.85</td>
<td>.70</td>
<td>.19</td>
</tr>
</tbody>
</table>

Although the GOF measures indicated that the measurement model is marginal at best, all items in the measures loaded significantly on their hypothesized factors. Furthermore, plausible alternative models fit significantly worse than the hypothesized model. In addition, removal of the two performance measures resulted in an acceptable fit of the hypothesized measurement model. Therefore, the hypothesized factor structure was retained and the items in their respective scales were combined to form a single score for each measure. Because the performance measures showed poor measurement properties, a structural model excluding these measures was tested. However, the items in the performance measures were also combined to form scales. This was done solely to examine all relationships hypothesized in the present study. Therefore, results of any analyses including the performance measures should be interpreted with caution. Scales were also formed for the Wonderlic, and the Agreeableness, Extraversion, and the Conscientious factors of the NEO-FFI. Descriptive statistics of all measures at the individual level of analysis are presented in Table 8.
### Table 8

**Descriptive data for all measures at the individual level of analysis**

<table>
<thead>
<tr>
<th>Measures</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>α</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wonderlic</td>
<td>134</td>
<td>23.64</td>
<td>5.64</td>
<td>0.79</td>
<td>50</td>
</tr>
<tr>
<td>Agreeableness</td>
<td>135</td>
<td>3.69</td>
<td>0.47</td>
<td>0.75</td>
<td>12</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>135</td>
<td>3.97</td>
<td>0.52</td>
<td>0.86</td>
<td>12</td>
</tr>
<tr>
<td>Extraversion</td>
<td>135</td>
<td>3.60</td>
<td>0.44</td>
<td>0.74</td>
<td>12</td>
</tr>
<tr>
<td>Task Experience</td>
<td>130</td>
<td>3.74</td>
<td>1.11</td>
<td>0.96</td>
<td>3</td>
</tr>
<tr>
<td>Teamwork Experience</td>
<td>130</td>
<td>4.29</td>
<td>0.72</td>
<td>0.94</td>
<td>3</td>
</tr>
<tr>
<td>Task-KS</td>
<td>127</td>
<td>4.51</td>
<td>0.57</td>
<td>0.97</td>
<td>3</td>
</tr>
<tr>
<td>Teamwork-KS</td>
<td>127</td>
<td>4.48</td>
<td>0.60</td>
<td>0.97</td>
<td>3</td>
</tr>
<tr>
<td>Task Motivation</td>
<td>127</td>
<td>4.14</td>
<td>0.61</td>
<td>0.83</td>
<td>4</td>
</tr>
<tr>
<td>Teamwork Motivation</td>
<td>127</td>
<td>4.12</td>
<td>0.61</td>
<td>0.85</td>
<td>4</td>
</tr>
<tr>
<td>Task Performance</td>
<td>127</td>
<td>4.23</td>
<td>0.65</td>
<td>0.97</td>
<td>7</td>
</tr>
<tr>
<td>Teamwork Performance</td>
<td>127</td>
<td>4.09</td>
<td>0.68</td>
<td>0.97</td>
<td>9</td>
</tr>
</tbody>
</table>

**Note:** Wonderlic is a 50-item test with the number of items answered correctly as the score. All other measures are on a 5-point scale with higher numbers indicating higher levels of the construct in question.

Examination of the descriptive statistics revealed that the participants' mean score on the Wonderlic is somewhat higher than what is observed in the general population. Since, the participants have gone through a rigorous selection process to gain entrance to the fire department, they should have higher cognitive ability than the general population. The standard deviation of the Wonderlic scores observed in the present study is 53.

The participants' mean scores on the Agreeableness, Conscientiousness, and Extraversion factors of the NEO-FFI are comparable to the results of a study conducted by Schmit and Ryan (1993). Furthermore, the standard deviations of these measures are also comparable to the Schmit and Ryan study.

The means of all measures developed for the present study (i.e., task experience, teamwork experience, task-KS, teamwork-KS, task motivation, teamwork motivation, task performance, & teamwork performance) are higher than the midpoint of the 5-point scale and the standard deviations are generally less than 1. Furthermore, the distributions of these measures, excluding the experience measures, are negatively skewed. These results seem to make sense since most job incumbents should have good knowledge and skills, high motivation, and perform well on the job, while a few may score low on these measures. On the contrary, the results showed that the experience measures are positively skewed. This is consistent with the finding that the distribution of the participants' job tenure is also positively skewed. In general, the means and standard deviations of the measures developed for the present study seem to be comparable to what was found in other studies (e.g., Greguras, 1998).

Correlation matrix of all variables at the individual level of analysis is presented in Table 9. The correlation matrix indicates that all of the variables measured via team-member-ratings (i.e., task-KS, teamwork-KS, task motivation, teamwork motivation, task performance, & teamwork performance) are highly correlated, while the
relationships among other hypothesized variables are not correlated or negatively correlated. For example, the correlation matrix indicates that Conscientiousness is negatively correlated with teamwork motivation, task performance, and teamwork performance. These results are inconsistent with research evidence (e.g., Barrick and Mount, 1991) that generally indicate that Conscientiousness is positively correlated to these variables.

The Effects of Individual Task and Teamwork Performance on Team Performance

Descriptive statistics of all measures at the group level of analysis are presented in Table 10. In general, the means and standard deviations of these measures were similar to other measures at the individual level of analysis. However, the supervisory rating of team performance had a lower mean and more variability than the team-member rating of team performance. This result seems to reflect the findings of various studies (e.g., Mount, 1984) that showed self-ratings to be inflated when compared to supervisory ratings.

A correlation matrix of all variables at the group level of analysis is presented in Table 11. The correlation matrix shows that all measures assessed via team-member ratings are highly related, while supervisory rating of team performance is not related or negatively related to the hypothesized variables.

55

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Table 9
Correlation Among All Individual Level Variables

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Wonderlic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Agreeableness</td>
<td></td>
<td>-.04</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Conscientiousness</td>
<td>.01</td>
<td>.30**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Extraversion</td>
<td>.25**</td>
<td>.42**</td>
<td>.33**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Task Experience</td>
<td>.15*</td>
<td>-.12</td>
<td>.12</td>
<td>.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Teamwork Experience</td>
<td>.22**</td>
<td>.09</td>
<td>.21**</td>
<td>.31**</td>
<td>.37**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Task-KS</td>
<td>.04</td>
<td>-.15</td>
<td>-.02</td>
<td>-.05</td>
<td>.13</td>
<td>-.09</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Teamwork-KS</td>
<td>.10</td>
<td>-.14</td>
<td>-.13</td>
<td>-.11</td>
<td>.02</td>
<td>-.09</td>
<td>.85**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Task Motivation</td>
<td>.16*</td>
<td>-.10</td>
<td>-.12</td>
<td>-.03</td>
<td>.02</td>
<td>-.07</td>
<td>.71**</td>
<td>.72**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Teamwork Motivation</td>
<td>.12</td>
<td>-.04</td>
<td>-.16*</td>
<td>-.00</td>
<td>-.03</td>
<td>-.10</td>
<td>.70**</td>
<td>.82**</td>
<td>.69**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Task Performance</td>
<td>.12</td>
<td>-.17*</td>
<td>-.15*</td>
<td>-.06</td>
<td>.06</td>
<td>-.09</td>
<td>.83**</td>
<td>.78**</td>
<td>.76**</td>
<td>.75**</td>
<td></td>
</tr>
<tr>
<td>12. Teamwork Performance</td>
<td>.06</td>
<td>-.09</td>
<td>-.18*</td>
<td>-.07</td>
<td>-.05</td>
<td>-.07</td>
<td>.78**</td>
<td>.83**</td>
<td>.73**</td>
<td>.83**</td>
<td>.88**</td>
</tr>
</tbody>
</table>

Note: * = Significant at .05, one-tailed; ** = Significant at .01, one tailed.
Table 10

**Descriptive Data for all Measures at the Group Level of Analysis**

<table>
<thead>
<tr>
<th>Measures</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervisory Rating of Team Performance</td>
<td>29</td>
<td>3.79</td>
<td>0.74</td>
<td>0.95</td>
</tr>
<tr>
<td>Team-Member Rating of Team Performance</td>
<td>37</td>
<td>4.48</td>
<td>0.43</td>
<td>0.96</td>
</tr>
<tr>
<td>Aggregated Task Performance</td>
<td>37</td>
<td>4.20</td>
<td>0.48</td>
<td>0.97</td>
</tr>
<tr>
<td>Aggregated Teamwork Performance</td>
<td>37</td>
<td>4.04</td>
<td>0.54</td>
<td>0.97</td>
</tr>
</tbody>
</table>

*Note:* All measures are on a 5-point scale with "1" indicating inadequate and "5" indicating superior.

Table 11

**Correlation Among All Group Level Variables**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Supervisory Rating of Team Performance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Team-Member Rating of Team Performance</td>
<td>-.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Aggregated Task Performance</td>
<td>-.27</td>
<td>.62**</td>
<td></td>
</tr>
<tr>
<td>4. Aggregated Teamwork Performance</td>
<td>-.37*</td>
<td>.65**</td>
<td>.91**</td>
</tr>
</tbody>
</table>

*Note:* * = Significant at .05, one-tailed; ** = Significant at .01, one-tailed.
Hierarchical regressions were conducted to test the contribution of team-member task and teamwork performance to team performance (see Figure 2). Task performance ratings of individual team-members were aggregated within each team. Similarly, teamwork performance ratings of individual team-members were aggregated within each team. These variables were examined to determine whether high levels of these individual performance dimensions within a work team contribute significantly to ratings of team performance. One set of analyses was conducted with supervisory ratings of team performance as the dependent variable, and another set of analyses was conducted with team-member ratings of team performance as the dependent variable.

**Figure 2**

**Contribution of Team-Member Performance to Team Performance**

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The results of a hierarchical regression with task performance in the first step and teamwork performance in the second step showed that the combined effects of task and teamwork performance were not significantly related to supervisory rating of team performance, $R^2 (2, 26) = .17, p > .05$. Furthermore, task and teamwork performance did not contribute significantly and uniquely to team performance: $\beta = .39, p > .05$, one-tailed, for task performance; and $\beta = -.73, p > .05$, one-tailed, for teamwork performance (see Table 12). Similarly, semipartial correlations showed that task performance was not significantly related to supervisory rating of team performance when teamwork performance was controlled for, $sr = .16, p > .05$, one tailed; and teamwork performance was not significantly related to supervisory rating of team performance when task performance was controlled for, $sr = -.30, p > .05$, one tailed.

**Table 12**

*Hierarchical Regression with Supervisory Ratings of Team Performance as the Criterion Variable and Task and Teamwork Performance as Predictor Variables*

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>$\beta$</th>
<th>$t$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggregated Task performance</td>
<td>-0.475</td>
<td>0.323</td>
<td>-0.272</td>
<td>-1.469</td>
<td>0.076</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggregated Task performance</td>
<td>0.685</td>
<td>0.757</td>
<td>0.393</td>
<td>0.906</td>
<td>0.187</td>
</tr>
<tr>
<td>Aggregated Teamwork performance</td>
<td>-1.098</td>
<td>0.652</td>
<td>-0.730</td>
<td>-1.684</td>
<td>0.052</td>
</tr>
</tbody>
</table>

*Note.* $f^2 = .07$ for Step 1 ($p > .05$); $\Delta R^2 = .09$ for step 2 ($p > .05$). $N = 27$. All $p$ values reflect one-tailed tests.
The results of a hierarchical regression with task performance in the first step and teamwork performance in the second step showed that the combined effects of task and teamwork performance were significantly related to team-member rating of team performance, $R^2 (2, 34) = .43, p < .05$. However, task and teamwork performance did not contribute significantly and uniquely to team performance: $\beta = .17, p > .05$, one-tailed, for task performance; and $\beta = .50, p > .05$, one-tailed, for teamwork performance (see Table 13). Similarly, semipartial correlations revealed that task performance was not significantly related to team-member rating of team performance when teamwork performance was controlled for ($sr = .07, p > .05$, one-tailed), and teamwork performance was not significantly related to team-member rating of team performance when task performance was controlled for ($sr = -.21, p > .05$, one tailed). These nonsignificant beta weights and semipartial correlations may reflect multicollinearity problems in the predictor measures (i.e., aggregated task and aggregated teamwork performance measures). As shown in Table 11, the correlation between aggregated task and aggregated teamwork performance was .91.

Taken together, these results indicate that Hypothesis 1 (Task and teamwork performance of individual team-members will be positively related to team performance) was partially supported. Specifically, both task and teamwork performance were not positively related to supervisory ratings of team performance. However, both task and teamwork performance were positively related to team-member ratings of team performance. Data also showed that task and teamwork performance were not related to team-performance when the effects of these variables on each other were controlled for.
Table 13

Hierarchical Regression with Team-Member Ratings of Team Performance as the Criterion Variable and Task and Teamwork Performance as Predictor Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggregated Task performance</td>
<td>0.556</td>
<td>0.118</td>
<td>0.622</td>
<td>4.695</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggregated Task performance</td>
<td>0.148</td>
<td>0.281</td>
<td>0.165</td>
<td>0.525</td>
<td>0.302</td>
</tr>
<tr>
<td>Aggregated Teamwork performance</td>
<td>0.395</td>
<td>0.249</td>
<td>0.501</td>
<td>1.590</td>
<td>0.061</td>
</tr>
</tbody>
</table>

Note. $r^2 = .39$ for Step 1 ($p < .05$); $\Delta R^2 = .04$ for step 2 ($p > .05$). $N = 36$. All $p$ values reflect one-tailed tests.

Interaction Effects of Motivation, and Knowledge and Skills on Performance

The interaction effects of motivation, and knowledge and skills on performance were tested with moderated regressions. Although researchers (e.g., Jaccard, & Wan, 1996; Ping, 1995) have proposed various methods to test interaction effects using SEM, the development of these methods are relatively new and further research is needed to determine the validity of these methods. For example, there is much debate in the literature regarding the treatment of error in such methods (McCloy et al., 1994). Furthermore, various statistical constraints have to be met when testing for interaction effects (Jaccard, & Wan, 1996). Because of these reasons, SEM is not widely used in the current literature to test interaction effects.
In the present study, hierarchical regression was conducted with task-KS and task motivation entered simultaneously in the first step and the product of these two variables (i.e., interaction term) entered in the second step. Change in \( R^2 \) was examined to determine whether the moderated model (the product of the two variables in step 2) significantly accounts for more variance in task performance than the additive model (the two variables entered simultaneously in step 1). A similar procedure was used to test the interaction effects of teamwork-KS and teamwork motivation on teamwork performance. This procedure for testing interaction effects using regression was suggested by Dwyer (1983). Results showed that the interaction of task-KS and task motivation did not account for more variance in task performance when compared to an additive model, \( \Delta R^2 (1, 123) = .00, p > .05 \), one-tailed (see Table 14). Thus, Hypothesis 2 (The interaction between task-KS and task motivation will affect task performance such that the relationship between task-KS and task performance will only hold when a minimal level of task motivation is present and vice versa.) was not supported. However, the results showed that the interaction of teamwork-KS and teamwork motivation accounted for more variance in teamwork performance when compared to an additive model, \( \Delta R^2 (1, 123) = .01, p < .05 \), one-tailed (see Table 15). Thus, Hypothesis 3 (The interaction between teamwork-KS and teamwork motivation will affect teamwork performance such that the relationship between teamwork-KS and teamwork performance will only hold when a minimal level of teamwork motivation is present and vice versa.) was supported.
Table 14

The Interaction Effects of Task-KS and Task Motivation on Task Performance

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
<th>1</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task-KS</td>
<td>0.682</td>
<td>0.073</td>
<td>0.596</td>
<td>9.361</td>
<td>0.000</td>
</tr>
<tr>
<td>Task Motivation</td>
<td>0.357</td>
<td>0.068</td>
<td>0.334</td>
<td>5.246</td>
<td>0.000</td>
</tr>
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<td>Step 2</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Task-KS</td>
<td>0.626</td>
<td>0.220</td>
<td>0.547</td>
<td>2.837</td>
<td>0.003</td>
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<tr>
<td>Task Motivation</td>
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<td>0.264</td>
<td>0.270</td>
<td>1.090</td>
<td>0.139</td>
</tr>
<tr>
<td>Interaction Term</td>
<td>0.016</td>
<td>0.059</td>
<td>0.106</td>
<td>0.106</td>
<td>0.394</td>
</tr>
</tbody>
</table>

Note. N = 126. All p values reflect one-tailed tests.

Table 15

The Interaction Effects of Teamwork-KS and Teamwork Motivation on Teamwork Performance

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
<th>1</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teamwork-KS</td>
<td>0.498</td>
<td>0.087</td>
<td>0.437</td>
<td>5.752</td>
<td>0.000</td>
</tr>
<tr>
<td>Teamwork Motivation</td>
<td>0.537</td>
<td>0.085</td>
<td>0.478</td>
<td>6.286</td>
<td>0.000</td>
</tr>
<tr>
<td>Step 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teamwork-KS</td>
<td>0.167</td>
<td>0.169</td>
<td>0.147</td>
<td>0.991</td>
<td>0.161</td>
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<tr>
<td>Teamwork Motivation</td>
<td>-0.009</td>
<td>0.255</td>
<td>-0.009</td>
<td>-0.038</td>
<td>0.484</td>
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<tr>
<td>Interaction Term</td>
<td>0.115</td>
<td>0.051</td>
<td>0.748</td>
<td>2.269</td>
<td>0.013</td>
</tr>
</tbody>
</table>

Note. N = 126. All p values reflect one-tailed tests.
Test of the Structural Model

Structural equation modeling was used to assess how individual attributes affect team-member performance. In SEM terms, constructs of interest are called latent variables (Schumacker & Lomax, 1996). Latent variables are what researchers are truly interested in. However, they cannot be directly observed. Therefore, various indicators or measures are used to obtain observable information regarding these variables. In SEM terms, these indicators are referred to as observed variables. For example, cognitive ability is a latent construct (i.e., it is the construct of interest but it cannot be directly observed). A score on the Wonderlic is an observed variable (i.e., it is an observable indicator of cognitive ability).

One advantage of SEM is that a full structural model can be tested depicting the relationships among all observed and latent variables. This method allows the researcher to account for measurement error in the traditional sense (i.e. uncorrelated measurement error) as well as correlated measurement error. However, test of a full structural model is not feasible in many situations because of the large number of parameters in such models. As a general rule-of-thumb, researchers (e.g., Raykov, & Widaman, 1995; Schumacker, & Lomax, 1996) suggest a sample size of 5 per estimated parameter. Therefore, a full structural model with a 30-item measure of one construct would require a minimum sample size of 150 just to test the relationship between the observed variables and one latent construct in the model. A full structural model with 3 such constructs would require a minimum sample size of 450. Such large samples may not be available to many
researchers and testing a model with a low parameter to sample size ratio has adverse effects on GOF measures (Cudeck, Henly, 1991; Williams & Holahan, 1994).

To resolve this problem, various researchers (e.g., Barrick, et al., 1993; Borman et al., 1995) have used scaled measures of the individual constructs as indicators of the latent constructs in question. For example, three constructs with 30 item measures each would be modeled such that the scaled score for each measure represents each latent variable. Using this approach reduces the number of estimated parameters in the model and thus such a model may be tested with a relatively small sample size.

In the present study, the above procedure was used to reduce the number of estimated parameters. Furthermore, measurement error was accounted for in the model by entering the error term (i.e. \[1- \alpha \sigma^2\]) for each measure (Bollen, 1989).

The GOF measures showed that a structural model with all measured variables has poor fit (see Table 16). Furthermore, examination of the path coefficients confirmed the findings of the GOF measures (see Figure 3). Specifically, task-KS and task motivation were significantly related to task performance, and teamwork-KS and teamwork motivation were significantly related to teamwork performance. However, task experience was not significantly related to task-KS, cognitive ability was not significantly related to task and teamwork-KS, Conscientiousness was negatively related to task and teamwork motivation, teamwork experience was not significantly related to teamwork-KS, and Extraversion and Agreeableness were not significantly related to teamwork motivation. Therefore, all remaining hypotheses were not supported.
As discussed previously, CFA revealed that task and teamwork performance measures may have been problematic. Therefore, the results of any analyses including these measures may be questionable. Thus, a structural model excluding these variables was examined. The results showed that a structural model excluding these variables also has poor fit (see Table 16).

![Structural Model](image)

Note: * = significant at .05, ** = significant at .01

Figure 3

**Structural Model**
Table 16

**GOF Measures for the Structural Model**

<table>
<thead>
<tr>
<th>Model</th>
<th>$\chi^2$</th>
<th>df</th>
<th>GFI</th>
<th>TLI</th>
<th>CFI</th>
<th>PNFI</th>
<th>RMSEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypothesized model</td>
<td>557.65</td>
<td>39</td>
<td>.62</td>
<td>.11</td>
<td>.48</td>
<td>.28</td>
<td>.32</td>
</tr>
<tr>
<td>Hypothesized model excluding performance measures</td>
<td>597.48</td>
<td>22</td>
<td>.47</td>
<td>-1.19</td>
<td>.00</td>
<td>-.01</td>
<td>.44</td>
</tr>
<tr>
<td>Alternative model</td>
<td>47.28</td>
<td>9</td>
<td>.93</td>
<td>.71</td>
<td>.96</td>
<td>.13</td>
<td>.18</td>
</tr>
</tbody>
</table>

In structural equation modeling, it is common practice to test the hypothesized model against alternative models (Schumacker & Lomax, 1996). In the present study, two alternative models were tested. First, a model representing direct paths between the individual attributes, and the two performance components (i.e., task & teamwork performance) was tested. This model represents relationships that are contradicting to Campbell et al.'s (1993) theory that the relationships between all individual attributes and performance are mediated by knowledge, skills, and motivation. The results showed that this alternative model has poor fit (see Table 16). Next, a model depicting all of the relationships in the hypothesized model plus direct links between ability and the two performance components, direct links between Conscientiousness and the two performance components, a direct link between Extraversion and teamwork performance, and a direct link between Agreeableness and teamwork performance was tested. This alternative model represents the findings of several studies that showed a direct
relationship between cognitive ability and performance in addition to the indirect relationship (e.g., Greguras, 1998), and studies that found a direct relationship between personality and performance in addition to the indirect relationship (e.g., Borman et al., 1991). In the present study, the solution to this model failed to converge.

There are several possible reasons why a solution to a structural model may not converge. These reasons include: inadequate number of iterations allowed to run, discrepant starting values of the unknown parameters, model misspecification, fluctuations in the variances and covariances in the observed variables, and small sample size (Bollen, 1989). In the present study, number of iterations allowed to run, and starting values were adjusted in an attempt to produce a converging structural solution. For example, number of iterations were adjusted up to 1,000, and starting values were set at .00 and .50. However, subsequent solutions with various adjustments did not converge. Therefore, it is unlikely that the nonconvergence of the structural solution is due to the number of iterations allowed to run or to the starting values of the unknown parameters. It is also unlikely that the nonconvergence of the structural solution has occurred because of the fluctuations in the variances and covariances in the observed variables because previous tests of the same set of data resulted in converging solutions. Model misspecification is also unlikely because this alternative model is almost identical to the hypothesized model with several added parameters. A more likely reason for the nonconvergence of the structural solution is that the sample size may have been inadequate given the number of parameters estimated in this alternative model. Monte Carlo studies have shown that nonconvergent solutions are often found in sample sizes
that are less than 150 (Bollen, 1989). Since the sample size in the present study was 135, it is likely that low sample size may have resulted in the nonconvergent solution of this structural model.
DISCUSSION

The purpose of this study was to present and to test a theoretical model that depicts how individual attributes affect team-member performance, and how team-member performance ultimately affects team performance. Although models of team performance have been proposed in previous studies (e.g., Cohen et al., 1996; Gladstein, 1984; Klimoski, & Jones, 1995; Nieva, et al., 1978), there is little or no empirical evidence supporting these models. Furthermore, the purpose of these models was to provide an all-encompassing view of team performance. Therefore, specific individual attributes that may be important to team performance were not specified. On the other hand, the literature on individual performance (e.g., Campbell et al., 1996; Hunter, 1983; Schmidt, et al., 1986) has explained how various individual attributes affect job performance at the individual level. The proposed model was based on the integration of the literature on individual and team performance. From a practical standpoint, understanding the relationships among the variables in the proposed model may be important for the selection of employees in team-based organizations.

In general, the results did not support the proposed model. However, some of the specific relationships proposed in the model were supported. First, both task and teamwork performance were significantly related to team-member ratings of team performance. In addition, both task-KS and task motivation were significantly related to task performance. Furthermore, both teamwork-KS and teamwork motivation were significantly related to teamwork performance. In addition, the relationship between teamwork-KS and teamwork performance was moderated by teamwork motivation.
Before making any conclusions regarding these results, some qualifications should be made. First, the test of the measurement model showed that the performance measures may have been problematic. In addition, the results of SEM showed that the proposed model did not fit the data. In other words, the overall theory proposed in the present study was not supported. Therefore, results regarding the relationships between individual variables should be interpreted with caution.

There are several possible reasons for the lack of support for the proposed model. First, the relationships depicted in the proposed model may not explain how individual attributes affect individual performance and how individual performance ultimately affects team performance. Perhaps other models may be more effective in explaining the relationships among these variables. In the present study, one alternative model was examined. This alternative model was based on the idea that all individual attributes directly affect performance. However, the alternative model was also not supported. Given the lack of significant correlations between many of the individual attributes and the performance variables, it is unlikely that any alternative model would fit the data in the present study.

Perhaps the individual attributes examined in the present study were poor predictors of performance. However, the predictors examined in the present study have been found to be valid across a large number of jobs. For example, numerous studies have demonstrated that cognitive ability may be the single best predictor of performance for virtually all jobs (e.g., Hunter & Hunter, 1984). Furthermore, a meta analysis by Barrick and Mount (1991) found that Conscientiousness was a valid predictor of job
performance across all occupational types. Therefore, it is unlikely that the predictors in the present study were problematic.

Another possible reason for the lack of results in the present study is that the criterion measures may have been problematic. For example, CFA revealed that problems in the measurement model were mainly caused by the poor fit of the task and teamwork performance measures. This issue in particular and other limitations of the present study will be discussed in the next section.

**Limitations**

In the present study, every attempt was made to reduce methodological limitations. However, as in any study, practical constraints made it impossible to remove all such limitations. There were several limitations in the present study. First, all participants in the present study were job incumbents who have gone through a rigorous selection process. Therefore, restriction of range may have been a problem. In general, the standard deviations of the knowledge and skills, motivation, experience, and performance measures were less than 1 on a 5-point scale. Although the variability of these measures was consistent with other studies (e.g., Greguras, 1998), these studies were also conducted with job incumbents. Second, because the present study was conducted in an organizational setting with active fire companies, several participants were interrupted during the survey to respond to fire alarms. This interruption may have affected how these participants completed the measures. Third, several teams were missing one or more members due to individuals being absent from work, being on vacation, attending a training class, or exercising their right not to participate. Although
data from teams with more than one member missing from the study were excluded from the group level analyses, these missing data may have affected the aggregated information regarding team-member task and teamwork performance. Third, because the proposed model hypothesized complex relationships across levels of analysis, the entire model could not be tested simultaneously as a single structural model. Therefore, definite conclusions regarding how individual attributes among team-members affect team performance could not be drawn. Although these limitations warrant some concern, one particular limitation may have been especially problematic. This limitation concerns the measures that were assessed via subjective ratings of team-members (i.e., peers).

In the present study, subjective ratings provided by the team-members were used to assess task-KS, teamwork-KS, task motivation, teamwork motivation, task performance, teamwork performance, and team performance. Team-member ratings of these constructs were used for several reasons. First, because the participants worked closely together in a team environment, team-members would have had the best opportunity to observe each other's behavior. Furthermore, due to the length of the battery of tests and questionnaires administered to the participants, assessing knowledge and skills through a written or a work sample test was impractical. In addition, team-member ratings were used instead of self-report measures because self-report measures may be prone to social desirability (Edwards, 1964). Furthermore, research suggests that peer ratings may be a valid measure of performance. For example Harris and Schaubroeck (1988) found that peer ratings are highly correlated with supervisory ratings of performance. In addition, in a multitrait-multirater study, Mount, Judge, Scullen,
Sytsma, & Hezlett (1998) found that peers ratings show discriminant validity between different performance factors.

In the present study, there are several findings which indicate that subjective ratings provided by the team-members may have been problematic. For instance, examination of the correlation matrix among all variables at the individual level of analysis showed that all measures that were assessed via team-member ratings were significantly related, with correlations ranging from $r = .69$ to $r = .88$ (see Table 9). However, measures assessed through other methods were not correlated at such a high magnitude. Although CFA showed that the hypothesized factors fit significantly better than factors based on method bias, high correlations among measures assessed via just one method of measurement is of concern. Furthermore, the relationships between the constructs measured via team-member ratings and constructs measured via other methods were inconsistent with the results of other studies in the literature. For example, in the present study, cognitive ability was not related to peer ratings of task or teamwork performance. This finding is inconsistent with the findings of numerous studies which have demonstrated that cognitive ability may be the single best predictor of performance for virtually all jobs (e.g., Hunter & Hunter, 1984). In addition, the magnitude of the relationships among constructs assessed though team-member ratings was inconsistent with the results of other studies in the literature. For example, in the present study, the relationship between peer ratings of task-KS and task performance was $r = .73$. However, other studies have shown a much lower relationship between these constructs (e.g., Hunter, 1983). Finally, examination of the correlation matrix among all variables at the
group level of analysis showed that subjective ratings provided by the team-members were negatively related to supervisory ratings of team performance (see Table 11). Although most of these negative relationships were non significant, this finding nevertheless indicates that the team-members were not in agreement with the supervisors regarding the performance of the team and other related aspects of performance at the group level.

There are several possible reasons for the problems with team-member ratings encountered in the present study. One possible reason is that the firefighters not only work closely together but they have close personal ties with each other. In fact, the firefighters spend a continuous 24 hour period with each other whenever they are on duty. Although they are at work during this period, the fire station is mostly made up of common areas where it would be impossible for the firefighters to not socialize with each other. In a restatement of Wherry’s theory of performance ratings, Wherry and Bartlett (1982) stated that close personal ties between the rater and the ratee would result in less accurate ratings because such a relationship gives the rater the opportunity to observe the behavior of the ratee in a context that is irrelevant to the job. Therefore, close personal ties among the team-members may have resulted in less accurate peer ratings and team-member ratings of the company as a whole. The high correlations among measures assessed through team-member ratings may reflect the observation of non-job-relevant behaviors influencing the team-members’ responses across these measures. The lack of relationship between measures assessed via team-member ratings and other measures may
indicate that the non-job-relevant behaviors reflected in these measures may not be related to cognitive ability, personality, and experience.

Another possible reason for the problems with team-member ratings in the present study is that the participants may have been reluctant to provide any negative information regarding their fellow team-members or their fire company due to a strong feeling of loyalty among the company members. Furthermore, the company members seemed to be distrustful of anyone associated with the fire headquarters or the city government asking questions regarding their performance. In fact, situations similar to the one encountered in the present study have been experienced by researchers conducting studies in other civil service organizations (A. M. Ryan, personal communication, February 25, 1999). In particular to the organization examined in the present study, the feelings of mistrust toward management may have been compounded by previous performance evaluations that have resulted in low performing firefighters being fired from their jobs. The strong feelings of loyalty among the firefighters coupled with their mistrust of upper management and outsiders to the department may have contributed to the problems with team-member ratings obtained in the present study. For example, the factors mentioned above may have caused the participants to upwardly bias the ratings of their fellow team-members. The high correlations among measures assessed through team-member ratings may be the result of these measures reflecting this bias. Furthermore, the lack of relationship between measures assessed through team-member ratings and other measures may indicate that the bias reflected in these measures may not be related to cognitive ability, personality, and experience.
According to Murphy and Cleveland (1995), rating context such as political conditions, and organizational climate and culture has an effect on subjective ratings. More specific to the team setting, results of studies on team-member performance appraisal have shown that team context has a significant effect on the ratings of the individual team members (e.g., Grey & Kipnis, 1976; Liden & Mitchell, 1983; Mitchell & Liden, 1982). Although, the participants were informed that all responses will be confidential and that the information that they provide will not affect any administrative decisions, the political climate of the organization may have been strong enough for them to ignore or discount these assurances.

In addition to the problems mentioned above, there may have been other problems with the performance measures used in the present study. For example, CFA revealed that problems in the measurement model were mainly caused by the poor fit of the task and teamwork performance measures. In the present study, the task performance measure was developed by examining existing job analysis data, and the teamwork performance measure was developed by reviewing the literature on teamwork performance. To keep the length of these measures reasonably short, one or two items were developed for major areas in each of these performance factors. For example, proficiency in applying tactical procedures is a major part of a fire fighter’s job consisting of many different tasks. However, this area of performance was assessed by just one item. It is possible that the poor measurement properties of the performance measures are due to each item in these measures representing separate subcomponents of task and
teamwork performance. In other words, task and teamwork performance may each consist of several subcomponents.

On the group level of analysis, supervisory rating of team performance was in large part negatively correlated to team-member rating of team performance and aggregated task and teamwork performance. This result may be due to the district fire chiefs working mainly at the district headquarters and not observing the behavior of the company level personnel on a daily basis. This problem may have been compounded by all of the problems with the team-member ratings and the performance measures discussed previously.

Another possible reason for the negative correlation between the team-member ratings and the supervisory ratings is that poorly performing individuals in certain fire companies may have inflated the ratings of their fellow team-members and the companies that they belonged to. This notion is consistent with the results of a study that showed that a rater's relative performance level affected their assessment of their peers and their team as a whole (Saavedra & Kwun, 1993). It is possible that poorly performing members are not able to discriminate between poor and good performance. Therefore, poor performers may rate their peers or their team as performing adequately, although their actual performance may be poor. Furthermore, poor performers may inflate ratings because they are more likely to make external attributions regarding performance. For example, poor performers may inflate the ratings of their peers because they may feel that the performance of their peers was caused by external factors such as equipment failure. Thus, inflated ratings from poorly performing team-members from poorly performing
teams may have caused a negative correlation between team-member ratings and supervisory ratings of performance.

**Implications**

Despite the lack of support for the proposed model, there were several interesting results in the present study. First, task-KS was found to be a separate construct from teamwork-KS, task motivation was found to be a separate construct from teamwork motivation, and task experience was found to be a separate construct from teamwork experience.

One implication of these findings is that assessing knowledge, skills, motivation, and experience for several appropriate job performance dimensions may be useful for selecting employees who may perform well in all aspects of their job. In team-based organizations, selecting individuals based on knowledge, skills, motivation, and experience regarding task and teamwork may result in employees who perform well on their job specific tasks and work well with others in a team environment.

As mentioned previously, there were various problems with the use of team-member ratings in the present study. These problems seem to be consistent with various studies that found that ratings in a team setting may be affected by contextual factors (e.g., Grey & Kipnis, 1976; Liden & Mitchell, 1983; Mitchell & Liden, 1982). Furthermore, these problems seem to have been magnified by the political context of the organization examined in the present study. Although these may have been limitations in the present study, this information has important implications for conducting performance evaluations in a team setting. In future research, every attempt should be made to reduce
these effects. For example, alternate methods of measurement such as supervisory ratings and objective measures should be considered. Furthermore, the political climate of the organization should be examined carefully before conducting any performance evaluations.

Conclusion

In the present study, an initial attempt was made to model the contribution of individual attributes to team performance. However, the results did not support the proposed model. Future research should focus on developing and testing alternative models of individual contribution to team performance. Although an alternative model was tested in the present study, the alternative model was also not supported. Because of the non significant correlations among many of the variables, it is doubtful that any alternative model would fit the data in the present study. Future research should replicate the present study with a different set of measures and context. Specifically, lessons learned from the use of team-member ratings in the present study should be applied in future research. Furthermore, future studies should examine models of individual contribution to team performance and with samples from different types of work teams. Understanding how individual attributes affect team performance is an important theoretical and a practical issue that warrants further research.
REFERENCES


*Psychometrika, 29*, 295-308.


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APPENDIX A

TAXONOMY OF TEAM PERFORMANCE FUNCTIONS

I. Orientation Functions
   A. Information exchange regarding member resources and constraints
   B. Information exchange regarding team task and goals/mission
   C. Information exchange regarding environmental characteristics and constraints

II. Resource Distribution Functions
   A. Matching member resources to task requirements
   B. Load balancing

III. Timing Functions (Activity Pacing)
   A. General activity pacing
   B. Individually oriented activity pacing

IV. Response Coordination Functions
   A. Response sequencing
   B. Time and position coordination of responses

V. Motivational Functions
   A. Development of team performance norms
   B. Generating acceptance of team performance norms
   C. Establishing team-level performance-reward linkages
   D. Reinforcement of task orientation
   E. Balancing team orientation with individual competition
   F. Resolution of performance-relevant conflicts

VI. Systems Monitoring Functions
   A. General activity monitoring
   B. Individual activity monitoring
   C. Adjustment of team and member activities in response to errors and omissions

VII. Procedure Maintenance
   A. Monitoring of general procedural-based activities
   B. Monitoring of individual procedural-based activities
   C. Adjustments of nonstandard activities

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APPENDIX B

SAMPLE QUESTIONS FROM THE WONDERLIC PERSONNEL TEST

1. Wire is 12.5 cents a foot. How many feet can you buy for a dollar? ..........[ ___ ]

2. APPEAL is the opposite of
   1 beseech, 2 entreat, 3 request, 4 deny, 5 invoke.................................[ ___ ]

3. A rectangular bin, completely filled, holds 640 cubic feet of grain.
   If the bin is 8 feet wide and 10 feet long, how deep is it?.........................[ ___ ]

4. What is the next number in the series? 16 4 1 .25.................................[ ___ ]
APPENDIX C

EXPERIENCE MEASURES

Please indicate your level of experience on each item by circling the appropriate response using the following scale. Your responses should be based on your level of experience compared to other firefighters.

1 = Little experience
2 = Some experience
3 = Moderate experience
4 = More than average experience
5 = Extensive experience

When answering the following three questions, please consider all of your experiences as a firefighter including volunteer work, training, experiences at fire and rescue scenes, and experiences from your current and all previous jobs as a firefighter.

<table>
<thead>
<tr>
<th>Question</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Working as a firefighter.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Performing the job of a firefighter.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Conducting fire and rescue operations.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

When answering the following questions, please consider all of your experiences in teamwork including sports and other extracurricular activities, and all job-related teamwork experiences from your current and all previous jobs.

<table>
<thead>
<tr>
<th>Question</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Working in teams.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Performing various activities requiring teamwork.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Being involved in situations where teamwork was required.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX D

SAMPLE ITEMS FROM THE NEO-FFI

All responses are on a 5-point scale with “SD” indicating “Strongly Disagree” and “SA” indicating “Strongly Agree”.

Conscientiousness Facet

I try to perform all the tasks assigned to me conscientiously.

I work hard to accomplish my goals.

When I make a commitment, I can always be counted on to follow through.

Extraversion Facet

I laugh easily.

I like having a lot of people around me.

I really enjoy talking to people.

Agreeableness Facet

I try to be courteous to everyone I meet.

I would rather cooperate with others than compete with them.

Most people I know like me.
APPENDIX E

TASK-KS MEASURE

Please rate the extent to which you agree or disagree with the following statements about this company member by circling the appropriate response using the following scale.

1 = Strongly Disagree
2 = Disagree
3 = Neither Agree or Disagree
4 = Agree
5 = Strongly Agree

1. This individual possesses the technical knowledge and skills required to be a firefighter.

2. This individual understands what is necessary to operate at a fire or rescue scene.

3. This individual is knowledgeable about firefighting.
APPENDIX F

TEAMWORK-KS MEASURE

Please rate the extent to which you agree or disagree with the following statements about this company member by circling the appropriate response using the following scale.

1 = Strongly Disagree
2 = Disagree
3 = Neither Agree or Disagree
4 = Agree
5 = Strongly Agree

1. This individual possesses the knowledge and skills required to be a “team player”.

2. This individual understands what is necessary to be a team-member.

3. This individual is knowledgeable about teamwork.
APPENDIX G

TASK & TEAMWORK MOTIVATION MEASURES

Please rate the extent to which you agree or disagree with the following statements about this company member by circling the appropriate response using the following scale.

1 = Strongly Disagree
2 = Disagree
3 = Neither Agree or Disagree
4 = Agree
5 = Strongly Agree

Task Motivation Items

<table>
<thead>
<tr>
<th>Item</th>
<th>1 2 3 4 5</th>
<th>1 2 3 4 5</th>
<th>1 2 3 4 5</th>
<th>1 2 3 4 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. If given the choice, this individual is likely to work as a firefighter rather than any other job.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. This individual works harder at firefighting than most other firefighters.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. This individual is willing to work extra hours to get the job done.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. This individual gives up easily when the task becomes too difficult or the working conditions become uncomfortable. (r)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Teamwork Motivation Items

<table>
<thead>
<tr>
<th>Item</th>
<th>1 2 3 4 5</th>
<th>1 2 3 4 5</th>
<th>1 2 3 4 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. If given the choice, this individual is likely to work with others rather than work alone.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. This individual does not get involved in team activities unless it is required. (r)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. This individual cooperates and coordinates activities with other company members.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. This individual is persistent at gaining acceptance and cooperation from the other company members.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: (r) represents reverse coding.
APPENDIX H

TASK & TEAMWORK PERFORMANCE MEASURES

Please rate this company member's performance on each work task using the following scale.

1 = Inadequate - Use this rating if the individual consistently performs poorly or inadequately on the task.

2 = Marginal - Use this rating if the individual performs some aspects of the task adequately and others inadequately.

3 = Average - Use this rating if the individual performs the task at a level that is normally acceptable.

4 = Above Average - Use this rating if the individual usually performs better than what is normally expected.

5 = Superior - Use this rating if the individual consistently performs the task in an outstanding manner.

<table>
<thead>
<tr>
<th>Job Specific Task Proficiency</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Proficiency in reacting to alarms.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Observing and evaluating fire and rescue ground situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Proficiency in applying tactical procedures.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Proficiency in operating in a post-fire scene.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Operating/using tools and equipment in an optimal manner.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Proficiency in utilizing firefighting equipment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Taking care of all assigned tools and equipment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teamwork Proficiency</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>----------------------------------------------------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>1. Communicating with other company members regarding important aspects of work.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. Coordinating activities with the activities of others in the company.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. Accepting constructive criticism from company members and correcting one's behavior accordingly.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. Providing appropriate feedback to company members regarding aspects of their behavior that affect the company as a whole.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. Motivating company members by praising their good performance.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6. Encouraging company members when they are not performing well.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7. Cooperating with others in the company to accomplish common goals.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8. Resolving conflicts with other company members in a tactful manner.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9. Being involved in tactical planning and contributing to team decisions.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
APPENDIX I

TEAM PERFORMANCE MEASURE

Please rate the performance of your FIRE COMPANY AS A WHOLE, using the scale provided below.

1 = Inadequate - Use this rating if your company consistently performs poorly or inadequately on the task.

2 = Marginal - Use this rating if your company performs some aspects of the task adequately and others inadequately.

3 = Average - Use this rating if your company performs the task at a level that is normally acceptable.

4 = Above Average - Use this rating if your company usually performs the task at a level that is better than what is normally expected.

5 = Superior - Use this rating if your company consistently performs the task in an outstanding manner.

| 1. Quickly and safely responding to alarms and radio communications. | 2  3  4  5 |
| 2. Extinguishing and controlling the intensity of fires. | 2  3  4  5 |
| 5. Conducting rescue operations. | 2  3  4  5 |
| 4. Conducting post-fire activities (e.g., salvage, overhaul). | 2  3  4  5 |
| 5. Allocating and using firefighting equipment in an optimal manner. | 2  3  4  5 |
| 6. Testing and maintaining firefighting equipment. | 2  3  4  5 |
| 7. Developing company morale. | 2  3  4  5 |
| 8. Conducting fire prevention and public safety activities. | 2  3  4  5 |
| 9. Overall company performance. | 2  3  4  5 |
| 10. Proficiency of the company in completing all assigned tasks. | 2  3  4  5 |
VITA

Joe J. Yum was raised in Honolulu, Hawaii, where he attended President William McKinley High School. Upon graduating from high school, he entered an early commissioning program at Kemper Military Junior College in Boonville, Missouri, where he served as a Company Commander and later as an Operations Officer for the Kemper Corps of Cadets. The author graduated from Kemper with an Associate of Arts degree in Liberal Arts and was also commissioned as a Second Lieutenant in the United States Army in May of 1989. He continued his college education at University of Hawaii at Manoa while serving as a Fire Support Officer for the Hawaii Army National Guard. The author graduated from the University of Hawaii with a Bachelor in Business Administration degree in Business Management in August of 1992. Upon graduation, he worked as a teacher in Honolulu and later moved to Portland, Oregon, where he worked as a recruiter for United Parcel Service. The author pursued his graduate education by enrolling in the Industrial and Organizational Psychology Program at Louisiana State University in August of 1995. He received a master of arts degree in psychology at Louisiana State University in December of 1997. The author's research interests include work teams and groups, performance appraisal, and employee selection. He is particularly interested in practical applications of research in an organizational setting. The author will receive the degree of Doctor of Philosophy in August of 1999.
Candidate: Joe J. Yum

Major Field: Psychology

Title of Dissertation: The Effects of Team-Member Attributes on Team Performance: A Model of Individual Contribution to Team Performance

Approved:

Major Professor and Chairman

Dean of the Graduate School

EXAMINING COMMITTEE:

Date of Examination:

5-4-1999