Criterion-Related Validity of Statistical Operationalizations of Group General Cognitive Ability as a Function of Task Type: Comparing the Mean, Maximum, and Minimum

ERIC ANTHONY DAY
University of Oklahoma

WINFRED ARTHUR, JR., BRUCE MIYASHIRO, AND BRYAN D. EDWARDS
Texas A&M University

TRAVIS C. TUBRÉ, AND AMBER HANSON TUBRÉ
University of Wisconsin, River Falls

The objective of the present study was to investigate the comparative criterion-related validity of different statistical operationalizations of group general cognitive ability (i.e., mean, maximum, and minimum) as a function of task type based on Steiner's (1966, 1972) task typology. In contrast to recent investigations, we hypothesized that, regardless of task type, the mean of group members' general cognitive ability would predict group performance as well as or better than other statistical operationalizations of group general cognitive ability. We conducted a laboratory study where 157 four-person groups worked on 4 tasks that conformed to Steiner's typology (additive, compensatory, conjunctive, and disjunctive). The results indicate that the mean was the strongest predictor of group performance across all 4 task types and, in particular, was significantly stronger than the maximum and minimum on both the disjunctive and conjunctive tasks.

Researchers have used different statistical operationalizations (e.g., mean, maximum, and minimum) in investigations of how group general cognitive ability and personality are related to group performance (e.g., Barrick, Stewart, Neubert, & Mount, 1998; Barry & Stewart, 1997; Neuman, Wagner, & Christiansen, 1999; Neuman & Wright, 1999). In these investigations, researchers frequently discuss the importance of task type to the operationalization of group ability. In contrast,

1Portions of the data were collected as part of Bruce Miyashiro's doctoral dissertation, completed at Texas A&M University and directed by Winfred Arthur. Data for this study were collected when Eric Day was a visiting professor at Ohio State University. Bryan Edwards is now at Tulane University.

2Correspondence concerning this article should be addressed to Eric Day, Department of Psychology, University of Oklahoma, 455 W. Lindsey, Room 705, Norman, OK 73019-2007. E-mail: eday@ou.edu
we argue that, regardless of the type of task, the mean of group members’ general cognitive ability predicts group performance as well as or better than other operationalizations of group general cognitive ability. To support this argument, we first present a critical discussion of Steiner’s (1966, 1972) typology and show that, contrary to recent statements (e.g., LePine, Hollenbeck, Ilgen, & Hedlund, 1997; Neuman & Wright, 1999), the mean is an appropriate operationalization of group general cognitive ability, regardless of task type. Second, we review the supportive empirical literature. Finally, we present results from a laboratory study where we explicitly manipulated the type of task in order to compare the criterion-related validity of the mean versus the maximum and minimum operationalizations of group general cognitive ability. It is important to note that the scope of our investigation is limited to contexts in which general cognitive ability is the predictor and task performance is the criterion of interest.

Staffing Groups and Group-Based Predictors

For more than 40 years, researchers have recognized the importance of work groups and teams to organizational functioning (e.g., Cummings & Malloy, 1977; Goodman, Ravlin, & Schminke, 1987; Hackman, 1987, 1990; Kanter, 1986; Levine & Moreland, 1990; Lorge, Fox, Davitz, & Brenner, 1958; Offermann & Gowing, 1990, 1993; Stevens & Campion, 1994). Indeed, reliance on groups is a pervasive phenomenon in organizations, with groups often outperforming individuals on many tasks (Goldman, 1965; Stasser & Stewart, 1992). Furthermore, many of today’s tasks involve physical and cognitive demands that are far too diverse and complicated for any single individual to accomplish successfully.

The prevalence of groups in organizations highlights the importance of group staffing (Stevens & Campion, 1999). Although groups are used widely in organizations, current selection models use individual-level predictor measures to make selection decisions for jobs (e.g., Cascio, 1998; Klimoski, 1993; Offermann & Gowing, 1993) that are performed within a group context. That is, there is a mismatch in the level of analysis between the criteria and predictors (Goodman et al., 1987; Rousseau, 1985). Therefore, it would seem more appropriate to use

3Cognitive ability refers to the power or capacity to engage in mental activities (Ree, Carretta, & Steindl, 2001). We consider general cognitive ability to be the element that is common across a variety of mental activities. Examples of mental activities include remembering information; producing ideas; solving problems; and perceiving, comparing, and evaluating stimuli (Guion, 1991). With respect to statistical operationalizations of group general cognitive ability, we take a perspective similar to that taken by LePine et al. (1997). That is, we consider a statistical operationalization an aggregation of individuals’ general cognitive abilities. We do not mean to characterize teams as intelligent. Rather, individuals can be characterized as intelligent. We view a statistical operationalization of group general cognitive ability as a way of representing the resources that a group has to engage in mental activities, which in turn influence a group’s task performance.
group-based information in these contexts. Specifically, the staffing of work groups may require group-level predictors, as opposed to individual-level predictors.

It is important to note that many researchers have made distinctions between groups and teams (e.g., Cannon-Bowers, Salas, & Converse, 1993; Dunphy & Bryant, 1996; Guzzo & Dickson, 1996). In the present study, we adopt Dunphy and Bryant's perspective that teams are a special kind of group, and as such, both the group and team literatures are relevant to our investigation. Consequently, where relevant, both group and team literatures will be cited, using the term group or team as they were employed by the original authors, realizing, however, that the authors may not have made the same distinctions between the two concepts.

Group-level predictors of ability can be operationalized in one of two ways: (a) by using statistical estimates or operationalizations of group ability (e.g., group mean, minimum, maximum, or standard deviation score on the predictor); or (b) by actually having the group collectively and collaboratively perform the predictor test to obtain a group ability score. The conceptual appeal of the latter approach lies in its ability to capture in the predictor the interactive processes that are important in group task performance and more closely approximate the processes the group will exhibit in the performance of the criterion task.

Despite the advantages associated with operationalizations of group ability that capture the interactional processes among group members, such operationalizations have yet to be used in either applied or research contexts. There are two primary reasons why this may be the case. First, the applied utility of interactional group-based validation efforts is based on the premise that the validation groups will, in fact, be hired and subsequently operate and perform within the organization as a functioning group or unit. This situation is most unlikely, given subsequent placement decisions that are typically made upon hire (cf. Moreland, Argote, & Krishnan, 1998). A second applied problem with serious legal implications is that such a selection and validation paradigm implies that hiring decisions, from an applicant's perspective, are based not only on his or her own ability, but also on that of the other individuals in his or her predictor group. As such, an applicant may fail to be hired based not on his or her own ability, but on the ability of other members of the predictor group. This issue is also relevant to decisions pertaining to compensation, promotion, and termination.

Type of Task and Statistical Operationalizations of Group Ability

Alternatively, because of their ease of use, researchers have used various statistical operationalizations in their investigations of how variables such as cognitive ability and personality are related to group performance (e.g., Barrick et al., 1998; Barry & Stewart, 1997; Neuman et al., 1999; Neuman & Wright,
In these investigations, researchers frequently discuss the importance of task type to the appropriate choice of statistical operationalization. Although multiple task typologies exist, researchers (e.g., Barrick et al., 1998; Neuman & Wright, 1999) typically invoke Steiner's (1966, 1972) typology.

Steiner (1966, 1972) identified four types of group tasks that differ in terms of how members' individual contributions are combined: additive, disjunctive, conjunctive, and compensatory. In the additive model, every member performs exactly the same task or function, and group performance is the sum of each individual member's contribution. Steiner used the example of group members pulling on a rope to illustrate this task type; but other real-world examples include individual members shoveling snow, picking berries, hoeing a field, and lifting heavy objects. More industrial examples include a group of workers who individually assemble complete products (e.g., sewing shirts) and a group of telemarketers who work in the same office.

In the disjunctive task, Steiner (1972) explained how the contribution of the group's most competent member determines the performance of the group. In the case of pulling a rope, the task would become disjunctive if each member was required to take an individual turn, and the group's score would be the score of the member who did the best. Steiner also described how problem-solving tasks are disjunctive when the group must select one of two or more discretely different options as the group's solution. This type of scenario is characterized by a problem in which a correct answer, whether intuitively recognized once presented ("Eureka!") or proven to be demonstrable when presented by a single individual, solves the problem for the group. An example of a disjunctive scenario would be a group of mathematicians solving the same equation.

In contrast, a task is said to be conjunctive when the worst performing member determines the group's performance. A rope-pulling contest would be conjunctive if each member was required to take an individual turn, and the group's score would be the score of the member who did the least well. Steiner (1972) also described how situations are conjunctive when all group members must succeed in order for the group to succeed. Examples of conjunctive tasks include a team of mountain climbers who can proceed no faster than the slowest member and a patrol of soldiers, all of whom must pass a sentry in order for the entire patrol to remain undetected. A key distinguishing feature of conjunctive tasks is that there is little redundancy between individual group members' roles and responsibilities. An example of a conjunctive task in an industrial context is a production assembly line.

Lastly, a compensatory task is one in which the group has to make a judgment about an issue or problem that has no readily demonstrable solution, and biases or errors in judgment are cancelled by opposing biases. Although for this type of

4Steiner (1972) also used the term discretionary when discussing the compensatory type.
task the group is frequently permitted to combine member contributions in any manner the group sees fit, the typical case is one in which each individual’s contribution is likely to influence the group’s final decision. Specific examples of this type of task include making judgments about the temperature of a room, estimating the number of beans in a jar, and forecasting stock prices.

Accordingly, it is commonly believed that the maximum should be used for group-level statistical operationalizations of general cognitive ability for disjunctive tasks, the minimum for conjunctive tasks, and the mean (or sum) for additive and compensatory tasks. Thus, it is not unusual for researchers to describe the nature of the group task in their investigations to justify the choice of one of these operationalizations (e.g., LePine et al., 1997; Neuman & Wright, 1999). However, a closer look at Steiner’s (1966, 1972) typology suggests that the mean of group members’ general cognitive ability may, in fact, be a better predictor of group performance compared to the maximum and minimum for disjunctive and conjunctive tasks, respectively.

Reconceptualizing Disjunctive and Conjunctive Tasks

Frequently, discussions of disjunctive tasks are inconsistent with the notion that the mean is the best operationalization of group ability. Because disjunctive tasks are often characterized as having objective (verifiable) solutions, it was initially proposed by Steiner (1966) that, as long as one group member could solve the group’s problem, the group would succeed. However, empirical research and reconceptualizations indicate that the more likely situation is one where there must be support for the correct solution from multiple members before a group will ultimately adopt the correct solution (Laughlin, Kerr, Davis, Halff, & Marciniak, 1975). In other words, the disjunctive type is more characteristic of the group’s potential for performance, rather than the group’s actual performance (McGrath, 1984; Steiner, 1966, 1972). Indeed, in his discussions of disjunctive scenarios, Steiner (1972) stated “the greater the proportion of group members who can solve the problem, the greater is the frequency with which the correct solution is proposed” (p. 27).

The actual performance of the group often falls below the group’s potential because the most competent person in the group is not always able to sway others in the group to adopt his or her decision. That is, if other group members initially favor a decision other than the decision of its most competent member, then the most competent member may have difficulty convincing the other members to adopt his or her decision. Moreover, the difficulty in convincing other group members will be compounded if the most competent member has low social status in the group, is not very confident of his or her own ability, or does not aggressively present arguments in support of his or her ideas (Steiner, 1972).
Along these lines, it is apparent that a group's performance is not solely a function of the abilities of its members, but it is also a function of motivation and coordination. Improving motivation and coordination is not simply a matter of increasing the participation of each group member. Without knowledge of group members' differing capabilities, increasing participation of all group members may even be deleterious to performance (Littlepage, 1991). Research on trans-active memory systems has indicated that it is not enough just to have highly capable members in a group; rather, the group also must be able to recognize and make effective use of those capabilities (Moreland, 1999).

With respect to disjunctive problems, when only one member knows the correct solution, it is essential that group members are able to identify who that individual is and implement his or her solution (Hollingshead, 1998). If members' differing capabilities are not obvious to all group members, then more than one group member must be able to individually arrive at the correct solution for the correct solution to be adopted. Although a single minority opinion can at times exert great influence on other group members (Moscovici, 1980), a minority member is more likely to influence other group members' private beliefs, rather than their public beliefs (i.e., opinions voiced in the presence of others; Wood, Lundgren, Ouellette, Busceme, & Blackstone, 1994). Moreover, a minority of two is more likely to sway the rest of the group than is a minority of one (Moscovici & Lage, 1976). Consequently, in cases where only one member knows the correct solution, it is likely that the other group members will rule against that person and the group will adopt an incorrect solution. In sum, for intellective tasks that can be labeled eureka problems, the proportion of group members who know the correct solution is a better indicator of group performance compared to whether or not the group simply has one member who knows the correct solution (cf. Laughlin & Bitz, 1975). Therefore, the mean of group members' general cognitive ability would provide a better estimate of group performance than the maximum for tasks that are described as disjunctive.

Researchers also have called for a reconceptualization of Steiner's (1966, 1972) conjunctive model. For example, Tziner and Eden (1985) experimentally manipulated the ability composition of three-men tank crews that consisted of three roles: mover, loader, and operator. Members of these tank crews were characterized as having very little, if any, redundancy in their roles and responsibilities. Therefore, these tank crews were consistent with Steiner's (1966, 1972) description of a conjunctive model. Their results, however, reflected both additive and nonadditive effects. Ability composition for crews containing two low-ability members with one high-ability member and one low-ability member with two high-ability members predicted group performance in an additive fashion, but the performance of crews containing three high-ability members was higher than that predicted by a purely additive model. Although in the discussion of
their findings Tziner and Eden stated that group performance for tasks requiring coordination between members who have distinct roles is likely to relate positively to the summed abilities of all group members, they also concluded that nonadditive, synergistic effects may occur when a group is composed of all highly capable individuals.

LePine et al. (1997) offered a helping hypothesis to explain why the minimum may not be the best choice for an operationalization of team ability for conjunctive tasks. They tested a conjunctive model with respect to the tactical decision making of four-person teams whose members had little redundancy in their responsibilities. Although they found initial support for the conjunctive model, they also found main effects for the additive and disjunctive models. Correlations with group performance for the mean, maximum, and minimum of cognitive ability were .39, .37, and .30, respectively. To explain these findings, they suggested that high-ability team members may have helped low-ability members to compensate for the negative (undermining) influence of low-ability members' behaviors.

Although this may be true for many conjunctive situations, there may be times when group members cannot immediately help each other with their respective duties. For example, the highly paced nature of many manufacturing assembly lines makes it difficult for group members to leave their posts to help another member of the assembly group. Even in these instances, we still would argue that the mean of group members' general cognitive ability would be a better predictor of group performance versus the minimum of group members' general cognitive ability because each group member has unique responsibilities (characteristic of the conjunctive task), and all individual roles and responsibilities must be successfully accomplished for the group as a whole to be successful. Even when the lowest ability member has successfully (or unsuccessfully) completed his or her responsibilities, other higher ability team members must perform their unique duties. Each member's ability will be related to the quality of the products pertaining to his or her unique individual roles. Hence, the overall quality of the team's performance is still a sum of the quality of each team member's individual performance. We argue that even on tasks where there is little redundancy in individual roles and responsibilities, a group with three high-ability members and one low-ability member would perform better than a group with four low-ability members. In contrast, the conjunctive argument suggests that a group with three high-ability members and one low-ability member would perform equally poorly compared to a group with four low-ability members. Thus, group performance on tasks where there is little redundancy in individual roles and responsibilities is more a function of the summed contributions of

---

5LePine et al. (1997) reported $R^2$s of .15, .14, and .09 for the mean, maximum, and minimum operationalizations, respectively.
individual group members than the contribution of the lowest ability member. Therefore, for conjunctive tasks, the mean of group members' general cognitive ability would provide a better estimate of group performance compared to the minimum.

Recent reviews of the empirical literature are consistent with our claim that the mean may be the best statistical operationalization of group general cognitive ability compared to the maximum and minimum, regardless of task type. In their review of the literature regarding group composition effects, Moreland, Levine, and Wingert (1996) noted that nonadditive findings like those obtained by Tziner and Eden (1985) are rare in the literature, whereas additive effects are much more abundant. For example, Jones (1974) examined the relationship between individual ability and team effectiveness in tennis, football, baseball, and basketball. Across all four sports, he showed that team effectiveness was "strictly a linear function of individual effectiveness" (p. 448). Although they discussed the importance of studying nonadditive composition effects, Moreland et al. also stated that nonlinear composition effects are difficult to detect and sometimes problematic to interpret.

In a meta-analytic review, Devine and Philips (2001) compared the validities of the mean, minimum, and maximum operationalizations of group-level cognitive ability. Their results indicated that the mean yielded the highest criterion-related validity (mean $r = .29$), followed by the minimum (mean $r = .25$) and maximum (mean $r = .21$). However, in the absence of not having performed any task-type moderator analyses, their findings cannot be considered conclusive or definitive. One can only conclude that the mean yielded the highest validity overall. Furthermore, many of the studies in their review did not report validities for all three operationalizations. Nevertheless, we believe that Devine and Philips's quantitative review provides preliminary evidence in support of our position.

We identified three primary studies in the extant published literature that reported correlations for all three operationalizations. The earliest study, by O'Brien and Owens (1969), involved two experiments in which the type of group task was manipulated and the three operationalizations of group cognitive ability were compared with respect to their predictive validities. Although they did not explicitly use Steiner's (1966, 1972) framework, the two tasks in O'Brien and Owens' first experiment could be described as compensatory and conjunctive. The three tasks in their second experiment could be described as compensatory, conjunctive, and combined compensatory/conjunctive. Groups were composed of four and three persons in the first and second experiments, respectively. For the two compensatory tasks, none of the operationalizations yielded statistically significant correlations (all $rs < .15$). For the two conjunctive tasks, the mean yielded the strongest correlation ($rs = .58$ and .52), followed by the minimum ($rs = .56$ and .49) and the maximum ($rs = .48$ and .32). For the combined
compensatory/conjunctive task, the minimum yielded the strongest correlation \( (r = .56) \). Although higher, the minimum did not yield a significantly stronger correlation compared to the mean \((r = .52)\). The correlation for the maximum was .19. Despite relatively small sample sizes (none larger than 20), these results suggest that, regardless of task type, the mean provides an estimate of team ability that is at least as strong a predictor of team performance as the minimum and maximum.

In the context of a task that required the generation of creative solutions, Williams and Sternberg (1988) reported correlations of .65, .65, and .43, respectively, for the mean, maximum, and minimum operationalizations of group cognitive ability for a sample of 24 three-person groups. Williams and Sternberg also reported substantial intercorrelations between the three operationalizations: .87, .79, and .46 between the mean and maximum, mean and minimum, and maximum and minimum, respectively. Finally, Barrick et al. (1998) also compared the three operationalizations of team cognitive ability in the context of 51 manufacturing work teams. In contrast to the aforementioned studies, the average group size was 13. Barrick and his colleagues described the type of tasks performed by the teams as a combination of additive and conjunctive elements. The mean yielded the strongest correlation with team performance \((r = .23)\), while both the maximum \((r = .03)\) and the minimum \((r = .02)\) yielded nonsignificant correlations. Barrick et al. also reported substantial intercorrelations between the three operationalizations: .57, .49, and .59 between the mean and maximum, mean and minimum, and maximum and minimum, respectively. Coupled with the findings of Devine and Philips’s (2001) meta-analysis, the results of these empirical studies suggest that the mean operationalization is at least as predictive, if not more predictive, of group performance compared to the maximum and minimum operationalizations of group general cognitive ability.

It is also important to note that when considering the correlations yielded by the different statistical operationalizations, one should be mindful that the computation of the mean includes both the minimum and maximum scores. Hence, the mean will be correlated with the minimum and maximum scores. Furthermore, the mean is likely to be a more stable estimate than the minimum and maximum because it is based on multiple data points instead of a single data point (Kenny, Kashy, & Bolger, 1998). However, because stability of measurement is a necessary but not sufficient condition for validity, we do not believe the relatively stronger correlations yielded by the mean are completely the result of its greater stability.

**Objective and Hypotheses**

In summary, the empirical literature and reconceptualizations of Steiner’s (1966, 1972) disjunctive and conjunctive task types suggest that, regardless of
the type of task, the mean of individuals' general cognitive ability is at least as predictive, if not more predictive, of group performance as the maximum and minimum of individuals' general cognitive ability. However, there have been no published studies that explicitly manipulated the type of task and compared the predictive validities for the three operationalizations of group ability. Thus, the objective of the present study was to investigate the comparative criterion-related validity of the three operationalizations of group general cognitive ability as a function of task type based on Steiner's task typology.

Previous investigations have examined either a single operationalization (e.g., Neuman & Wright, 1999) or multiple operationalizations on the same task (e.g., Barrick et al., 1998; Williams & Sternberg, 1988). Furthermore, the existing studies that reported correlations for all three statistical operationalizations used relatively small sample sizes ($ns < 52$). It is also important to recognize that previous studies that have invoked Steiner's (1966, 1972) taxonomy frequently operationalized their task types by manipulating task content or constraining members' interactions. Similarly, researchers who have used real work groups typically characterize their tasks within Steiner's framework by describing the content of the job and the nature of the workers' interactions. However, the crux of Steiner's taxonomy is the way in which group members' contributions are combined into one group outcome. McGrath (1984) offered a cogent reminder of this fact when he stated:

Steiner's unitary task types depend on the way in which members' contributions are combined into a final product—the way in which group performance is "scored," so to speak. They don't necessarily translate directly to relations among the behaviors of members during their task performances; nor do they depend on physical/ environmental properties of the task; nor do they relate to the performance processes called for by the task. (p. 58)

We addressed this methodological issue by operationalizing task type in two ways: (a) by manipulating the task content and constraints on member interactions, and (b) by varying the way members' individual contributions were combined into a final group score. Accordingly, we used a within-subjects design and conducted a laboratory study that involved 157 four-person groups working on four tasks that conformed to Steiner's (1966, 1972) typology. Also, we rescored the additive task so that it would be consistent with the conjunctive and disjunctive models. Based on the preceding conceptual arguments and review of the literature, we tested a mean hypothesis:

Mean hypothesis. Group general cognitive ability, operationalized as the mean of group members' individual general cognitive
ability scores, will be the strongest predictor of group performance compared to the maximum and minimum of group members' general cognitive ability scores for all four task types (additive, disjunctive, conjunctive, and compensatory).

Although the mean hypothesis is consistent with Steiner's (1966, 1972) additive and compensatory tasks, it could be argued to be inconsistent with disjunctive and conjunctive tasks. Accordingly, we tested two alternative hypotheses, both of which competed with the mean hypothesis. Specifically, these alternative hypotheses are as follows:

*Maximum hypothesis.* Group general cognitive ability, operationalized as the maximum of group members' individual general cognitive ability scores, will be the strongest predictor of group performance on a disjunctive task compared to the mean and minimum of group members' general cognitive ability scores.

*Minimum hypothesis.* Group general cognitive ability, operationalized as the minimum of group members' individual general cognitive ability scores, will be the strongest predictor of group performance on a conjunctive task compared to the mean and maximum of group members' general cognitive ability scores.

Other researchers have also included group-level operationalizations based on the variability of a trait (e.g., variance; Barrick et al., 1998; Neuman et al., 1999). For the most part, such operationalizations have been restricted to non-ability variables (e.g., personality), and Steiner (1966, 1972) made no statements regarding how the heterogeneity of group members' general cognitive ability should be related to group performance. Nevertheless, for exploratory purposes, we included the standard deviation of group members' general cognitive ability in our investigation.

**Method**

*Participants*

Participants were 644 undergraduate students, who received partial fulfillment of course requirements for Introductory Psychology. Students participated in 4-person groups that varied in gender composition. Comparisons of group performance by gender composition failed to reveal any significant differences; thus, we aggregated the data across gender composition.

Data were collected from a total of 161 groups at two large universities: one in the Southwest \((n = 106)\), and the other in the Midwest \((n = 55)\). Incomplete
data from four groups reduced this sample size to 157. The final sample consisted of 361 females and 235 males (32 failed to report their gender) participated in the study. The average age of participants was 18.78 years ($SD = 1.51$).

**Group General Cognitive Ability**

The Wesman (1965) Personnel Classification Test (PCT) was the predictor used to obtain statistical operationalizations of group general cognitive ability. The Wesman PCT is a 60-item paper-and-pencil measure of general cognitive ability ($g$) that consists of both verbal reasoning (40) and quantitative ability (20) items. The scores obtained from the two parts are summed to provide a total score. The administration times for the two parts are 18 min and 10 min, respectively.

We used two alternate forms of the Wesman (1965) PCT, Form A and Form B, which were both used as the predictor and the disjunctive criterion task. The test manual reports three Form A/Form B alternate-form reliabilities for three independent samples, which are .84, .88, and .89. The current data yielded coefficient alphas of .79 for both the Form A verbal and quantitative components, and coefficient alphas of .77 and .73 for the Form B verbal and quantitative components, respectively. The two forms were counterbalanced in the present study so that approximately half (53.2%) of the groups received Form A as the predictor and Form B as the disjunctive criterion task, and vice versa.

**Task Manipulations**

**Additive task.** The additive task consisted of two components: (a) a word-search puzzle, consisting of 16 words related to a common subject (e.g., a vacation in the Caribbean); and (b) a set of 10 mathematical problems. A different word-search puzzle and mathematical problem set was distributed to each of the group members (i.e., there were four sets for each component), and each was balanced for item type and difficulty. These components were administered individually to the participants, and they were given 5 min to work on the word-search puzzle and 5 min to work on the math problems. Consistent with the standard definition of an additive task, participants were told that group performance would be the sum of words found and problems correctly solved by the individual group members.

**Compensatory task.** The compensatory task was the “stranded in the desert” situation (Johnson & Johnson, 1987). For the desert-survival situation, participants were told that they were on a geology club field trip and had survived an automobile accident in the desert. They were told that 12 items were salvaged from the wreckage, and their task was to rank-order the items according to their importance to survival. Participants first ranked the items as individuals and then
ranked the items as a group. Scores on this task were the absolute difference between the group rankings and survival experts’ rankings, summed across all 12 items. Lower scores indicate better performance. Groups were given 15 min to complete this task. Because a group’s decision on this task is essentially an average of all members’ ideas, this task is consistent with Steiner’s (1966, 1972) definition of a compensatory task.

**Disjunctive task.** The disjunctive task consisted of a Wesman (1965) PCT form (either Form A or Form B). Each item in the Wesman PCT has an objectively correct answer, and groups were instructed to work on individual items together and to arrive at a solution before progressing to other items. The group-based administration of the Wesman PCT was in accordance with standard instructions. However, we permitted and encouraged interaction and cooperation among group members. The time allowed to complete each section of the Wesman PCT was also extended to allow for group interaction: 22 min (instead of 18 min) were allotted for the verbal items, and 12 min (instead of 10 min) for the quantitative items.

**Conjunctive task.** The conjunctive task consisted of a combination of word-jumble and crossword clues arranged in a four-component trial that simulated an assembly-line process. With this task, each member of a 4-person group rotated through four separate, yet sequentially linked task components. Overall, the group’s objective was to solve a series of two-item crossword puzzles with each puzzle consisting of one “down” puzzle and one “across” puzzle. For each trial, the first member’s task was to solve a word jumble that completed a crossword clue for the “across” word (Component 1). The second member would then solve the crossword clue and fill in the “across” word (Component 2). The third member would solve another word jumble that completed the clue for the “down” word (Component 3), and the final member would solve that clue and fill in the “down” word (Component 4). The components were rotated within the group over successive trials. For example, Member 1 solved an “across” word jumble for Trial 1, an “across” crossword clue for Trial 2, a “down” word jumble for Trial 3, a “down” crossword clue for Trial 4, and so on.

The groups completed a total of 16 trials, working on one trial at a time. For each trial, there was a total of four correct responses, one for each component. Consistent with Steiner’s (1966, 1972) definition of a conjunctive task, we considered a group to be successful on a trial only if all four group members were successful in completing their parts. Thus, scores on the conjunctive tasks potentially could range from 0 to 16. Participants were told that they could not help one another and could not begin work on their component until the other group members had completed all preceding components, beginning with the first. Groups had 1 min to complete all four components on each of the 16 trials (roughly 15 s per component).
Conjunctively and Disjunctively Scored Performance

We rescored the additive task (word-search and math problems) so that it would be consistent with the conjunctive and disjunctive models. To rescore the task disjunctively, a group’s score was represented by the score of its highest performing member (i.e., the person who produced the highest number of correct word-search and math solutions). To rescore the task conjunctively, a group’s score was represented by the score of its lowest performing member (i.e., the person who produced the least correct word-search and math solutions). Through these rescoring methods, we were able to operationalize Steiner’s (1966, 1972) conjunctive and disjunctive models purely in terms of how group members’ contributions are combined into a single group outcome.

Procedure

Upon arrival to the study, participants were informed that the purpose of the study was to examine the relationships between different kinds of problem solving and decision making. Participants were also told that they would be working on several different kinds of problem-solving and decision-making tasks, both individually and in small groups. Participants then completed the individual administration of the Wesman (1965) PCT (i.e., predictor). As previously stated, individual Wesman PCT scores were used to construct the operationalizations used to define group ability and to predict group performance on the four criterion tasks. The specific operationalizations were the group mean, maximum, minimum, and standard deviation. Participants were then randomly assigned to their 4-person groups. Next, participants completed each of the four group criterion tasks. We varied the sequence of these tasks to counterbalance order effects. All tasks were completed during a single 2-hr experimental session.

Results

Table 1 shows the means, standard deviations, and intercorrelations for different statistical operationalizations of group cognitive ability and performance on the four manipulated task types. The mean, maximum, and minimum scores were all positively correlated with one another. In other words, higher minimum scores were associated with higher maximum and mean scores. Likewise, higher maximum scores were associated with higher mean scores. The standard deviation of group ability scores was negatively correlated with the group minimum scores, and positively correlated with the group maximum scores. The standard deviation of scores was not correlated with the group mean. In addition, the additive, disjunctive, and conjunctive group performance scores were all moderately correlated with one another. However, none of these task scores was correlated with compensatory task performance.
Table 1

Means, Standard Deviations, and Intercorrelations for the Statistical Operationalizations of Group General Cognitive Ability and Task Performance

<table>
<thead>
<tr>
<th>Variable</th>
<th></th>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group ability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Minimum</td>
<td>25.62</td>
<td>5.35</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Maximum</td>
<td>40.54</td>
<td>5.34</td>
<td>.35**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. M</td>
<td>33.12</td>
<td>4.42</td>
<td>.76**</td>
<td>.78**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. SD</td>
<td>6.65</td>
<td>2.76</td>
<td>-.58**</td>
<td>.54**</td>
<td>-.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Additive</td>
<td>64.27</td>
<td>7.98</td>
<td>.27**</td>
<td>.22**</td>
<td>.33**</td>
<td>-.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Disjunctive</td>
<td>43.80</td>
<td>6.02</td>
<td>.43**</td>
<td>.44**</td>
<td>.55**</td>
<td>-.01</td>
<td>.22**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Conjunctive</td>
<td>2.67</td>
<td>1.61</td>
<td>.38**</td>
<td>.27**</td>
<td>.47**</td>
<td>-.11</td>
<td>.37**</td>
<td>.28**</td>
<td></td>
</tr>
<tr>
<td>8. Compensatorya</td>
<td>49.31</td>
<td>9.76</td>
<td>.07</td>
<td>.16*</td>
<td>.18*</td>
<td>.08</td>
<td>.02</td>
<td>.12</td>
<td>.08</td>
</tr>
</tbody>
</table>

Note. N = 157. Minimum = ability score of the lowest scoring member. Maximum = ability score of the highest scoring member. M = mean of members' ability scores. SD = standard deviation of members' ability scores.

aLower scores on the compensatory task indicate better performance. To be consistent with the other tasks, we reversed the direction of the observed correlations for the compensatory task.

*p < .05. **p < .01.
Manipulated Task Types

With respect to the predictive validity of the different statistical operationalizations, the mean and maximum were significantly correlated with performance on all four tasks. The minimum was significantly correlated with performance on all the tasks except the compensatory task. The standard deviation was not correlated with any of the four tasks. Across the four task types, the group mean yielded the strongest validities (mean $r = .38$), followed in descending order by the minimum (mean $r = .29$), maximum (mean $r = .27$), and standard deviation (mean $r = -.02$). Thus, consistent with the mean hypothesis, the group mean was the strongest predictor of group performance compared to the other operationalizations of group general cognitive ability across all four task types.

As a more stringent test of the mean hypothesis, we compared the validities within each task type, using $t$ tests for nonindependent correlations. In conducting these $t$ tests, we followed procedures recommended by Steiger (1980). An examination of the coefficients on the additive task indicates that the predictive validity for the mean was significantly stronger than the validity for the maximum, $t(154) = 2.19, p < .05$. In contrast, the predictive validity for the mean was not significantly stronger than the validity for the minimum, $t(154) = 1.13, p > .05$. Therefore, the results for the additive task offer favorable but partial support for the mean hypothesis.

For the compensatory task, the predictive validity for the mean was significantly stronger than the validity for the minimum score, $t(154) = 2.01, p < .05$. In contrast, the predictive validity for the mean was not significantly stronger than the validity for the maximum, $t(154) < 1.00, ns$. Therefore, the results for the compensatory task offer favorable but partial support for the mean hypothesis.

For the disjunctive task, the predictive validity for the mean was significantly stronger than the validity for both the maximum, $t(154) = 2.43, p < .01$, and minimum scores, $t(154) = 2.55, p < .01$. Therefore, the results for the disjunctive task support the mean hypothesis. Furthermore, because the mean was a stronger predictor than the maximum and the maximum was not significantly stronger than the minimum, $t(154) < 1.00, ns$, the results are very much in opposition to the maximum hypothesis.

For the conjunctive task, the predictive validity for the mean was significantly stronger than the validity for both the maximum, $t(154) = 4.27, p < .01$, and minimum scores, $t(154) = 1.82, p < .05$. Therefore, the results for the conjunctive task support the mean hypothesis. Furthermore, because the mean was a stronger predictor than the minimum and the minimum was not significantly stronger than the maximum, $t(154) = 1.29, p > .05$, the results are very much in opposition to the minimum hypothesis.

Although the correlation analyses yielded results that were contrary to both the minimum and maximum hypotheses, they offered no information regarding
the unique or incremental contribution that the minimum and maximum might make in the prediction of task performance on the conjunctive and disjunctive tasks. Therefore, we used hierarchical regression analysis to further assess the extent to which the minimum and maximum predicted group performance, relative to the mean, on the conjunctive and disjunctive tasks, respectively. Specifically, we first examined two regression models: one model with performance on the conjunctive task (disjunctive task) regressed on the minimum (maximum), and a second model with performance on the conjunctive task (disjunctive task) regressed on both the minimum (maximum) and mean. We then conducted similar analyses with the mean and minimum (maximum) entered in reverse order. The results of these analyses are shown in Table 2.

For the conjunctive task, the mean made a statistically significant incremental contribution when the minimum was first entered into the equation, whereas the

---

Table 2

Regression Analyses for the Conjunctive and Disjunctive Tasks

<table>
<thead>
<tr>
<th>Model</th>
<th>$\beta^a$</th>
<th>$R^2$</th>
<th>$\Delta R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conjunctive task</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>.38**</td>
<td>.14**</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>.43**</td>
<td>.22**</td>
<td>.08**</td>
</tr>
<tr>
<td>Conjunctive task (reverse order)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>.47**</td>
<td>.22**</td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>.05</td>
<td>.22**</td>
<td>.00</td>
</tr>
<tr>
<td>Disjunctive task</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>.44**</td>
<td>.19**</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>.53**</td>
<td>.30**</td>
<td>.11**</td>
</tr>
<tr>
<td>Disjunctive task (reverse order)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>.55**</td>
<td>.30**</td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>.03</td>
<td>.30**</td>
<td>.00</td>
</tr>
</tbody>
</table>

*Note. $N = 157$. Minimum = ability score of the lowest scoring member. Mean = mean of members’ ability scores. Maximum = ability score of the highest scoring member.

$^a$Standardized regression weights when each variable was first added to the equation.

**$p < .01$. No estimates were significant at $p$ levels less than .05 and greater than .01.

---

6Compared to regressions involving all four operationalizations of group ability, we used this two-step approach because it (a) offered a more straightforward test of our hypotheses, and (b) yielded interpretable results that were not confounded by multicollinearity.
Table 3

*Means, Standard Deviations, and Intercorrelations for Group General Cognitive Ability and Conjunctively and Disjunctively Scored Group Performance*

<table>
<thead>
<tr>
<th>Group score</th>
<th>M</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conjunctive</td>
<td>11.94</td>
<td>2.89</td>
<td>.28**</td>
<td>.07</td>
<td>.24**</td>
</tr>
<tr>
<td>Disjunctive</td>
<td>20.25</td>
<td>2.51</td>
<td>.15</td>
<td>.16*</td>
<td>.25**</td>
</tr>
</tbody>
</table>

*Note. N = 157. Minimum = ability score of the lowest scoring member. Maximum = ability score of the highest scoring member. Mean = mean of members' ability scores. Group score is the score of the group's lowest performing member. Group score is the score of the group's highest performing member.*

Minimum did not make a statistically significant incremental contribution when the mean was first entered into the equation. Similar results were obtained for the disjunctive task and the maximum; the mean made a statistically significant incremental contribution, whereas the maximum did not make a statistically significant incremental contribution. These results show that the minimum and maximum do not explain variance in performance on conjunctive and disjunctive tasks that is not already explained by the mean. Similar regression analyses show that neither the minimum nor the maximum made incremental contributions to the mean for the additive and the compensatory tasks.

**Conjunctively and Disjunctively Scored Performance**

We conducted similar analyses using the same operationalizations of group ability as the predictors and the rescored conjunctive and disjunctive operationalizations of group performance (using the additive task) as the criteria. Table 3 shows the results of the correlational analyses, and Table 4 shows the results of the regression analyses. The results indicate that the mean was a statistically significant predictor of both the rescored conjunctive ($r = .24, p < .01$) and disjunctive ($r = .25, p < .01$) operationalizations of group performance. The minimum was positively correlated with conjunctive performance ($r = .28, p < .01$), but the correlation between the minimum and disjunctive performance did not reach statistical significance ($r = .15, p > .05$). The maximum was positively correlated with disjunctive performance ($r = .16, p < .05$), but the maximum was not correlated with conjunctive performance ($r = .07, p > .05$). Regarding conjunctive performance, although the predictive validity for the minimum was slightly stronger
Table 4

Regression Analyses for Conjunctively and Disjunctively Scored Group Performance

<table>
<thead>
<tr>
<th>Model</th>
<th>( \beta^a )</th>
<th>( R^2 )</th>
<th>( \Delta R^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conjunctive (^b)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>.28**</td>
<td>.08**</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>.06</td>
<td>.08**</td>
<td>.00</td>
</tr>
<tr>
<td>Conjunctive (reverse order)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>.24**</td>
<td>.06**</td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>.23</td>
<td>.08**</td>
<td>.02</td>
</tr>
<tr>
<td>Disjunctive (^c)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>.16*</td>
<td>.03*</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>.32*</td>
<td>.06**</td>
<td>.03*</td>
</tr>
<tr>
<td>Disjunctive (reverse order)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>.25**</td>
<td>.06**</td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>-.09</td>
<td>.06**</td>
<td>.00</td>
</tr>
</tbody>
</table>

Note. \( N = 157 \). Minimum = ability score of the lowest scoring member. Mean = mean of members’ ability scores. Maximum = ability score of the highest scoring member. 

\(^a\)Standardized regression weights when each variable was first added to the equation.

\(^b\)Group score is the score of the group’s lowest performing member. \(^c\)Group score is the score of the group’s highest performing member.

\( *p < .05. **p < .01. \)

than the predictive validity for the mean, this difference was not statistically significant, \( t(154) < 1.00, ns. \) Thus, the mean of group members’ general cognitive ability was just as good a predictor as the minimum when group members’ contributions were combined conjunctively. For disjunctive performance, the predictive validity for the mean was significantly stronger than the predictive validity for the maximum, \( t(154) < 1.76, p < .05. \) Thus, the mean of group members’ general cognitive ability was a stronger predictor compared to the maximum when group members’ contributions were combined disjunctively.

Results of the regression analyses indicate that the mean did not make a statistically significant incremental contribution to the prediction of conjunctively scored performance when the minimum was first entered into the equation. However, the minimum also did not make a statistically significant incremental contribution (although it did approach statistical significance; \( p = .054 \)) when the
mean was first entered into the equation. For disjunctively scored performance, the mean made a statistically significant incremental contribution, whereas the maximum did not make a statistically significant incremental contribution. These results show that the minimum and maximum do not explain variance in either conjunctively or disjunctively scored performance that is not already explained by the mean.

Discussion

Work groups are frequently used in organizations, but the methods for selecting members and predicting group performance typically rely on individual-level data. In the present lab study, we tested the hypothesis that, regardless of task type, the mean of group members' general cognitive ability would be the best predictor of group performance compared to other statistical operationalizations of group general cognitive ability. Consequently, we examined how different operationalizations of group general cognitive ability were related to group performance on four different task types that conformed to Steiner's (1966, 1972) typology (additive, disjunctive, conjunctive, and compensatory). Our primary contribution to the extant literature is that we offer a more comprehensive comparison of different statistical operationalizations by manipulating task type in a within-subjects design and also by operationalizing task type both in terms of task content and in the way individual contributions were combined into a group score.

Despite recent claims that the choice of operationalization depends on the type of task (e.g., Barrick et al., 1998; LePine et al., 1997; Neuman & Wright, 1999), we predicted that, regardless of task type, the mean of group members' general cognitive ability would predict group performance as well as or better than other operationalizations of group general cognitive ability. Consistent with the mean hypothesis and contrary to the maximum and minimum hypotheses, our findings indicate that the mean was either the strongest predictor or just as strong a predictor as other operationalizations across the four task types, both in terms of manipulated task content and in the way individual contributions were combined into a group score. Our findings were also consistent with the meta-analytic results obtained by Devine and Philips (2001).

Conceptually, the finding that the mean was the strongest predictor for the additive and compensatory tasks is consistent with the original proposals made by Steiner (1966, 1972). On the other hand, some researchers have proposed that for disjunctive and conjunctive tasks, the mean will not always be the best operationalization of group general cognitive ability. Rather, they have suggested that the maximum will be a better predictor for disjunctive tasks and the minimum will be a better predictor for conjunctive tasks. However, our finding that the mean was a stronger predictor of group performance on a disjunctive task is
consistent with the reconceptualization (Laughlin et al., 1975; McGrath, 1984; Steiner, 1972) that group performance on tasks that have ostensibly demonstrable solutions is more a function of the proportion of group members who know the correct solution rather than whether or not the group simply has one member who knows the correct solution. Our finding that the mean was also a stronger predictor of group performance on a conjunctive task is consistent with the argument that group performance on tasks where there is little redundancy in individual roles and responsibilities is more a function of the summed contributions of individual group members than the contribution of the lowest ability member.

Implications

There are several implications of our findings for both researchers and practitioners. First, our results suggest that it is unnecessary and perhaps inappropriate for researchers to use statistical operationalizations other than the mean (i.e., the minimum or maximum) when examining the correlation between general cognitive ability and task performance in groups, no matter what is the nature of the task. Second, from an applied perspective, our results suggest that managers who are considering how to maximize task performance across multiple work groups do not have to implement complex schemes when deciding how to place individual workers of varying levels of general cognitive ability in their respective work groups. In fact, our results suggest that the manner in which general cognitive ability is distributed across multiple work groups in an organization will not greatly influence overall effectiveness (Jones, 1974). However, such a conclusion assumes that the ability of group members does not interact with non-ability factors (Jones, 1974; Moreland & Levine, 1992). Alternatively, managers should devote more attention to other variables (e.g., personality, background) and how they might affect both the immediate and the long-term performance of groups.

Limitations and Future Research

There are a number of caveats and limitations to our study that are worth mentioning. First, one may contend that our tasks were not pure operationalizations of Steiner's (1966, 1972) types. This may be especially true for our disjunctive and conjunctive tasks. Regarding our disjunctive task, one could argue that the problems involved in the Wesman (1965) PCT do not fully capture the nature of eureka problems. That is, perhaps the correct solutions are not easily demonstrable. With respect to our conjunctive task, one could argue that because group members rotated task component responsibilities across individual problems, there was indeed much redundancy between individual group members' roles and responsibilities. In addition, perhaps the time limit was so restraining (1 min per problem equals 15 s per component, on average) that it resulted in the higher
ability participants performing at the same level as the lower ability participants; participants simply did not have enough time to solve their puzzle components. Although our manipulations of task content may not have fully represented Steiner’s types, the results involving our rescoring manipulations (i.e., conjunctively and disjunctively scored performance) bolster our conclusions regarding the robustness of the mean as the most valid representation of group cognitive ability.

To further investigate the robustness of the mean, we randomly generated nominal groups of differing sizes ranging from 2 to 12 persons and conducted correlational analyses similar to those involved in the rescoring of the additive task to fit the conjunctive and disjunctive task types. In looking at the pattern of results across the different-sized groups, there was a striking trend showing that as group size increased, the mean of group members’ general cognitive ability became a distinctly stronger predictor of performance than both the minimum and maximum, regardless of whether the word-search/math task was scored additively, conjunctively, or disjunctively. With 2-person groups, the predictive validities for the mean, minimum, and maximum were all statistically significant, with slightly stronger validities for the mean. For conjunctive performance, the validities for the mean and minimum were .41 \( (p < .01) \) and .37 \( (p < .01) \), respectively. For disjunctive performance, the validities for the mean and maximum were .33 \( (p < .01) \) and .29 \( (p < .01) \), respectively. On the other hand, for 12-person groups, only the mean yielded statistically significant predictive validities across additive, conjunctive, and disjunctive scores. Moreover, the mean was a much stronger predictor of conjunctive performance \( (r = .38, p < .01) \) compared to the minimum \( (r = .24, p < .05) \). Similarly, the mean was a much stronger predictor of disjunctive performance \( (r = .49, p < .01) \) compared to the maximum \( (r = .21, p > .05) \). We believe that these results reflect a greater stability in the mean as an operationalization of group general cognitive ability compared to both the maximum and minimum because the mean is based on multiple data points instead of a single data point. Coupled with the results of the primary investigation, the results of these supplementary analyses provide strong support for the mean hypothesis.

A second limitation is that we randomly assigned participants to their respective groups instead of matching groups based on general cognitive ability. By matching groups, we could have ensured that each group had a similar distribution of general cognitive ability scores. In this matter, one might argue that the mean would be just as strong a predictor as the minimum and maximum for conjunctive and disjunctive tasks, respectively, only for groups that have very little variability in their members’ general cognitive ability. To address this issue, we separated groups with little variability in member general cognitive ability from those with a high degree of variability and conducted separate correlation analyses. We used the standard deviation of group general cognitive ability to
separate the groups. We also conducted correlation analyses based on both a median split and a top versus bottom quartile split. Regardless of the type of split, there were no differences in the pattern of correlations: The validity for mean was always stronger than the validities for the minimum and maximum for every task type, including the conjunctive and disjunctive rescoring of the additive task.

Another limitation to our study is that our results only speak to contexts where general cognitive ability is the sole predictor of interest. Although we demonstrated that the mean of group members’ general cognitive ability is the strongest predictor of group performance compared to the maximum and minimum for all of Steiner’s (1966, 1972) task types, it is not our contention that the same may be true for non-ability variables (e.g., personality). For example, Barrick et al. (1998) showed that the minimum was the only statistical operationalization of extraversion and conscientiousness that was significantly correlated with task performance. When considering the large number of individual differences that influence human behavior, it is also important to consider how multiple ability and non-ability factors might interact to influence the task performance of groups (McGrath, 1998). In disjunctive or compensatory task situations, statistical operationalizations of group general cognitive ability other than the mean might be more valid when their interactions with specific personality variables are considered. For example, a high-ability member who is also highly extraverted may have a more positive influence on the group’s task performance than a high-ability member who is more introverted. Likewise, a low-ability member who is also highly extraverted and highly disagreeable may negatively influence the group’s performance more than a low-ability member who is introverted and agreeable. Such interactions may be even more or less pronounced depending on groups’ awareness of their members’ differing levels of expertise (i.e., transactive memory systems; Hollingshead, 1998; Moreland, 1999). The influence of an extraverted and disagreeable member with low ability may be stronger in groups with little awareness of expertise, and the influence of a high-ability member may be stronger in groups with great awareness of expertise.

The influence of personality variables may also be greater, and even overshadow the overall influence of ability, in task situations involving few constraints on how group members interact with one another. Because our study did not include personality variables or measures of group member interactions, our results do not directly address interactions between ability, personality, and task characteristics. However, we did find general cognitive ability to be a substantially weaker (yet statistically significant) predictor of performance on the compensatory task than on the additive, conjunctive, and disjunctive tasks, which all involved more constraints on member interactions than the compensatory task. It is also worth noting that O’Brien and Owens (1969) found significant correlations between ability and group performance for all the tasks in their two experiments, except for the task that was consistent with the compensatory type.
Given that many of today’s work groups are empowered to solve problems, make critical decisions, and simultaneously handle a variety of tasks (Waller, 2000), exploring the interaction between ability and non-ability factors and extending task considerations beyond Steiner’s (1966, 1972) typology (McGrath, 1984) would have much applied value. Furthermore, research that assesses the nature of member interactions and other group processes as mediating variables would shed further light on the way in which task performance in groups is influenced by individual differences. In sum, we believe that much could be learned about small-group phenomena from research that explores the interplay between a variety of individual-difference variables across a variety of task and group situations.

We also propose that our understanding of group composition effects would benefit greatly from future research that explores a variety of criteria related to groups. Our study offers a limited perspective on group-based outcomes by only focusing on task performance. Consequently, generalizations regarding other criteria should be made with caution. For example, the mean of group members’ general cognitive ability, or any other individual-difference variable, may not be the strongest predictor when the criterion of interest is something other than task performance, such as the long-term viability of the group or the extent to which the group satisfies the needs of its members (Hackman, 1987; McGrath, 1998).

In more conjunctive-like tasks, for example, the visibility of the lowest capable group member may cause discontent among the higher ability members, undermining the long-term viability of the group. Moreover, hypotheses regarding the linkages between ability, personality, and different aspects of group performance could be guided by the recent distinction made between task and contextual performance at the individual level (Borman & Motowidlo, 1997). Research distinguishing task and contextual performance has shown that cognitive ability is more strongly correlated with task performance; and personality is more strongly related to contextual outcomes, such as dependability, cooperation, and citizenship (Borman & Motowidlo, 1997; Hattrup, O’Connell, & Wingate, 1998; LePine & Van Dyne, 2001).

Based on these findings, one would hypothesize that personality, rather than cognitive ability, would play more of a role in the long-term viability of groups and in the degree to which group members’ needs are satisfied. Indeed, Barrick et al. (1998) concluded that personality variables (e.g., agreeableness, emotional stability) might play more important roles in team effectiveness, as opposed to individual performance. Therefore, future research is warranted that further examines causal models that illustrate how both ability and non-ability variables are related to various group processes and long-term group effectiveness. From an applied perspective, operationalizations other than the mean for non-ability factors may be worthwhile to consider when staffing groups.
Finally, the nature of the tasks we used was not fully representative of the tasks found in organizational environments, nor was the nature of our groups representative of the high levels of social integration found in real work groups. Although it is true that the tasks we used were not similar in content to those found in organizational environments, they very much conformed to Steiner's (1966, 1972) typology. Because previous researchers have emphasized the importance of Steiner's typology in decisions concerning the appropriateness of group-level operationalizations of individual attributes, we believe that a laboratory study where the explicit manipulation of task type could be made was an appropriate choice in research methodology. Nevertheless, generalizations to real work groups should be made with caution.

Our groups only met for a 2-hr period and worked on tasks that, although intellectually stimulating, had little consequence to their lives. In natural groups that are more meaningful to their members, nonadditive composition effects may be more likely to occur (Moreland et al., 1996). Furthermore, members of natural groups that have worked together for a long time are more likely to be familiar with each other's capabilities and biases (Moreland et al., 1998). Thus, nonadditive, synergistic effects may be more likely to occur in more mature groups (Watson, Michaelsen, & Sharp, 1991). We recommend that future researchers consider employing experimental designs that allow the researcher to manipulate the ecological validity of working in a group (for an example of an experimental design with high ecological validity, see Pritchard, Hollenback, & DeLeo, 1980) in order to examine the degree to which composition effects vary as a function of social integration and group maturity.

In conclusion, we manipulated the type of task that groups performed according to Steiner's (1966, 1972) typology and showed that, regardless of the task type, the mean of group members' general cognitive ability consistently predicted group performance better than did the minimum and maximum of group members' general cognitive ability. In general, our results suggest that the current practice of using individual-level-based selection for group-based performance contexts may indeed be psychometrically sound since the use of the mean of individual cognitive ability scores can be used to predict the task performance of groups.

References


Hollingshead, A. B. (1998). Distributed knowledge and transactive processes in decision-making groups. In D. H. Gruenfeld (Ed.), *Composition* (pp. 103-123). Stamford, CT: JAI.


学霸图书馆

www.xuebalib.com

本文献由“学霸图书馆-文献云下载”收集自网络，仅供学习交流使用。

学霸图书馆（www.xuebalib.com）是一个“整合众多图书馆数据库资源，提供一站式文献检索和下载服务”的24小时在线不限IP图书馆。

图书馆致力于便利、促进学习与科研，提供最强文献下载服务。

图书馆导航：

图书馆首页 文献云下载 图书馆入口 外文数据库大全 疑难文献辅助工具