Forging Work Teams: Effects of the Distribution of Cognitive Ability on Team Performance

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The relationship between team cognitive ability and team performance was studied in a real-world, semi-autonomous work team environment. Four models (i.e., additive, conjunctive, disjunctive, and heterogeneity of variance) of the relationship between team member cognitive ability and performance were investigated. Group leaders provided performance ratings for 97 work teams formed from 917 employees. A composite of scores from the General Aptitude Test Battery was used as a measure of cognitive ability. The results showed that certain combinations of cognitive ability were significantly related to team performance, with the most significant impact occurring for teams with fewer than eight members. A complete PDF version of this article can be obtained at www.radford.edu/~applyhrm.

The issue of the effects of team composition on performance has been a topic of interest to researchers for over 60 years, dating back at least to a study by Gurnee in 1937 (Devine & Philips, 2001). Such team composition variables as race (Baugh & Graen, 1997; Davis, Cheng, & Strube, 1996), gender (Karakowsky & Siegel, 1999; Savicki, Kelly, & Lingenfelter, 1996), personality (Barrick, Stewart, Neubert, & Mount, 1998; Neuman, Wagner, & Christiansen, 1999) and cognitive ability (Devine & Philips, 2001) have been examined. Interest in the question of the optimal composition of groups is not limited, however, to academicians or researchers. As work teams have become an increasingly popular strategy for encouraging productivity and quality in organizations, a critical question facing human resource managers is one of how best to assign a set of employees to a variety of work teams (Ilgen, 1999; Neuman & Wright, 1999), and, more specifically, what is the effect of diversity versus homogeneity of cognitive ability on work team performance?

Review of Team-level Cognitive Ability Aggregation Literature

The literature on the relationship between member cognitive ability and team performance has recognized four major methods of aggregation: (1) the mean of all team members' cognitive ability scores, (2) the lowest team member's cognitive ability score, (3) the highest team member's cognitive ability score, and (4) the dispersion or standard deviation of team members' cognitive ability scores (Barrick et al., 1998; Devine & Philips, 2001; Steiner, 1972). The first approach suggests that team member

ability combines in a straightforward, additive manner (e.g., Hill, 1982; Shaw, 1976; Steiner, 1972; Williams & Sternberg, 1988). From this perspective, team performance increases proportionately to the ability of the team's members, regardless of the distribution of ability between team members (Bouchard, 1972; Johnson & Torcivia, 1967). This position is commonly represented as the mean of the individual cognitive ability scores (Steiner, 1972).

Other research has indicated the relationship between team performance and member ability goes beyond a simple linear or summative model (i.e., the whole is greater than the sum of its parts; Goldman, 1971; Laughlin & Branch, 1972; Rohrbaugh, 1981; Tziner & Eden, 1985). This second position (i.e., a non-additive model) is composed of two theoretical positions for combining team cognitive ability: the conjunctive and disjunctive approach (Coombs, 1964; Dawes, 1964; Einhorn, 1971).

In a conjunctive model, the lowest performers in the team have the most impact on overall team performance. Research on this model has led to conflicting results as the conjunctive model predicted team performance for human resource teams in a retail organization ($r = .33$, Neuman & Wright, 1999), but did not predict performance for production teams ($r = .02$; Barrick et al., 1998).

A disjunctive model, on the other hand, is a compensatory model. With a disjunctive model, the highest performing members of the team are able to make up for the weaknesses of the other members and are then the drivers of performance. Again, results using this model are contradictory. Lepine, Hollenbeck, Ilgen, and Hedlund (1997) found that higher scoring staff members were able to compensate for lower scoring staff members in a laboratory setting. They concluded that having some members who had high cognitive ability might even compensate for a leader who was low in cognitive ability. Barrick et al. (1998), however, found the disjunctive model to have a low predictive validity ($r = .03$) for their production teams.

Finally, the last method concentrates on the variability, or heterogeneity, of individual characteristics. This approach often examines the effect of demographic variables on team performance and determines indices based on the variance of individual scores for a particular trait (e.g., Jackson et al., 1991, Jackson, 1996). Under some versions of this approach, heterogeneity or diversity is seen as having a positive effect on performance. However, under other versions of the heterogeneity of variance model, some combinations of ability are seen as inhibiting group performance (Steiner, 1972). Theorists argue that large variations in group-member ability may have detrimental effects on performance, perhaps because of the frustration it creates between members of different ability levels (Secord & Backman, 1974). Relatively few studies appear to have examined the dispersion of team member cognitive ability scores. However, Barrick et al. (1998) found a small to moderate relationship between the variance of cognitive ability scores and team performance ($r = .22$).

The current study evaluated these models in a real-world, semi-autonomous work team environment where team members were responsible for automobile production tasks. To accomplish this, four measures of team cognitive ability were calculated and evaluated against the performance of the work team:

a.   The average (mean) of team member cognitive ability, which corresponds with the additive model.

b.   A conjunctive utility function that was operationalized as the cognitive ability of the lowest cognitive ability team member.

c.   A disjunctive utility function that was operationalized as the cognitive ability of the highest cognitive ability team member.

d.   Heterogeneity in team member cognitive ability, operationalized as the standard deviation in intra-team cognitive ability.

Cognitive ability in the current study was operationalized as each team member's composite GATB (General Aptitude Test Battery) score collected at the time he/she was selected into the company (approximately two years prior to data gathering for the current study). Although not a perfect measure of cognitive ability and input to the team, tests of general cognitive ability, such as the GATB, have been shown to be valid predictors of job performance (Hunter & Hunter, 1984; Schmidt & Hunter, 1998). Furthermore, empirical results for production team members in the current organization indicated that the composite GATB score was a statistically significant predictor of supervisory ratings of team member performance (O'Connell, 1992).

Facets of Team Performance

The relationship between aggregated team ability and group performance is usually seen as being dependent upon the task type (Steiner, 1972). Corresponding to the aggregation models, the task types are usually identified as additive, conjunctive, and disjunctive. An additive task is one where performance is dependent upon the total or summated effort of the group. Examples in a production facility might include the team having to move a heavy object by hand by pushing the object across the floor, or the total number of parts inspected by a team where each member performs the inspection task independently. A conjunctive task situation is one where the group's performance is seen as depending upon the least effective group member; if one team member fails, the entire team fails (Neuman & Wright, 1999). For example, if one worker in a team is not able to perform part of his/her task at an acceptable level on a motor assembly production, it will affect the performance of the entire team. If one part of the motor is bad, the whole motor is likely to fail. Disjunctive tasks are those in which there is a single solution to a problem and as soon as one person solves the problem, he/she effectively solves the problem for the entire group. These types of tasks are often referred to as Eureka tasks (McGrath, 1984) and frequently involve some type of problem solving task.

The performance of a work team involves the execution of a number of tasks, some of which might be considered additive, some disjunctive, but most as being conjunctive. The type of work carried out by the semi-autonomous work teams used in this study would appear to be best classified as conjunctive. In addition to involving a number of different types of tasks, the performance of a work team can be assessed along a number of dimensions or factors. For instance, a team that has a very low error rate but also has very low productivity is not as effective as a team that has a low error rate and high productivity. In the current study, five aspects of team performance were evaluated: productivity, safety, teamwork, improvement ideas generated, and quality.

Although these five factors were not intended to be a comprehensive list of performance dimensions for team success, they do represent important aspects of work team performance. Not only do these five dimensions of team performance provide a more complete description as compared to simple supervisory ratings of team performance, they also provide an opportunity to evaluate the potential differential effects of the aggregation models as a function of the type of criterion. Based on the assumptions underlying each of the four models of team performance, four hypotheses were generated.

Hypotheses Regarding Team Member Cognitive Ability

Hypothesis 1: Average team member cognitive ability will be positively related to each of the five aspects of team performance.

This hypothesis assumes that because general cognitive ability, or "g," has been shown to be a valid predictor of performance for a wide variety of jobs (Hunter & Hunter, 1984; Schmidt & Hunter, 1998), teams with higher "g" will, in general, have a higher probability of performing better in all aspects of work. Not only is this a "common sense" hypothesis, but it also is supported by research in small group behavior. Goldman (1971) found that the performance of two-person teams was highest for teams with high ability team members. Specifically related to production, laboratory studies (e.g., Kabanoff & O'Brien, 1979; O'Brien & Owens, 1969) found that, for coordinated tasks, the summed ability of team members was significantly related to team performance. A positive relationship between crewmember ability and overall crew performance was also found in a quasi-experiential field study of three-person military tank teams conducted by Tziner and Eden (1985).

Hypothesis 2: The conjunctive measure of team member cognitive ability, as operationalized as the ability level of the lowest ability team member, will be positively related to all five aspects of team performance.

This hypothesis is based on the "weakest link in the chain" rationale, because the majority of job activities performed by production team members can be classified as conjunctive (i.e. coordinated) in nature. For example, if one worker in a team is not able to perform part of his/her task at an acceptable level on a production line, it will affect the performance of the entire team, no matter how well the other team members performed their tasks.

This hypothesis has been supported by research in coordinated group settings. For instance, O'Brien and Owens (1969) found the ability of the least able member was significantly negatively related to performance. Neuman and Wright (1999) also found the least able member predicted team performance in a field study.

Hypothesis 3: The disjunctive measure of team member cognitive ability, operationalized as the ability level of the highest ability team member, will be positively related to only one aspect of team performance, generating ideas

The disjunctive measure is hypothesized not to be related to other aspects of team performance primarily because of the nature of the task in this organization. The rationale for this hypothesis is based partially on Steiner's (1972) finding that groups seldom perform up to the level of their best member. Further, this hypothesis takes into account the type of task(s) actually being performed by production team members. In a production setting, generating ideas for quality improvement would appear to provide the closest fit to a prototypical disjunctive task.

Research studies that find support for the disjunctive function are typically of the Eureka type. For instance, Laughlin, Branch, and Johnson (1969) found the highest ability team member had the most impact on team performance when the team, working collaboratively rather than in a coordinated fashion (as is done in a production task), performed a concept mastery task (i.e., the number of problems correctly solved). With the exception of generating improvement ideas, this is not commonly the type of activity found in production work teams. Empirical results also support this logic, as Barrick et al. (1998) found no relationship between team performance and the disjunctive model in their study of production teams.

Hypothesis 4: Variability in team member ability will be positively related to all areas of team performance, especially ideas generated.

Although this hypothesis appears counter-intuitive and also seems contrary to Steiner's (1972) and Secord and Backman's (1974) suggestion that increased variability may lead to frustration among team members, the majority of research evidence suggests that group variability is positively related to team success (c.f. Pearce & Ravlin, 1987). Although there is a good deal of research to indicate that more cohesive groups perform more effectively (Miesing & Preble, 1985; Norris & Niebuhr, 1980; Wolfe & Box, 1988), these studies did not find that variability in ability necessarily leads to less cohesive teams. Further, research by Aamodt and Kimbrough (1982) and others (Hawley & Heinen, 1979; Terborg, Castore, & DeNinno, 1976) has shown that heterogeneity in personality traits and abilities is related to higher quality solutions to problems and other measures of performance. In summarizing research evidence related to heterogeneity and work team performance, Pearce and Ravlin (1987) proposed the following, "*To increase innovation and productivity in an uncertain task environment semi-autonomous work groups must be designed to enhance the variety of potential responses. . .To the degree that the initial selection of members is heterogeneous, variety of potential responses will increase*" (p. 774). Barrick et al. (1998) empirically supported this conclusion in their study of production workers.

Team Size as a Moderator

A review of the literature on small group behavior indicates that most research has been conducted, not surprisingly, on small groups. For instance, 71% (20/28) of the field and laboratory studies summarized by Pearce and Ravlin (1987), for which team size was reported, were based on teams of six or smaller. Thus, there is very little research to indicate what happens to the relationship between team member cognitive

ability and performance as work group size increases.

Hypothesis 5: The magnitude of all relationships between team member cognitive ability and team performance will be higher, both positive and negative, for smaller teams than for larger teams.

One theory that is relevant to this potential moderating role of team size is social impact theory (Latané, 1981). One of the three psychosocial principles that Latané discusses is division of impact. This principle would predict that the impact of any given team member on team performance would tend to decrease as the number of team members increases (O'Connell, Doverspike, & Blumental, in press).

Method

Subjects

Forty-four (44) group leaders at a large midwestern automobile production facility provided team performance ratings for 97 work teams. These teams consisted of a total of 917 members. The groups were set up as relatively autonomous work teams with members responsible for monitoring team quality, inventory, meeting production goals, scheduling vacations and overtime, making improvement recommendations, and even selecting team members and team leaders. Team members had been part of their respective teams for a period of at least six months. This facility was a greenfield site (a new physical location of work), opened two years prior to gathering data for the current study. Thus, team members had been members of their teams for a minimum of six months and a maximum of two years. Demographic data on the team members was not gathered as part of this study.

Measures

Group leader ratings. Group leaders were asked to complete a six-item measure of the performance of each of the work teams under their supervision. This measure was designed to tap five key areas of team performance: productivity, quality, safety, teamwork, and idea generation. In addition, the scale also contained an overall measure of team performance.

Team member cognitive ability. Scores for each team member were gathered from company personnel records. A single GATB composite score, consisting of general cognitive ability, psychomotor ability and perceptual ability scores, which was used as an initial screen in the selection process, was available for each team member. This measure was completely confidential and neither group leaders, nor team members, had ever seen or been informed of the selection battery scores.

Results

Descriptive statistics and intercorrelations for each of the variables used in this study are provided in Table 1. The results for most of the tests of the hypotheses can be taken directly from this table.

Average team member cognitive ability was not significantly related to any of the six measures of team performance. Thus, Hypothesis 1 was not supported. Hypothesis 2, which predicted that the conjunctive function of team member cognitive ability (i.e., the impact of the lowest cognitive ability team member) would have a significant positive impact on team performance, was not supported; there was a significant relationship but it was in the negative direction. The conjunctive measure was significantly and negatively related to the ideas generated ($r = -.20$, $p < .05$) and overall performance ratings ($r = -.23$, $p < .05$).

Hypothesis 3, which predicted that the disjunctive function of team member cognitive ability (i.e., the impact of the highest cognitive ability team member) would have a significant and positive impact on idea generation, was not supported. The disjunctive function was operationalized as the cognitive ability level of the highest ability team member. This index was not significantly related to any of the six measures of team performance.

Hypothesis 4 predicted that variability in team member cognitive ability, operationalized as the standard deviation of team member cognitive ability, would be positively related to all measures of team performance, especially new ideas generated. This hypothesis was partially supported. Team member variability was positively related to ideas generated ($r = .19$, $p < .05$), as well as overall team performance ($r = .23$, $p < .05$). It was not significantly related to other measures of team performance, although the correlations were in a positive direction in all cases.

Table 1
Descriptive statistics for all variables

	1	2	3	4	5	6	7	8	9	M	SD
1. Lowest-ability team member										82.81	10.60
2. Highest-ability team member	.12									103.96	4.57
3. Mean team-member ability	.74**	.53**								94.42	3.61
4. Standard deviation	-.88**	.17	-.60**							7.30	4.09
5. Productivity	-.08	-.09	-.05	.07						4.95	1.17
6.. Safety	-.15	-.06	-.19	.15	.56**					4.66	0.93
7. Teamwork	-.08	-.03	.02	.11	.55**	.27**				4.71	1.32
8. Ideas generated	-.20*	-.02	-.10	.19*	.33**	.26**	.50**			4.34	1.38
9. Quality	-.05	.11	.04	.08	.42**	.31**	.39**	.43**		4.85	1.30
10. Overall group performance	-.23*	.01	-.09	.23*	.73**	.52**	.72**	.62**	.64**	4.73	1.08

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

Hypothesis 5 predicted there would be a moderating effect of team size on all of the different functions of team member cognitive ability and team performance. It was hypothesized that the correlation between team member cognitive ability and team performance would be smaller in magnitude for larger teams and greater in magnitude for smaller teams. To test for moderation, groups were split into two groups based on a median split at eight members. Teams with fewer than eight team members ($M = 5.67$, $SD = 1.15$, $n = 39$) were considered small teams, and teams with eight or more team members ($M = 10.33$, $SD = 2.20$, $n = 57$) were considered large teams.

Separate correlation matrices were calculated for both large and small groups and differences between these correlations were tested. This approach was adopted as opposed to performing moderated regression analyses for two reasons: (1) the results are much easier to interpret, and (2) based on Fisicaro and Tisak's (1994) discussion of the problems inherent in moderated regression with random variables and/or artificially dichotomized variables. A comparison of the two sets of correlations appears in Table 2.

The differences between small and large teams were fairly dramatic. Relationships between team member cognitive ability and performance for small teams were typically of much greater magnitude than for larger teams. The lowest cognitive ability team member was significantly negatively related to both safety ($r = -.47$, $p < .01$) and overall team performance ($r = -.40$, $p < .05$). Surprisingly, average team member cognitive ability was also significantly negatively related to safety ($r = -.58$, $p < .001$). Variability in team member cognitive ability was significantly positively related to both safety ($r = .41$, $p < .01$) and overall team performance ($r = .33$, $p < .05$). These results for teams with less than eight team members were, for the most part, consistent with the results for the total group. For large teams, those with eight or more team members, none of the cognitive ability indices was significantly related to any of the team performance measures.

Table 2
Comparison of correlations between four measures of team member ability and six indices of team performance by size of the team

	Productivity	Safety	Teamwork	Ideas Generated	Quality	Overall Performance
Lowest Ability Team Member						
Small teams	-.27	-.47**	-.12	-.27	-.08	-.40*
Large teams	.14	.10	-.03	.03	-.16	.02
Z	1.96*	-2.75**	-.44	-1.4	.39	-2.02*
Highest Ability Team Member						
Small teams	-.11	-.20	-.02	-.01	.03	-.04
Large teams	-.03	.12	-.05	-.01	.17	.08
Z	-.36	-1.56	.14	0.0	-.68	-.58
Average Team Member Ability						
Small teams	-.29	-.58**	.03	-.13	-.12	-.27
Large teams	.18	.06	.02	.06	.17	.18
Z	-2.26*	-3.06	.05	-.92	-1.41	-2.16*
Standard Deviation in Team Member Ability						
Small teams	.23	.41**	.12	.21	.09	.33*
Large teams	-. 01	.01	.11	.03	.22	.06
Z	1.58	1.93*	.06	.88	-.64	1.31

$p < .05$, ** $p < .01$ *Note*: Zs are Fisher zs for the difference in the correlations

Although the results indicate that, for a number of indices, there was a dramatic difference between small and large teams, this was not simply a matter of larger correlations for smaller than larger teams. To test the difference in absolute magnitude between these two groups, all of the correlations between the four ability measures and the five indices of team performance were transformed into Fisher z scores and an average across the 20 correlations was calculated. Although the average correlation was larger in absolute magnitude for smaller teams, the difference was not statistically significant ($r_{z1} = .20$ vs. $r_{z2} = .09$, z = .54). Thus, Hypothesis 5 was only partially supported.

Discussion

The current study attempted to evaluate the relationship between team member cognitive ability and team performance in a semi-autonomous work team environment. Previous research, both in applied settings as well as in more controlled laboratory settings, indicated that the relationship between cognitive ability and performance is far from straightforward (Devine & Philips, 2001). Based on previous research and theory regarding how the abilities of individuals combine and interact in group settings, several hypotheses were postulated and tested.

One of the most consistent findings from the current study was that heterogeneity in team member cognitive ability was significantly and positively related to team performance both in terms of the quality of ideas generated by the team and overall team performance. This finding, especially with regard to the quality of ideas generated is consistent with other research on heterogeneity and performance. Furthermore, this finding was consistent with Pearce and Ravlin's (1987) proposition that heterogeneity should increase the variety of potential responses to work-related problems and thereby increases innovation and productivity, as well as Barrick et al.'s (1998) empirical findings.

The cognitive ability of the lowest ability team member was negatively related to team performance. This finding of a negative relationship between the ability level of the lowest ability team member and group performance was inconsistent with the conjunctive hypothesis. In fact, significant negative correlations were found where significant positive correlations were expected. However, this result was consistent with the above finding on the standard deviation or variance, since the groups that were most heterogeneous would be those with the largest spread in ability between high ability members and low ability members. Consistent with this principle, in this study there was a strong, negative correlation ($r = -.88$) between the standard deviation of team ability and the ability of the lowest ability team member. Thus, the higher the ability level of the lowest ability team member, the lower the overall variance in ability within the group.

Although the negative relationships for the conjunctive function were consistent with the results for heterogeneity, or the standard deviation, this consistency does not explain why diversity in terms of cognitive ability would be related to group performance. One possible explanation, supported by observations at the site, is that a

compensatory strategy is at work during the selection process. That is, if we were to ask why an individual with low cognitive ability would be selected for the job, one reason would be that they had other abilities that compensated for their cognitive ability score. Thus, it is possible that the low cognitive ability applicants had other strengths, such as previous production experience, knowledge of welding, or being highly motivated. These alternative strengths proved to be especially important when working within the group or team context.

The disjunctive function of team member cognitive ability, operationalized as the cognitive ability of the highest ability team member, was hypothesized to be positively related to idea generation. This hypothesis was not supported. This index was not significantly related to any of the measures of team performance.

Perhaps the most surprising finding from the tests of these hypotheses was that average team member cognitive ability was not significantly related to any of the indices of team performance, as was originally hypothesized. This is surprising because previous research has consistently found that teams composed of higher cognitive ability team members tend to outperform teams of lesser cognitive ability (Devine & Philips, 2001; Laughlin et al., 1969; O'Brien & Owens, 1969; Tziner & Eden, 1985). In fact, for teams with fewer than eight team members, average team member cognitive ability was significantly and negatively related to group leader ratings of team safety ($r = -.52, p < .001$). Furthermore, prior research in the current organization indicated that the cognitive ability index (i.e., a GATB composite) gathered as part of the selection process, was significantly positively related to supervisor ratings of individual team member performance. Thus, although cognitive ability was positively related to individual team member performance, the mean cognitive ability was in some cases negatively related to the performance of the overall team. This finding clearly runs counter to the common sense and the often-supported finding that the best teams are composed of the smartest team members.

The results of this study can also be compared to the results of a meta-analysis of the team composition research conducted by Devine and Philips (2001). Using a sample of 25 published and unpublished correlations, the results indicated the mean of members' scores was the best predictor of team performance, followed by the lowest and highest member's individual cognitive ability scores. The authors concluded that these results are likely moderated by other variables, one of which was the setting of the study (lab versus field).

The findings of this study were inconsistent with those of the meta-analysis conducted by Devine and Philips (2001), which found that the mean was the best predictor of team performance. This is likely the result of the setting in which the study was performed: a field organization that utilized semi-autonomous production teams. On the surface, these findings appear to contradict the general results, but they do support the notion that cognitive ability of team members may be combined differently depending on the nature of the task performed. Devine and Philips (2001) asserted that cognitive ability may not be as important in a production task as compared to an intellectual or information processing task. This was not entirely the case in this study; rather, a different method for combining team members' cognitive ability emerges as most important for predicting performance: heterogeneity. In addition, the notion of performance in this study was much broader than performance as measured by the meta-

analysis.

One potential explanation for this finding is that although general intelligence is related to individual performance for team members, there are many other facets of ability, such as physical stamina, strength, conscientiousness, interpersonal skills, etc., that form a complete ability composite for manufacturing team members. Another potential explanation, especially with regard to the significant, negative relationship with safety, is that the more intelligent team members tend to ignore safety regulations, because they feel they can "get away with it without anything bad happening." This explanation is based on the first author's experience with the current organization, which at the time of the present study, had mentioned that it was hard to get many of the team members to follow strict safety standards, because many of the team leaders and team coordinators did not follow them. It is unclear whether a negative safety rating from a group leader relates to actual accident rates or to observations of safety regulations not being adhered to properly. Thus, although one might argue that the more intelligent employees should be the ones who realize the risk of ignoring safety regulations, they may also be the ones who have more confidence in their ability to avoid injury and therefore, take more chances. The current study, however, was not able to test this hypothesis.

The current study also found partial support for a social impact theory (Latané, 1981) explanation of the relationship between the cognitive ability of team members and team performance. It was hypothesized that the magnitude of the relationship between all of the team member cognitive ability indices and team performance would be greater in smaller teams than in larger ones. There were five significant correlations between ability and performance in the small group, whereas there were no significant relationships in the large group. Further, of the 20 possible correlations, there were significant differences between seven of these possible pairs between small and large teams. Especially for the two ability measures that were significantly related to performance in the total group, (i.e., variability and the cognitive ability of the lowest ability team member) these differences were pronounced between small and large teams. The average correlation, however, was not significantly greater in magnitude in small teams than in larger teams.

Therefore, this study addresses one of the issues raised in the recent meta-analysis (Devine & Philips, 2001), the search for potential moderators. Team size appears to moderate this relationship, with smaller teams impacted more by member cognitive abilities in relation to performance. Team size was not one of the moderators identified by Devine and Philips in their conceptual model of the relationship between team performance and team cognitive ability. Team size may, however, capture some of the team process variables they indicated (e.g., information sharing, information integration, conflict). This study, then, is one of the first to identify a potential moderator of this complex relationship.

The impact of group composition would also appear to be clearly a function of the type of task involved. In particular, the production teams in this organization performed a complex duty requiring the performance of a number of tasks and subtasks. The type of task may also dictate what types of abilities or personality factors are related to group performance.

In summary, the current study found that certain combinations of cognitive

ability for production work team members were significantly related to team performance. Contrary to expectations, average team member ability was not significantly positively related to team performance and, in fact, was significantly negatively related to team safety ratings in teams with less than eight members. The highest ability team member was not significantly related to any of the performance measures in the total group, in small teams or in larger teams. Variability in team member cognitive ability was positively related to team performance, in small teams as well as in the entire group of 97 teams, and the ability level of the lowest ability member was significantly negatively related to performance. Finally, significant differences were found in terms of team member cognitive ability and team performance between small and large teams, with the impact of cognitive ability appearing to be greater in smaller teams.

Implications

From an applied perspective, the current findings provide support for Pearce and Ravlin's (1987) earlier prescription and should encourage designers of work teams to increase the heterogeneity of cognitive ability, and perhaps other abilities and/or personality factors, in their teams. From a theoretical perspective, although there is a growing body of evidence that heterogeneity in cognitive ability is positively related to work group performance, there is little empirical research regarding the group dynamics that may actually lead to performance and the generation of ideas, as well as potential boundary conditions which may enhance or inhibit the effect of heterogeneity.

Although results from a single study do not provide us with sufficient information to provide recommendations that will succeed in all situations, the results from the present study, taken together, do lead to one straightforward and testable recommendation to designers of work teams. When selecting employees for these work teams, practitioners should be careful to identify the knowledge, skills and abilities (KSAOs) needed for success on the job and utilize some approach, whether empirical or judgmental, to establish some minimally acceptable levels for those KSAOs which all team members must pass. Once a group of qualified employees is identified, they should be assigned to teams in a manner that enhances the heterogeneity of ability on all teams. However, there may be a limit to how much heterogeneity is desirable. A meta-analysis by Aamodt, Freeman, and Carneal (1992) suggests that slightly heterogeneous groups perform better than homogeneous or highly heterogeneous groups. It may also be that too much heterogeneity may have negative effects on group processes and satisfaction.

This recommendation should be useful to practitioners because of it's ease in application, as well as its ability to be clearly testable in more controlled environments or in quasi-experimental field studies. Future research should focus on identifying other ability or dispositional components that may affect team performance. Further, research should also evaluate the dynamics of group behavior in both large and small teams to help gain a better understanding of how, why and under what conditions the impact of these individual abilities change and potentially become dissipated as the number of team members increases.

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