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The Contribution of Group Members' Cognitive Resources to the Effectiveness of Small Groups

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Contracting Officer's Representative
Michael Drillings

Basic Research
Michael Kaplan, Director

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This project identifies the condition under which certain cognitive resources, specifically, the work-related experience and intellectual abilities of leaders, contribute to effective performance. This report describes the main activities and principal findings of this effort.

Experience contributes to performance under stress. More intelligent leaders search for more information and view information items more often than do less intelligent leaders. More experienced leaders search for less information than inexperienced leaders and make more accurate decisions only under stress. Stress did not affect such leadership functions as communication and administrative duties.

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The Contribution of Group Members' Cognitive Resources to the Effectiveness of Small Groups

This project seeks to identify the conditions under which certain cognitive resources, specifically, the work-related experience, training, and intellectual abilities, contribute to effective organizational performance. The research is based on Cognitive Resource Theory (Fiedler, 1986; Fiedler & Garcia, 1987), extending Blades' (1976) earlier research.

The theory seeks to identify the conditions under which the leader's experience and cognitive abilities contribute to performance. These conditions include the leader's directiveness, group support and motivation (Blades, 1976), and amount of stress in the relationship with such key persons as the immediate superior and important subordinates (Fiedler, 1986).

Implications for the military services. Our current selection and achievement tests are highly reliable and valid in predicting the individual's capacity to perform. But our research shows that this capacity can be effectively utilized only under certain limited conditions. It suggests that unit performance could be substantially improved by training the individual and/or supervisor to find or develop the required conditions.

Background. A substantial body of research shows that measures of experience and abilities of army leaders as well as of civilian managers are essentially uncorrelated with organizational performance. This is clearly a counter-intuitive finding: practically every employment interviewer and application form inquires about the candidate's previous work history, and many decisions to hire or promote to responsible positions are based primarily on the individual's track record in previous positions.

The underlying assumption is, of course, that leadership is a skill which is common to all leadership jobs, and that it is a skill or ability that can be learned. Previous experience presumably provides an opportunity to acquire these skills and abilities, or to demonstrate that the individual has these skills or abilities. The fact is that the relationship between previous work experience and leadership performance is low or non-existent. This suggests two alternative explanations: (a) experience does not teach one to be an effective leader or that effective leadership cannot be learned by on-the-job training; or (b) experience and certain leader abilities and skills may contribute to performance only under certain conditions but not others. It is essential to learn, therefore, what these specific conditions are, and how to develop them.

Definitions.

The term leader refers to the individual in a group or organization who directs the work of others. This person may emerge as the most influential group member, or be appointed or elected for the purpose of supervising and coordinating the work of the group.

By the term experience we shall mean the time an individual has spent in a group or organization, or in a leadership job. While other definitions of experience are appropriate, this basic definition indicates the opportunity an individual has for gaining job- and organization-relevant knowledge. For a more sophisticated operational definition of experience, see Bettin (1983).

Performance refers in this context to the accomplishment of tasks assigned by the organization, or goals which group members set for themselves. We are not concerned with groups that have as their goal the growth, development or personal enjoyment of individual group members (e.g., classes, social organizations, social clubs, therapy groups, etc.).

Previous research. The question of how leader experience affects leadership performance has been largely ignored by organization theorists. This point is well illustrated by the absence of any index entry to leader experience in the authoritative Stogdill's Handbook of Leadership (Bass, 1981).

The first study, conducted by the Principal Investigator, (Fiedler, 1970) showed that experience and leadership performance, overall, were uncorrelated, and subsequent investigations have supported this earlier finding. Studies under a previous ARI contract by Blades and Fiedler (1976), Bons and Fiedler (1976), Borden (1980), and Potter and Fiedler (1981) showed that experience, as indicated by time in service or time in a leadership position, correlated with performance only when the leader experienced stress, and especially stress with the immediate superior.

During the past three years, we have concentrated on the more specific leadership functions in which experience, and cognitive resources in more general terms, play a major role in determining the effectiveness of the leader's decision-making functions. The major advances are summarized in this report.

The Effect of Stress on the Leader's Decision-Making

Borden (1980), in a study of infantry division leaders, found positive correlations between leader intelligence and performance under low and moderate stress, but slightly negative correlations when leaders reported high stress with their boss (.52, .48, -.08). Similar results were reported by Fiedler and Leister (1976) in a study of army squad leaders, by Zais (1979) in a study of army company commanders and staff officers, and by Knowlton (1979) in dyads composed of army company commanders and their first sergeants (Fiedler, Potter, Zais & Knowlton, 1979). The effect of job stress on cognitive resource utilization was relatively minor (Fiedler & Garcia, 1987).

We suggest that job stress, caused by short deadlines or the complexity of the task, focuses the individual's intellectual attention on the task. However, stress with such important others as a boss, focuses attention on task-irrelevant factors (e.g. the boss' feelings, worry about failure), none of which contribute to task performance.

Research Conducted Under this Contract

Research Questions

The project investigated four main questions:

a. Which of the various leadership functions is most directly affected by stress?

b. Which type of stress is most detrimental to the use of cognitive abilities: the stress that comes from the job itself or stress generated by a demanding boss?

c. Which specific intellectual abilities are most strongly affected by stress?, and finally,

d. Which specific behaviors account for the finding that the more intelligent leaders and their groups perform less well than do less intelligent leaders?

Empirical Findings

Re-Analysis of the Coast Guard Study (Potter & Fiedler). To identify the specific leadership functions which are adversely affected by boss stress, we re-analyzed Potter and Fiedler's (1981) study of 130 Coast Guard officers and petty officers. Each of the participating officers and petty officers completed questionnaires indicating the amount of stress they experienced in the relationship with their boss as well as stress generated by the job itself. Participants also estimated the proportion of effort devoted to each of 10 job

functions. These functions could, in turn, be classified as decision-making, routine paper work, communication, implementation of plans, etc.

Subjects who reported devoting a high proportion of their job-related effort to one of these categories were divided into those who reported low and high job and boss stress, and correlations were then computed between their Wonderlic (1977) intelligence score, their time in service, and rated performance. As can be seen in Table 1, only the decision-making dimension was strongly affected by boss stress. Intelligence correlated positively with the effectiveness of decision-making under low stress, but highly negatively under high stress. The effect of job stress on the effective use of intelligence, especially on decision making jobs was considerably less than the effect of boss stress.

Insert Table 1 About Here

As can be seen, almost all correlations between intelligence and performance in the high boss stress condition were negative, and strongly negative in the decision-making and policy advising functions. The effects of boss stress on the intellectually less demanding functions (routine paper work, attending staff meetings, training subordinates, etc.) were insubstantial. However, experience and performance correlated positively when boss stress was high (Table 2).

Insert Table 2 About Here

The In-Basket Study (McGuire & Fiedler). To cross-validate the results of the coast guard study, 34 Army ROTC cadets completed the army's in-basket exercise under conditions of relatively low and high boss stress. A scoring manual identifies various "behaviors" that are to be judged on the basis of the subjects' responses (Table 3).

Insert Table 3 About Here

Cadets randomly assigned to the low stress condition were told to come to the laboratory in civilian clothes and were informed that the in-basket exercise would not affect their military grade. Cadets in the high stress condition were told to appear in uniform; their performance was monitored by two army captains, and they were told that they might have to justify their responses to their military commander.

While the stress manipulation was successful, some cadets reported low stress in the "stress condition" while others reported relatively high stress in the "low stress" condition. Although the results were similar for analyses using both reported and manipulated stress, the analysis based on reported stress rather than experimentally induced stress yielded more interpretable results.

This study also enabled us to identify which of two components of intellectual ability is most affected by stress. Each cadet completed scales from Horn's (1968) sampler of measures of crystallized and fluid intelligence. Crystallized intelligence, measured here with a vocabulary scale, indicates the individual's incorporation of previously learned facts and concepts. It measures ability to learn from experience (e.g., school), and correlates with most standard intelligence scales. Fluid intelligence, measured by number and letter series items (e.g. A D C ?; 2 8 4 ?) indicates the ability to perceive relationships among patterns, draw inferences from relationships, and comprehend implications.

Table 1

Correlations of Performance and Intelligence under Low and High Boss and Job Stress in the Coast Guard Study (Potter & Fiedler, 1981).

	Intelligence and Performance							
	Boss Stress				Job Stress			
	Low		High		Low		High	
Decision-Making								
Making decisions	.11	(21)	-.47	(13)	.06	(24)	-.24	(23)
Policy advising	.27	(30)	-.46*	(22)	.15	(25)	-.19	(23)
Communicating and Executing Orders								
Supervising subs.	.07	(29)	.04	(18)	.15	(23)	-.01	(24)
Training	.11	(26)	-.17	(21)	.03	(16)	-.12	(24)
Public representation	.04	(26)	-.36	(16)	.09	(19)	-.04	(13)
Administration								
Paper work	.01	(25)	-.25	(21)	-.03	(25)	-.16	(21)
Project engineering	.38	(20)	-.16	(21)	.27	(22)	-.05	(19)

* $p < .05$.

Table 2

Correlations of Performance and Experience under Low and High Boss and Job Stress in the Coast Guard Study

	Boss Stress				Job Stress			
	Low		High		Low		High	
Decision-Making								
Making decisions	.01	(23)	.47	(14)	.00	(32)	.31	(16)
Policy advising	.06	(35)	.43*	(22)	.06	(30)	.44*	(29)
Executing Orders								
Supervising subs.	-.06	(31)	.41	(19)	.08	(23)	.10	(27)
Training field units	-.09	(31)	.42*	(23)	-.25	(24)	.38*	(38)
Administration								
Paper Work	-.28	(27)	.44*	(22)	.05	(27)	.01	(22)
Project engineering	.30	(22)	.13	(22)	.15	(22)	.27	(22)

* $p < .05$.

Table 3

Leadership Dimensions Used in the Army In-Basket Exercise

DECISION-MAKING SKILLS:

PROBLEM ANALYSIS - The skill required to identify a problem, secure information relevant to the problem, relate problem data from different sources, and determine possible causes of problems.

JUDGMENT - The ability to develop alternative courses of action based on logical assumptions that reflect factual information.

DECISIVENESS - The readiness to make decisions, render judgments, take action or commit oneself.

ADMINISTRATIVE SKILLS:

PLANNING AND ORGANIZING - The ability to establish a course of action for self or others to accomplish a specific goal; planning proper assignments of personnel and appropriate allocation of resources.

DELEGATION - The ability to use subordinates effectively; the allocation of decision-making and other responsibilities to the appropriate subordinates.

ADMINISTRATIVE CONTROL - The ability to establish procedures for monitoring and regulating processes, tasks, or activities of subordinates and job activities and responsibilities; to monitor actively the results of delegated assignments or projects.

COMMUNICATION SKILLS:

WRITTEN COMMUNICATION - The skill required to express ideas clearly, in writing, using good grammatical form.

PERSONAL/MOTIVATIONAL BEHAVIOR:

INITIATIVE - The discipline that requires attempting to influence events to achieve goals beyond those called for; originating action; self-starting rather than passive acceptance.

INTERPERSONAL BEHAVIOR:

SENSITIVITY - Those actions that indicate a consideration for the feelings and needs of others.

Correlations were computed between crystallized and fluid intelligence and performance on each in-basket dimension for the low and high stress groups, respectively. The results of this analysis are shown in Table 4. As can be seen, stress affected the correlations between fluid intelligence and performance. In addition, substantial differences were obtained between fluid intelligence and performance in categories related to decision-making under low and high stress conditions. We found no substantial effects of stress on the correlations between crystallized intelligence and performance. Again, job stress did not strongly affect utilization of leader intelligence.

Insert Table 4 About Here

As in the coast guard study, stress most strongly affected behaviors related to planning and decision-making, but only the use of fluid intelligence was affected by boss stress. The obvious next problem was to determine exactly what the more intelligent leaders do under stress that depresses their performance.

Content Analysis of Previous Creativity Studies (Gibson, Fiedler & Daniels, 1990). Several explanations may be offered to account for the finding that the brighter leaders perform less well than less bright leaders when they are distracted by stress. One of these is that more intelligent people have higher expectations of their ability to cope with intellectually demanding tasks and, therefore, are more anxious to prove themselves.

If this is the case, we would expect individuals with high intellectual ability to (a) take a more active part (talk more) in attempting to deal with intellectually challenging tasks, thus reducing their group members' opportunity to contribute, (b) strain for exotic solutions; and (c) be more critical than less intelligent leaders and, therefore, reduce the number of ideas that are produced.

These hypotheses were partially supported in a content analysis of tape recordings made in an earlier study of group creativity (Fiedler, Meuwese & Oonk, 1961). This study investigated 32 groups of 4 male college students. All subjects in this study completed a version of the Miller Analogies test as a measure of intelligence, along with other measures. Post-session tests measured pleasantness and tension, and a sociometric questionnaire verified group members who had made destructively critical comments.

The experimental task consisted of inventing stories based on two pictures from the Henry Thematic Apperception Test (TAT) for groups. The stories were rated by three judges who were blind as to experimental conditions. The content analysis of the protocols included a category of "new ideas" (Looks like a father scolding his son) and of "irrelevant comments" (This room is getting hot). In addition, the number of comments in each of the sessions was counted.

We found a marginally significant but substantial correlation ($r=.70$, $p<.10$) between leader intelligence and the total number of comments in the more stressful condition but not in the non-stressful condition ($r=.02$). Furthermore, leader intelligence correlated negatively with task-irrelevant comments by group members under low stress ($r= -.28$) but positively ($r=.34$) under high stress. In other words, under stress, intelligent leaders and their group members "babbled," they talked more but said less to the point than did less intelligent leaders and their group members.

The suggestive findings from this study were formally tested by Gibson, Fiedler and Daniels (TR 90-1) with data from a group creativity study by Meuwese and Fiedler (1965). The original experiment used 54 three-man teams of ROTC cadets who were assigned at random to various stress conditions; in one of the conditions they performed tasks while facing a high-ranking army officer who took copious notes of their behavior.

Perceived stress was measured using the Alexander and Husek (1962) state anxiety scale. The Multi-Aptitude Test (Psychological Corporation) measured intelligence and the Guilford, Berger and Christensen (1954) Plot Titles and Alternative Uses tests measured

Table 4

Correlations Between Fluid Intelligence and In-Basket Dimensions Under Conditions of Low and High Perceived Stress

	PERCEIVED STRESS CONDITION		
	LOW (N = 19)	HIGH (N =15)	FISHER'S SIGNIFICANCE OF DIFFERENCE (2 TAIL P VALUES)
Decision Making			
PROBLEM ANALYSIS	.54*	-.13	.06
JUDGMENT	.12	-.56*	.05
DECISIVENESS	.43*	-.58*	.01
Administrative Behaviors			
PLANNING & ORGANIZING	.48 *	-.33	.026
DELEGATION	.40	-.33	.046
ADMINISTRATIVE CONTROL	-.20	-.37	N.S.
Personal/Motivational Behavior			
INITIATIVE	.35	-.07	N.S.
Interpersonal Behavior			
SENSITIVITY	.22	-.28	N.S.
Communication Skills			
WRITTEN COMMUNICATION	.22	.24	N.S.

* $p<.05$

creativity. The Plot Titles test presents the subject with short story plots for which clever titles must be invented. The latter asks for alternative uses for such common items as a brick (e.g., book ends, door jambs) or coat hanger (e.g., to stir paint), and was scored using a standardized manual.

Subjects were told to invent a fable for elementary school children. Five independent judges evaluated task performance. The estimated interrater reliability of the summed ratings was .67.

A content analysis of the typescripts counted behaviors in four categories: (a) amount of talking by the leader and (b) by group members; (c) number of substantive ideas by the leader and (d) by members. In addition, judges rated the degree to which the leader and members communicated clearly and understandably. Finally, we developed a "babble" index by dividing the number of substantive ideas by the amount of talk, thus indicating how much substance there was in the leader's or group member's comments.

These analyses led to five main conclusions:

1. Under stress, leaders with relatively high intelligence tended to talk more than those with less intelligence.

2. Under stress, members of groups led by more intelligent leaders talked less than did members of groups led by less intelligent leaders.

3. Under stress, more creative leaders suggested fewer ideas than their less creative counterparts.

4. Group members led by more creative leaders under stress also suggested fewer ideas than did group members led by less creative leaders.

5. Under stress, the quality of the more creative leaders' contribution, as indicated by the ratio of ideas to amount of talk (babble), was less that of less creative leaders. The same findings held for group members in these groups.

Figure 1 shows the interactions of leader creativity and reported stress on leader "babble". Figure 2 shows the effect of leader creativity and stress on member babble. Both interactions are highly significant. These results suggest that the gifted leaders' abilities inhibit performance under stress by causing them to suppress the ability or opportunity of their group members to contribute to the solution of the group problem

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Insert Figures 1 & 2 About Here

The Information Search Study (Locklear, Powell & Fiedler). This study asked how stress affects the decision maker's ability to search for, and acquire, the necessary information with which to make sound decisions. Subjects were 31 present and previous platoon leaders and 27 platoon sergeants from an active duty army battalion. Since intelligence scores and experience measures of officers and NCOs differed significantly, the two subject groups were analyzed separately. Horn's measures of crystallized (Gc) and fluid (Gf) intelligence were used. Leaders searched for information required to rank 5 army training schedules in order of merit.

Figure 1

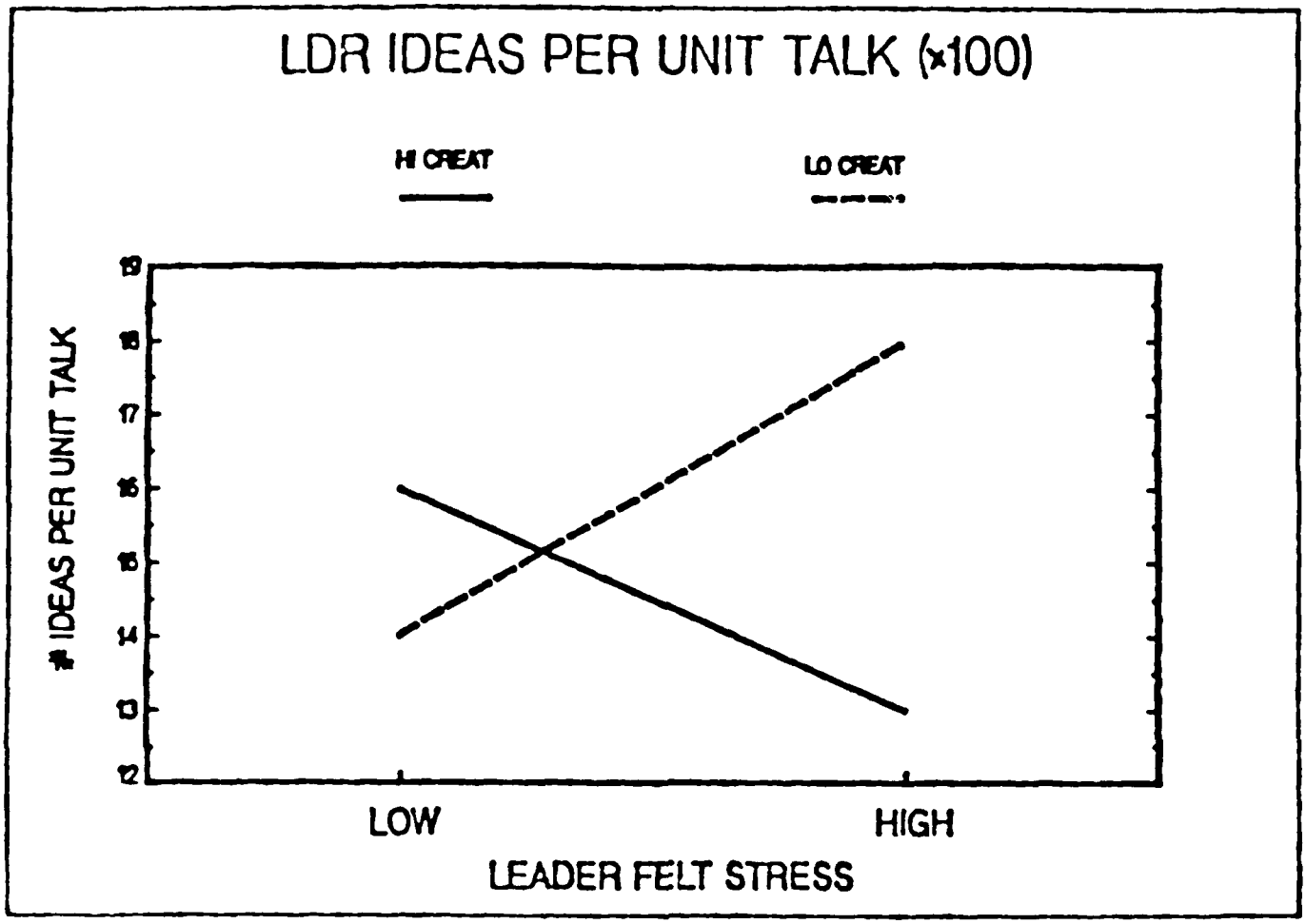
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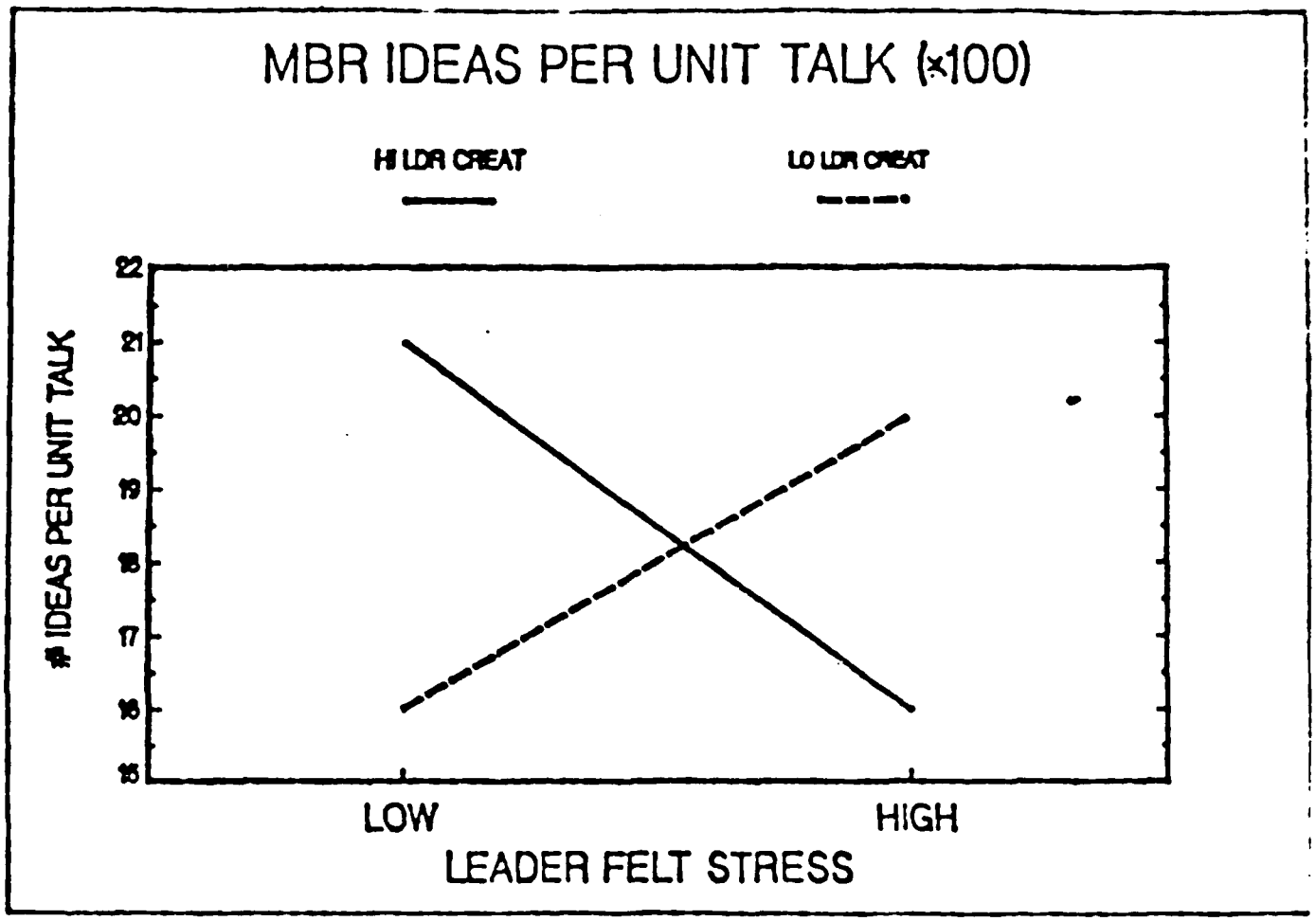
Figure 2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LOW
HIGH
LEADER FELT STRESS

The subjects were presented with "information boards" (Wilkins, 1967; Payne, 1976) which contained all the data needed to perform the ranking task. Each information board (3 ft x 4 ft) listed five hypothetical weekly training schedules;
the top of the board listed 7 attributes that the training schedule had to satisfy to a greater or lesser extent.

The task was performed under three stress conditions, using parallel forms of information board items. In the "base-rate" condition, the subjects worked under relatively little pressure and were reassured that they had sufficient time for the task. In the "evaluation apprehension" condition, stress was induced by having subjects perform the task in front of a television camera after being told that their performance would be evaluated by their superiors. In the third situation ("1/2 Time") subjects were (incorrectly) informed that they would have only half the time normally required to complete the task to induce time pressure. Subjects in all conditions had an equal amount of time to complete the task.

Observers recorded the subject's search behavior, listing 1) the number of information items inspected during the process of information search, 2) how often the same item was reinspected, 3) to what degree the ranking was similar to that of a panel of experts, 4) what types of items were preferred across all conditions, and 5) whether search was organized around attributes or alternatives.

We obtained the following results:

1. A multi-variate analysis showed that officers viewed more items of information in all conditions than did NCOs (officers = 56.9; NCOs = 37.08; $F(1,56) = 18.69$, $p < .001$).

2. Officers with higher crystallized intelligence examined more information items than did less intelligent officers.

3. Officers tended, across all situations, to reinspect more information (mean = 28.23, 51.1% reinspections) than did NCOs (mean =13.3, 30.7% reinspections); ($F(1,54)= 13.04$, $p < .001$).

4. Officers with higher crystallized intelligence viewed more items and made more repeated inspections ($F(1,29)= 4.43$, $P < .05$), while the NCOs' fluid intelligence correlated at a marginal significance level with repeated inspections for all three conditions ($F(1,25)=3.92$, $p = .06$).

5. Subjects with higher crystallized intelligence performed better in all three conditions than did subjects with lower Gc ($F(2,54) = 6.15$, $p<.05$).

6. As expected from previous studies, the more experienced leaders out-performed the less experienced leaders only in the "evaluative stress" condition ($F(1,54) = 7.88$, $p < 0.01$).

7. Finally, it is of interest to note that the number of information items viewed by subjects, and the reinspection of these items, was negatively correlated with their ranking performance. While not very high, the correlations were significantly negative for NCOs in the base rate and the evaluation stress conditions, suggesting that too much information leads to poor decisions, at least in this particular task.

THEORETICAL AND PRACTICAL SIGNIFICANCE

The significance of this research program for understanding the role of intellectual abilities and of experience in leadership performance was discussed in the first section of this report. The role of intelligence and experience in leadership is still not clearly understood, although the evidence shows all too well that the intellectual abilities, creative abilities and knowledge available in the majority of work groups are "wasted", or at least not effectively utilized.

From a practical point of view, it seems highly probable that our findings will lead to a substantial improvement of the utility of paper-and-pencil selection and classification tests by specifying under which specific conditions these tests would be most predictive. The findings of the completed contract lay out a direction for programmatic research to be conducted in the immediate future. The problems that appear most in need of further investigation are here indicated:

1. We need to validate the effect of stress on "babbling" by the relatively more intelligent leaders and the members of their groups under experimentally controlled conditions. This problem is of considerable importance to the military services since it affects the leader's most critical function, namely, to make sound decisions under stress. An experiment is now under way to investigate this phenomenon.

2. We need to determine more specifically the conditions under which experience and training contribute to effective leadership performance. In particular, we need to consider the relative contributions on technical experience and interpersonal experience under conditions of low and high stress. We also need to investigate the degree to which such personal attributes as self-efficacy and self-confidence are able to buffer interpersonal and job stress.

3. We need to identify the usefulness of such organizational interventions as stress management training and organizational designs that will increase the utilization of cognitive resources of leaders as well as of rank and file military personnel. A field experiment of this nature is now in the planning stage.

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Military Officers Involved with Studies

Major Frederick W. Gibson, U. S. Air Force
Captain Roland Jacobs, U. S. Army
Captain Jody C. Locklear, U. S. Army
Captain Mark A. McGuire, U. S. Army
Captain Charles G. Powell, U. S. Army
Captain Douglas Vargas, U. S. Army

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