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TRAINING FOR COGNITIVE COMPLEXITY

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for

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It is impossible to evaluate the effectiveness of training without adequate measurement techniques. In the research covered by this research note, measurement was accomplished through simulation technology; subjects were tested in a first simulation, and later re-tested.

A consistent improvement in performance was found when people were given practical and conceptual information about how to apply conceptual stylistics to management efforts, especially decision-making. All measures of performance showed improvement.

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TRAINING FOR COGNITIVE COMPLEXITY

This contract was primarily concerned with the question: "Can managerial competence, as described by cognitive complexity, be trained?" Any potential for training, of course, presupposes measurement. Without prior assessment (and without post-training reassessment) we cannot determine whether a training program has been effective. Prior to the initiation of this research program, we knew very little about measurement techniques which might assess forms of cognitive complexity that are associated with managerial competence. As a result, we were also ignorant about the potential for training in cognitive complexity. Fortunately, this research program has provided us with a wealth of information which can aid us at least in a preliminary understanding of the issues at hand and, in addition, can point the way toward research questions that need yet to be explored.

This final report to the U.S. Army Research Institute for the Behavioral and Social Sciences has two purposes. First, it will serve to review results that have been reported in earlier papers concerned with the present effort. Those earlier reports have primarily focused on measurement, its potential, reliability, validity and applicability. In the second part of the present paper we will deal with training data that were collected in the final year of this research effort. We will report where training turned out to be useful or not useful. Finally, we will consider the implications of the research program for applied settings and for subsequent research.

MEASUREMENT

Psychologists, personnel specialists as well as others who have wanted to assess managerial competence have tended to prefer objective paper-and-pencil techniques. Unfortunately, effective objective measures of cognitive complexity, especially with relevance to managerial competence, are not available. While some useful paper-and-pencil measures which assess domain specific differentiation (one component of cognitive complexity) have been designed and have been validated in lab settings (e.g., the Role Concept Repertoire [REP] test of Kelly, 1955, and associates, cf. Bieri, 1955, 1961, 1966, 1968; Bieri, Atkins, Briar, Leaman, Miller and Tripodi, 1966; Bieri and Blacker, 1956), those tests are too restrictive to be applicable to managerial efforts. For example, the REP test specifically measures "perceptual social differentiation." Certainly, a manager often needs that capacity. However, the same manager must be able to integrate as well. The REP test (and related instruments) was not designed to measure integration. In fact, even "perceptual social" <u>integration</u> would, as scored by the REP test, produce data that fail to distinguish between rather simplistic non-differentiated responses and integrated responses (cf. Streufert and Streufert, 1978).

Scott and associates (e.g., Scott, Osgood and Peterson, 1979) have developed some paper-and-pencil measures that are viewed as estimates of specific integration and discrimination (cf. Scott, 1962, 1963a, 1963b, 1966, 1969, 1974). Scott tends to define the terms "integration" and "discrimination" in a way that does not permit strict comparisons with the theoretical or measurement approaches of other scientists. Moreover, his measures tend to be based on mathematical theorems that do not include an interactive "flexibility" component as do some other complexity theories, limiting the usefulness of his measurement approach within the arena of management.

Broader and more useful measurement techniques have employed subjective techniques, e.g., the Sentence (also called Paragraph) Completion Test (e.g., Schroder and Streufert, 1962; Schroder, Driver and Streufert, 1967) and the Impression Formation Test (Streufert and Schroder, 1963; Streufert and Driver, 1967). The subjective nature of these tests renders them less useful. Scoring tends to follow a slow and cumbersome procedure. Raters must be extensively trained. Some raters, despite extensive training, never achieve the expected inter-rater reliability of $r = +.9$ or better.

Finally, both research in our laboratory as well as research by others (e.g., H. M. Schroder, personal communication, November 1985, December 1986) suggests that even subjective tests have often failed to be superior predictors of executive performance. The lack of adequate validity is likely due to the fact that differentiation and integration (the two complexity components assessed by these tests) represent only two aspects of the rather complex executive style that is related to cognitive complexity. These two components apparently interact extensively with other aspects of that executive style. In other words, the specific and isolated measurement of differentiation and integration alone is inadequate for prediction purposes.

Nonetheless, it has become evident that the capacity for differentiation and integration is a basic and necessary ingredient for executive excellence (cf. Streufert and Swezey, 1986). That capacity is needed to perform well in a variety of managerial settings and jobs. It is especially needed at higher managerial levels and whenever uncertainty is present, when task complexity is considerable and where application of strategy is required. Since previous efforts at measuring the kind of cognitive complexity required in managerial settings have not been especially successful, it appeared useful to develop and test new assessment techniques. The initial two years of the present research were primarily devoted to that purpose.

The Purpose of Measurement

If we wished to select a junior executive or a younger officer for an especially difficult and complex assignment, we would want to assure that this person has the needed intelligence, is highly motivated and has, if possible, some relevant experience. The person we finally select for the job may accomplish the assigned task very well, implying a promising career in the future. Nonetheless, some day, at some advanced level, the individual may not be promoted, may be sidelined or even fired. What has happened?

The person under consideration would likely be as intelligent and probably as motivated as before. He or she has likely even grown in relevant experience. Personal animosities or political issues may not have played a role in the decision to promote someone else. In many cases, our unsuccessful candidate has failed for reasons that were not even considered at the time of earlier career decisions. In other words, the kind of competence that had been assessed at junior levels was not enough or is no longer appropriate.

Our executive who suddenly failed to achieve promotion or who did not do well at a more advanced job is not alone. There have been many supposedly highly competent executives, managers, military officers and so forth that have suddenly failed at advanced career levels. For example, Napoleon was certainly an excellent General, possibly the best of his time. Nonetheless, he lost his campaign against Russia and was sent into exile. Custer knew the Indians well, yet was soundly defeated by them. The captain of the Titanic was the best sailor of his fleet, yet he and many others drowned as his ship sank to the bottom of the Atlantic Ocean. The executives of Coca Cola are well known for their international managerial skills, yet they introduced "New Coke." In all these cases, the "right" decision, based on "competent" reasoning, turned out to be wrong. Why did all of these managers make faulty decisions at an advanced level in their respective careers?

All of them engaged in something which managers like to call "straight line thinking." All of them applied their intelligence meaningfully. They considered the obvious facts. They were motivated to be successful, and so forth. Yet, their style of thinking was flawed. They did not apply the needed cognitive complexity. Their thought processes did not approach complex problems in a multidimensional flexible way. They tended to focus only on the few or only on one salient aspect(s) of the situation or task at hand. They did not consider alternative informational dimensions that could affect the situation with which they had to deal.

Napoleon had already claimed victory over a number of nations. When he took the capitol of Prussia, he had been victorious over that nation. It had been the same elsewhere. He expected the same in Russia. One night, he slept in the burning Russian capital. He believed that he had won. But the Russians kept on fighting. Napoleon's army, at that point, was exhausted and had to retreat.

Custer knew the Indians well. He had spent considerable time among them. He knew that the Indians fought among each other and was sure that they would never unite to fight the white man. Custer was known to send out scouts to find the enemy and explore enemy capability. His scouts must have told him about the overwhelming number of Indians at Little Bighorn. Likely he did not believe and paid with his life and that of his troops.

The Captain of the Titanic was indeed the best sailor of his fleet. He would not have been trusted with a ship that was the pride of the company if he had not been the best. It was the maiden voyage of the Titanic; both the captain and the designer of the ship were on board. The ship was built to withstand collisions with icebergs. With that fact in mind, the decision was made to take a far northerly route to capture the speed record for Atlantic crossings. The Titanic did collide with an iceberg, but one that was far larger than anyone had imagined. The damage was too great and the ship sank.

Coca Cola had conducted a taste test which proved that the public would prefer new Coke to standard Coca Cola. In response, the company changed the flavor of their primary sugared soft drink. The public was outraged and sales fell drastically. In fact, the taste of new coke was somewhat similar to Pepsi. Most supermarket consumers were already buying Pepsi, probably because they preferred Pepsi over Coke. While those Pepsi drinkers probably preferred the new coke over the old, they were nonetheless committed to Pepsi and had no reason to switch. On the other hand, people who preferred Coca Cola were outraged by new Coke. Coca Cola was forced to return the old formula to the shelves as "Classic Coke."

All four failures represent "straight line", i.e., "unidimensional" thinking. All of the decision makers involved had considered only salient aspects of the situation at hand. For Napoleon it was capturing the capitol. Custer probably could not conceive of a large number of Indian warriors. The captain of the Titanic focused only on the speed record. The Coca Cola executives apparently believed in the taste test. In each case, the consideration of other (alternative) dimensions would have prevented or at least might have ameliorated the "disasters" that ensued. In each case, <u>what</u> these decision makers were thinking was reasonable and based on experience and competence. However, <u>how</u> the decision makers were thinking was ineffective (cf. Streufert, 1986; Streufert and Swezey, 1986).

The needed "how" of thinking reflects a multidimensional <u>style</u> of information processing. That style consists of a number of components:

(1) Differentiation. Sometimes also called "concept formation" or "divergent thinking," differentiation implies the application of two or more alternate dimensions of judgment and/or decision making to the environment. For example, the differentiating manager may use a number of diverse categories of information, may interpret a single event in a number of ways and may consider a number of diverse decisions that have predicted alternate outcomes or implications. The same manager may simultaneously pursue a number of alternate strategies.

(2) Integration. Sometimes called "conceptual flexibility" integrative thought allows the manager to see the whole picture: to keep various perspectives or alternatives that were generated via differentiation operative at the same time and for a common purpose or goal. Integration permits a view (or actions) that

place(s) events, decision points, etc., into a new light. It is the basis for effective strategic thinking. It provides the opportunity for exploring (and dealing with) the strategy of an opponent.

(3) Flexibility. Differentiation and integration might occur in a constant and fixed fashion or may be flexible. Where fixed, interrelationships among events, ideas, strategies etc., have generally been learned and are repeated over and over again, despite changes in task demands. In a relatively constant task environment, these fixed (hierarchical) approaches to differentiation and integration may be appropriate. However, in frequently changing environments, or in tasks that contain uncertainty, flexible multidimensionality is needed.

(4) Adaptation. Tasks change. Periods that permit planning and strategy development may be suddenly replaced by time periods that contain emergencies which require rapid and decisive responding. Multidimensional differentiation and flexible integration tend to be optimal managerial stylistics as long as immediate respondent action is not required. In other words, excellence of multidimensional managerial style requires that the executive should monitor the urgency of current task demands. Planning at a time of serious problems that require immediate responding may be as inappropriate as "decisive" unidimensional action at a time when strategic thinking would have been appropriate.

In sum, any approach to the measurement of executive competence, especially at senior levels (and for those executives who might advance to senior levels in time), requires that the four characteristics of executive style we have described be <u>added</u> to the generally familiar demands for intelligence, motivation, experience, and so forth. To some extent, the reader may recognize a subset of the four characteristics we have discussed in some of the current notions of Sternberg (1984) and associates. They are also evident in the observations of senior executive excellence discussed by Isenberg (1984). Other, somewhat related, concepts have been discussed by Boyatzis (1982) and by Lawrence and Lorsch (1967a, 1967b).

Development of Measures: Objective Tests

As part of this project, we have attempted to develop and to improve an objective measure of cognitive complexity and flexibility. Any objective measure requires that respondents provide a relatively honest answer to questions that "make sense" to them. The degree of honesty of responses can be influenced by controlling the degree of social desirability inherent in test questions (cf. the work of Edwards, 1957, and Marlowe and Crowne, 1961). It is much more difficult to influence or control the "understanding" which respondents have of questions that they are asked. In the case of cognitive complexity (and associated managerial effectiveness), that task is especially difficult. As suggested earlier, we are dealing with questions of <u>how</u> people think. All of us are quite aware or <u>what</u> we are thinking and can, if we wish, provide meaningful answers to questions that are concerned with the content of our thought. However, we rarely, if ever, consider how we think. Executives whose style of thought is especially excellent often explain the "how" of their thoughts as "intuition." In other words, they use a descriptive term that does not provide any information about how their information processing is accomplished. They, themselves, do not know how they think. They do not know, in other words, why they are functioning as effectively as they are, and they cannot explain the reason for that effectiveness to others.

In other words, developing a test which would ask an executive how he or she is thinking would not be useful, even if social desirability could be avoided. Consequently, we made the decision to develop (or, in the cases of some items, improve) a test that would potentially assess multidimensionality by inference, i.e., by how hypothetical example problems might be approached and resolved.

The accomplished work centered around an initial set of 253 items concerned with stylistic tendencies related to differentiation, integration, flexibility and incongruity preference/ adaptation. Two initial factor analysis procedures focusing on differentiation and integration drew subjects from two different population samples. The first group consisted of 287 individuals including medical students, hospital residents, graduate students and low to mid-level managers/administrators from the Milton S.

Hershey Medical Center, Hershey, Pennsylvania, as well as professional artists and low to mid-level managers from Detroit, Michigan.

Six factors were extracted from a set of 156 items which had been written to focus primarily on differentiation and integration. The meaningful factors were:

(1) "Dogmatic differentiator/integrator" (Eigenvalue of 13.50 accounting for 7.50% of the variance);

(2) "Hasty decision maker" (Eigenvalue of 11.56 accounting for 5.89% of the variance);

(3) "Unidimensional authoritarian" (Eigenvalue of 5.50 accounting for 5.85% of the variance);

(4) "High integrator" (Eigenvalue of 4.18 accounting for 4.85% of the variance);

(5) "Rigid decision maker" (Eigenvalue of 3.95 accounting for 4.40% of the variance), and

(6) "Differentiator/low integrator" (Eigenvalue of 3.54 accounting for 4.37% of the variance).

A second set of subjects consisted of 227 individuals comprised of adults employed in the military, government or industry in the Washington, D.C. area and currently enrolled in graduate level programs at George Mason University or Northern Virginia Community College. Seven factors were extracted from the same set of 156 test items. The meaningful factors were:

(1) "Unidimensional decision maker" (Eigenvalue of 14.05 accounting for 8.85% of the variance);

(2) "High level integrator" (Eigenvalue of 11.04 accounting for 6.60% of the variance);

(3) "Rigid decision maker" (Eigenvalue of 6.03 accounting for 5.25% of the variance);

(4) "Dogmatic differentiator/integrator" (Eigenvalue of 4.81 accounting for 4.98% of the variance);

(5) "Avoidance of pondering" (Eigenvalue of 4.32 accounting for 4.47% of the variance);

(6) "Differentiator" (Eigenvalue of 4.04 accounting for 4.44% of the variance), and

(7) "High differentiator/low integrator" (Eigenvalue of 3.40 accounting for 3.43% of the variance).

Using the group of individuals from the Washington, D.C. area, 12 factors were extracted from an additional set of 97 items that were primarily written to measure incongruity adaptation. The following factors were generated:

(1) "Variety seeking" (Eigenvalue of 9.96 accounting for 4.60% of the variance);

(2) "Moderate novelty seeking" (Eigenvalue of 6.56 accounting for 4.33% of the variance);

(3) "Extensive novelty seeking" (Eigenvalue of 5.03 accounting for 4.09% of the variance);

(4) "Variety seeking in daily routine" (Eigenvalue of 3.88 accounting for 3.86% of the variance);

(5) "Desire for predictability I" (Eigenvalue of 3.59 accounting for 3.48% of the variance);

(6) "Intolerance of incongruity/emotional disturbance upon inconsistency experience" (Eigenvalue of 3.51 accounting for 3.47% of the variance);

(7) "High goals and need for achievement with frustration upon failure" (Eigenvalue of 3.00 accounting for 3.16% of the variance);

(8) "Preference for slight incongruity" (Eigenvalue of 2.56 accounting for 2.84% of the variance);

(9) "Dislike for variety" (Eigenvalue of 2.47 accounting for 2.67% of the variance);

(10) "Desire for familiarity" (Eigenvalue of 2.43 accounting for 2.55% of the variance);

(11) "Desire for predictability II" (Eigenvalue of 2.34 accounting for 2.45% of the variance), and

(12) "Preference for high levels of challenge" (Eigenvalue of 2.22 accounting for 2.27% of the variance).

In addition, a third factor analysis procedure was carried out on the entire 253 items involved in both parts of the questionnaire, combining the two groups of participants. Ten meaningful factors were extracted:

(1) "Authority oriented unidimensionality" (Eigenvalue of 16.13 accounting for 10.15% of the variance);

(2) "Differentiation" (Eigenvalue of 14.06 accounting for 9.57% of the variance);

(3) "Incongruity preference/devil's advocate" (Eigenvalue of 8.46 accounting for 7.37% of the variance);

(4) "Random responding plus intolerance of ambiguity" (Eigenvalue of 5.68 accounting for 7.00% of the variance);

(5) "Strategy/goal oriented integration" (Eigenvalue of 4.52 accounting for 5.53% of the variance);

(6) "Desire for acceptance on the basis of being 'right'" (Eigenvalue of 3.83 accounting for 4.97% of the variance);

(7) "Rigid adherence to own point of view; some tolerance of other's differed opinion" (Eigenvalue of 3.68 accounting for 4.86% of the variance);

(8) "Desire for some novelty" (Eigenvalue of 3.47 accounting for 4.86% of the variance);

(9) "Variety preference" (Eigenvalue of 3.30 accounting for 4.49% of the variance), and

(10) "Desire for predictability" (Eigenvalue of 3.00 accounting for 4.19% of the variance).

Based on these initial analyses, factor scores were compared to a number of other relevant measures, including Sentence Completion Test Scores, a variety of physiological measures etc. A shorter version of the objective test, consisting of 129 items taken from items loading highly on factors of the previous factor analyses was developed. Responses on this test were again compared to responses on a number of other measures. While some improvements in predictive capacity were obtained, it was judged inadequate to proceed with further development at present. As a rule, the test items tended to allow the exclusion of some persons lacking the capacity to differentiate and/or integrate. Specific selection of "cognitively complex" persons would have been possible with only very few items that would have been insufficient in number to assure reliability. While the content of those items appeared not related to social desirability, independence and predictive capacity (for executive personnel) was in some question. After careful consideration of the findings at hand, we concluded that direct measurement of performance in a simulated setting would represent a preferable approach.

Measurement via Simulation Technology

On the basis of other work accomplished in association with private industry, the Yugoslav Dilemma Simulation (Swezey, Streufert, Criswell, Unger and Van Rijn, 1984) and the TNG experimental simulation technique (Streufert, Clardy, Driver, Karlins, Schroder and Suedfeld, 1965 and Streufert, Kliger, Castore and Driver, 1967) had been drastically revised to provide an executive assessment technique. Two scenarios, one based on the TNG as well as an entirely new scenario, developed with Ciba Geigy Corporation, were available. Both techniques involve man-machine quasi-experimental simulation technology (cf. Fromkin and

Streufert, 1983; Streufert and Swezey, 1986). Participants in these simulations (functioning as either individuals or groups) fill the roles of decision makers who are exposed to ongoing, partially fixed complex and changing events. Decision outcomes are uncertain. Feedback is realistic but only partly responsive. The simulation technology is described in detail elsewhere (e.g., Streufert, 1983; Streufert, Pogash and Piasecki, 1986; Streufert, Pogash, Piasecki, Hunter, and Repman, 1986).

The underlying IBM AT/e software calculates a number of performance measures which were reported in detail previously (Streufert, Pogash and Piasecki, 1986). This research project was in part concerned with an evaluation of the simulation procedure and the data obtained via that procedure. Two reports to ARI focused specifically on the reliability and on the validity of the techniques.

Streufert, Pogash, Piasecki, Hunter and Repman (1986) obtained considerable reliability for simulation measures that are "structural" in orientation, i.e., concerned with how research participants dealt with the problems at hand. For example, strategy measures showing the sequential interrelationships among decisions and related measures generated high test/retest reliabilities (generally between r = .7 and .9, with some values higher than .9). In contrast, scenario specific measures that were concerned with what decision makers did failed (as expected) to correlate meaningfully.

With excellent test retest reliability for measures that were designed to assess differentiation, integration, flexibility and adaptability established, it was deemed useful to obtain validity estimates. Promotions at age, income at age and other related variables were used to predict simulation based scores. Significant validity levels were reported for a number of measures (cf. Streufert, Pogash, Piasecki, Repman and Swezey, 1986).

Test retest reliability was based on subject performance in two different simulation scenarios (Shamba and Disaster Simulations) superimposed over the same underlying software program. With the similarity of the demands and performance outcomes of the two diverse scenarios established, it became possible to intersperse procedures of interest between exposure of subjects to the two scenarios (of course presented in randomized order). For another project (with Ciba Geigy), a drug phase was compared with a placebo phase. For the present research effort, training procedures of diverse kinds as well as a no training control conditions were interspersed to measure the effect of training methods on performance in a second simulation. Since simulation performance was shown to predict executive performance in real world management settings, it could be reasonably assumed that improvement in simulation performance after training might affect management performance in actual executive settings as well. The next section of this paper will report on the results of our training research efforts.

EFFECTS OF TRAINING ON PERFORMANCE

The Training Technique

To assure that all participants in specific conditions of the research would be exposed to identical training procedures, a computer based training procedure was developed. The text of the training technique, available via a computer keyboard, was presented in the form of 10 chapters. Seven of the chapters contained conceptual information. Two chapters provided practical hints on how to increase performance. One chapter was devoted to an introduction to the theory of cognitive complexity. Selection of chapters for presentation to subject trainees depended on training conditions. The following training conditions were employed:

(1) No training (No chapters)

(2) Both conceptual and practical training (All chapters)

(3) Practical training only (Chapters containing introductory material and practical hints.)

Order of simulation scenario presentation was, in all cases, randomized. Where training was introduced, participants had to pass an examination after training as soon as they stated that they now knew the information in the training text. Participants were free to read the training text (on the computer screen) as often as they wished (in any sequence) before volunteering for the exam. If they passed 80% of the objective (multiple choice) questions, they were considered adequately trained. Only one person failed the exam on first try and had to be returned to the training system. Following completed training, participants entered the second simulation on the next day. Data were obtained by comparing the various measures obtained during the initial (pre-training) and the subsequent (post-training) performance.

Results

The results reported in this paper reflect changes in managerial simulation performance from the first (pre-training) simulation to the second (post-training) simulation. We will, omit the discussion of measure specific comparisons that did not reach or approach significance. Where no results are reported (cf. some of the simulation measures reported previously by Streufert, Pogash, and Piasecki, 1986), the reader should conclude that significance was not obtained. We will discuss the three training conditions in sequence.

(1) No Training Condition

Because of the large number of measures in the analysis, some significant comparisons between performance scores in the first vs. the second simulation might be expected by chance. However, such randomly generated significance should neither favor performance scores obtained during the first nor the second simulation. Such an inconsistent pattern of results was indeed obtained, when performance on three computer generated performance measures (and some of their derivatives) was compared.*

Despite the obtained inconsistency, it is important to evaluate the obtained results carefully. Changes in performance scores obtained for comparisons of the second with the first simulation might indeed be due to random error, but might also represent isolated "practice effects." To exclude potential practice effects, we must assure that improvement was not generated by experience in the simulation setting alone. Either a particularly consistent pattern of obtained results or significance of change scores that would extend considerably beyond marginality should be investigated further. Consistent or isolated but highly significant results, in the absence of training, might represent the potential impact of practice.

The data show that untrained research participants made more respondent decisions (Measure 2) in the first than in the second simulation, regardless of scenario content ($F = 5.07$, $p = .032$). In contrast, serial connections (Measure 12) occurred with somewhat greater frequency in the second simulation ($F = 5.00$, $p = .033$). A marginally greater number of integrations within categories (Measure 22, $F = 3.29$, $p = .08$) was obtained in the second simulation. Finally, a marginally greater proportion of

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*The reader should, of course, remember that order of presentation of the two scenario contents was randomized. In other words, the obtained results are not due to scenario characteristics.

information search decisions (Measure 27P, F = 3.63, p = .07) and marginally greater frequencies of respondent decisions that were specifically relevant to an induced disaster (Measure 33, F = 3.61, p = .067) occurred in the first simulation.

The limited number of significant results, associated with marginality in three out of five measures and with opposite directionality of the results suggests that the significance for the No Training Condition are most likely not meaningful. We would conclude that absence of training does not greatly modify performance in the time elapsed between the first and the second simulation. Apparently there were no practice effects. In the absence of meaningful significance for the control condition, we are now free to evaluate the effects of training procedures.

(2) Conceptual Plus Practical Training

For this condition, all chapters provided via the training software were available (and were tested). The procedure employed generated consistent significant results. We will (where significant) initially report both simple F ratios (which compare scores obtained in the second simulation with scores obtained in the first simulation). In addition, significant interaction F ratios (Training vs. No Training, two levels between, by First vs. Second Simulation, two levels, within) will be reported. All results obtained in this comparison did reflect higher levels and/or improved performance during the second simulation.

Measure 2, Number of Respondent decisions, generated approximately 6% higher scores after training ($F = 7.95$, $p = .012$). The interaction F ratio ($F = 15.05$, $p < .001$), moreover shows that performance on this measure decreased for the second simulation if no training was provided. Parallel data were obtained for the proportion of Respondent decisions (Measure 2P).

Respondent decision making, in and of itself, is not necessarily a reflection of high quality of managerial task performance. Respondent actions are, of course, needed where they are appropriate, e.g., when immediate responding to emergencies is needed. If not excessive in number, respondent decisions tend to reflect attention to information and to problems at hand. In contrast, where any increase in respondent decisions is closely associated with a major increase in the Number of General Unintegrated Decisions, it may signal a drop in the quality of performance. This was not the case here. In contrast, the obtained increase in the number of respondent decisions reflected greater attention to incoming information, in other words, a rather positive development.

Measure 8, another indicant of respondent decision making, also increased after training ($F = 14.53$, $p = .002$). Here, the increase was about 38%. Again, performance on this measure decreased when training was not provided (interaction $F = 14.17$, $p < .001$). Where the earlier measure (Measure 2) counted the number of information items that resulted in responses, the present Measure 8 considers only those actions that were not part of a strategic sequence. The interpretation of this result is, nonetheless, similar to that discussed in association with Measure 2 (see above).

Measure 13 assesses planning activity. Training increased the planning score by about 27% (F = 6.95, p = .018). The planning activity reflected in this measure does not necessarily result in subsequent strategies that are actually carried out. Lack of completed plans may be the result of at least two phenomena: (1) multiple simultaneous strategies toward common goals do not require completion of all plans and (2) the "artificial" end of the simulation may eliminate the potential for completion of planned strategies. Of course, poor planning may also be a course of non-completion. However, it should be emphasized that planning efforts provide the necessary precondition for subsequent completion of strategic efforts and, where strategies are effective, for success. The meaningfulness of the planning measure must be evaluated in terms of measures of strategy.

The completion of plans via strategic activity is in part assessed by Measure 20 (Total Forward Integrative Activity). Some increase in performance on this measure after training was observed (F = 3.59, p = .076), reflecting a rise in performance of about 36%. No change was observed for persons who were not trained (interaction F = 3.37, p = .073). In other words, increased planning, at least to some extent, was reflected in an increase of total integrative (strategic) activity after training.

Measure 19, Total Integrative Activity (both forward and backward) includes, among other component values, a count of actions that, while not necessarily strategic, are nonetheless based on opportunism. A 38% increase after training, although of marginal significance because of considerable variability among trainees, was obtained ($F = 3.59$. $p = .076$). Performance without interspersed training did not increase or decrease performance on this measure (interaction $F = 3.67$, $p = .06$).

Finally, a substantial 83% performance increase was obtained for Measure 23, Proportion of Category Integrations. This measure reflects (especially for tasks that are multifaceted, complex and fluid) the overall quality of integrative strategic activity. That form of managerial quality tends to be generated by a substantial breadth of an individual's strategic overview. While performance on this measure in the absence of training decreased by about 10%, the substantial increase for trained individuals indicates that the training effort (interaction $F = 5.98$, $p = .018$) was clearly successful.

In summary, training individuals by providing both conceptual and practical information about the application of cognitive complexity stylistics to managerial efforts, especially decision making, did generate consistent improvement in simulated managerial decision making performance. The increase in performance for planning (Measure 13), Total Forward Integrative

(Strategic) Activity (Measure 20), Total Integrative (Opportunistic) Activity (Measure 19) and Proportion of Category Integrations (reflecting the obtained Breadth of Strategic Overview, Measure 23) is shown in Figure 1. One might assume that the improvement evident in this figure would be even greater if training techniques had been individualized (see the summary section below).

(3) Practical Training

Practical training after participation in a first simulation provided only information on "how" to score highly in the second simulation, without informing the trainee about the conceptual rationale or about the reasons for the usefulness of the associated managerial style. If such training would be helpful, one should expect that simpler forms of strategy, planning, information orientation and so forth might be adopted, but that the more complex components of the cognitively complex managerial style (as it applies to management) would not be learned. If that view is correct, one might also expect lesser generalization of learned behavior across tasks (e.g., to other day to day work settings).*

The obtained results generally support a view suggesting that only simpler stylistic components would be adopted. A significant increase in performance for the post-training simulation was obtained for the most basic integration measure:

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*The latter was not tested in this research effort.

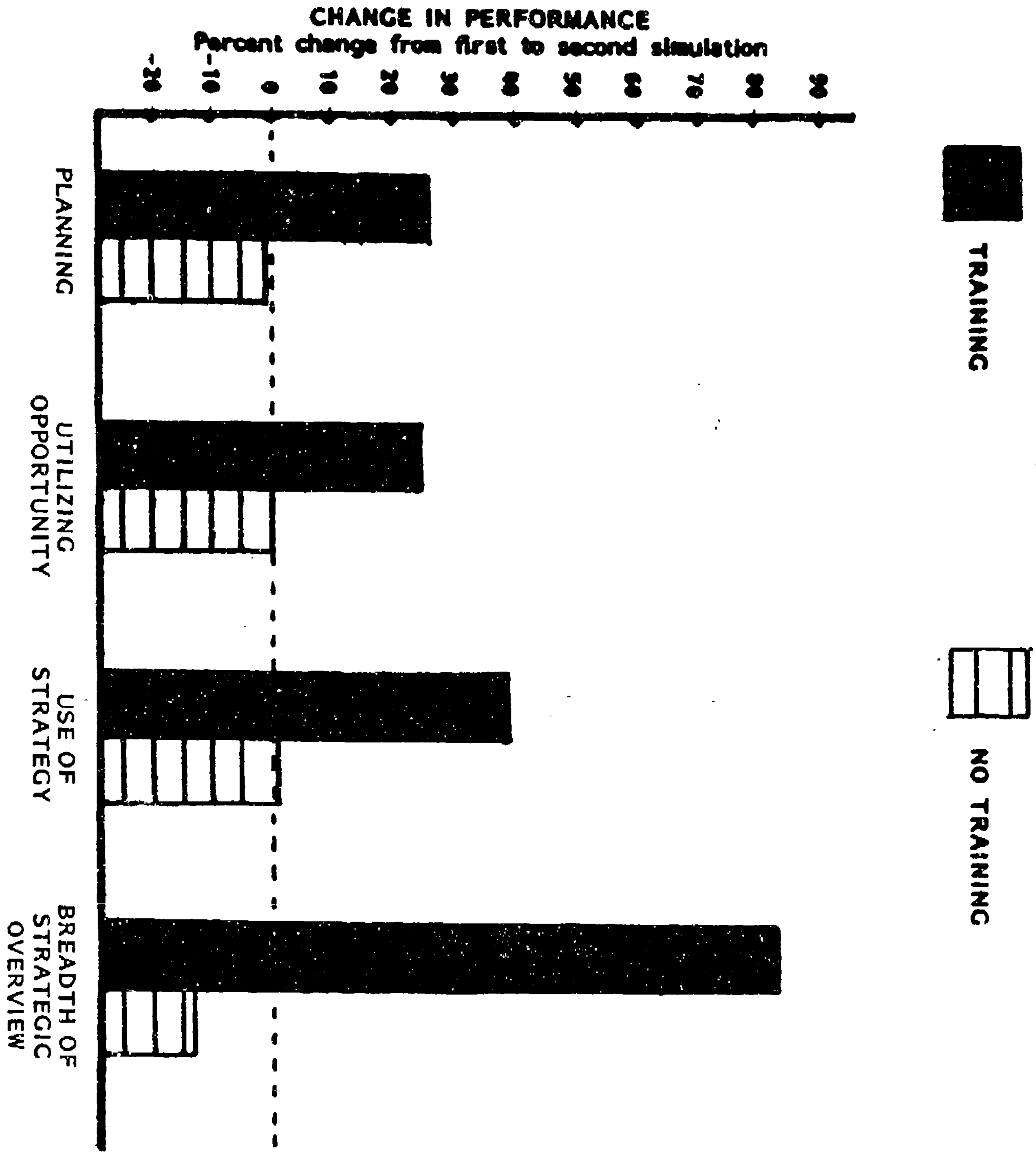

FIGURE 1. Effects on training on simulation performance.

Measure 4 (Number of strategic forward integrations, F = 6.44, p = .04). In contrast, however, the independent contribution of time length of planning (Measure 6Q) tended to decrease (F = 5.10, p = .06). Significant increases in performance after training were observed for Measure 19 (Total Integrative Activity, F = 24.72, p = .002) and Measure 20 (Total Forward Integrative Activity, F = 6.99, p = .03), however not for Measure 23, indicating little or no improvement in the trainees' strategic overview. Strategies within a narrow range of related decision areas tended to increase with practical training (F= 7.34, p = .03). However, no improvement in strategies across a wider range of less inter-related decision areas was observed. In other words, the data support the suggestion that practical training at the level employed in this research generated only simpler "copying" of recommended behaviors.

SUMMARY AND INTERPRETATION

At the beginning of this paper, we suggested that training effectiveness cannot be evaluated without adequate measurement techniques. Reliable and valid measurement was accomplished through simulation technology, specifically via the more structurally oriented measures that are programmed as part of our simulation software. The same simulation technology could be employed for training purposes. Data were obtained by comparing performance in a first simulation with performance during a second simulation. Training was interspersed between the two simulations. The two simulations differed in scenario content but not in demands made on participants' managerial competence. Of course, the simulation scenario sequence employed in pre-training vs. post-training conditions was randomized.

Training procedures were based on a fixed computerized training program that was presented to all participants in identical form. The only possible variation in training exposure across individuals was self induced. Each individual was free to read and reread the text (or text segments) at will any number of times. In other words, the trainee was able to select areas where his competence might have been especially weak if that trainee was indeed aware of such a weakness. Because of the general inability of most personnel to understand the how of their own thinking (see above), it would, however, be unlikely that trainees did have the necessary awareness.

A more optimal training program than the one employed in this research could be easily developed. Such a training program would, by necessity, have to be individualized. It would assess the specific (stylistic) structural competencies or shortcomings of a manager to focus training on areas of potential weakness. Such a training program might even provide the trainee with examples of alternate actions that might have avoided errors made during the first simulation exposure. Such a method would generate a better understanding by managers in training of executive styles that are associated with cognitive complexity. Because of the experimental nature of this research effort, such individualized training was not possible in the present research program. If our training procedures had been individualized, detractors might have argued that the obtained data would be confounded by experimenter demand characteristics, and so forth.

Clearly, one would expect less effective training where that training is non-specific and fails to emphasize areas of weakness in a manager's specific actions (as in the present research). The fact that increased performance after training was, nonetheless, obtained is quite encouraging. Similarly encouraging are the differential findings that were obtained via conceptual plus practical training and via practical training alone. One might conclude that practical training alone is useful only if a relatively fixed set of relatively complex tasks must be performed over and over again. In contrast, combined conceptual and practical training toward a greater understanding and application of cognitive complexity concepts (and related managerial stylistics) appears to be highly useful to improve effectiveness. Apparently a greater understanding of the how of managerial thinking and/or managerial decision making does provide the opportunity to improve one's own managerial style, especially if practical suggestions are included. With the finding that cognitive complexity can be trained and by establishing the reliability and validity of measurement for cognitive complexity and associated styles, the present research program has accomplished its purpose.

The research purposes of this project have, of course, been limited. Since we now know that complexity training is possible, a number of additional research efforts appear advisable. Such projects would, among others, serve to answer questions such as:

(1) How can information search and information utilization leading to more cognitively complex managerial functioning be optimized via training?

(2) How can adaptability, e.g., shifts between emergency and strategic responding, be optimized?

(3) What kind of jobs do and what kinds of jobs do not benefit from complexity training procedures?

(4) When, in a person's advancing career, should complexity based managerial training begin?

(5) What kind of person might and what kind of person might not benefit from training?

(6) How, exactly, should individualized training be handled for optimal results to generate the lowest costs in personnel, time, and financial resources?

(7) How should training differ for persons in different job categories?

(8) Would training be better accomplished in settings that are remote from a person's day-to-day job or would training be more useful within the person's job field (even though previous biases, behavior patterns and learned "standard" responses might interfere)?

(9) Present training techniques are emphasizing the decision making component within a rather complex multifaceted task setting. Should other components of the managerial task (e.g., social interaction components) be added to the training methodology?

(10) Clearly, higher level jobs benefit even more from a cognitively complex managerial style. At what level in the hierarchy is training (or training after assessment) a necessity and at which level can we do without such training at a still acceptable loss in performance?

We would hope, that future research efforts will aid us in answering these questions as well as a number of similar others. Answers that lead to the improvement of managerial performance both in the public (including military) and the private sector are necessarily of considerable value.

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