Technical Report 514

EXTENSION AND VALIDATION OF RESEARCH ON ACQUISITION AND RETENTION OF COGNITIVE VERSUS PERCEPTUALLY ORIENTED TRAINING MATERIALS

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The purpose of the study was to investigate the relationships between existing population specific aptitude patterns and training performance for experienced REDEYE gunners and initial CHAPARRAL/VULCAN trainees. The technical objective was "to expand on current, successful research efforts in the application of population specific instructional strategies by determining the generalizability of present categories of trainee population characteristics and by analyzing training specifications of existing Short Range Air Defense (SHORAD) weapons

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systems as a function of existing population characteristics and specified instructional strategies.

The program was accomplished in two phases, the REDEYE Study and the CHAPARRAL/VULCAN (C/V) Training Analysis. Within the REDEYE Study were two different phases of analysis (confirmatory and exploratory). The REDEYE Study was conducted using an extension of the basic aptitude x treatment interaction (ATI) approach.

The confirmatory analysis was designed to test the interaction between specific aptitude profiles, which had been identified in earlier research, and the instructional strategies designed to match the profiles on performance. Results confirmed the existence of the same three aptitude profiles for REDEYE gunners that had been previously identified. While significant aptitude profile by instructional strategy interaction effects were not observed, at least one of the strategies had a differential effect on performance for different profile groups.

The ATI methodology that was used in Phase I (building and implementing instructional strategies appropriate to aptitude characteristics of a specific population) remains a promising approach for the improvement of military training if appropriate controls can be maintained while the methodology is perfected.

After completion of the confirmatory analyses, exploratory analyses (factor analyses and canonical correlation analyses) were conducted in an effort to explain the underlying structure upon which the aptitude profiles were based and to investigate the relationships between the set of performance measures and an expanded set of aptitude variables. Factor analytic results suggested additional variables important to the underlying structure of aptitude patterns in the REDEYE sample.

Phase II, the CHAPARRAL/VULCAN Training Analysis, was entirely exploratory in nature. The analyses paralleled those during the exploratory portion of the REDEYE study.

Activities during the C/V analysis included analyzing existing Advanced Individual Training (AIT) and collecting and analyzing AIT performance data as it related to the aptitude patterns in the C/V samples. Two independent sets of data were collected during Phase II, one for CHAPARRAL and one for VULCAN. Results suggested that the most important aptitudes which characterize C/V trainees are not necessarily the most important in predicting training performance.

Finally, the results of the Phase I exploratory analyses and the C/V analyses were synthesized in order to suggest common patterns concerning psychological abilities that relate to air defense training performance. In addition, the synthesis revealed some unique patterns between the three groups (REDEYE, CHAPARRAL, VULCAN).

The second part of Phase I and all of Phase II resulted in the identification of many common factors which varied in both strength and relative predictive ability. The analyses suggested a number of additional variables that appear to be important as part of aptitude profiles and which may be important for instructional strategy development.

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FOREWORD

The US Army Research Institute for the Behavioral and Social Sciences (ARI) has been concerned with identification of the relationships of the cognitive, perceptual, and affective characteristics of soldiers to military training and on-the-job performance. The ARI Field Unit at Ft. Bliss, TX in its work unit, "Evaluating Air Defense Crewmen Aptitude and Performance," is building a data base on the relationship between individual differences and Air Defense Advanced Individual Training. The data base is designed to support the following alternatives: (1) improve selection criteria for training, (2) aptitude profile for training strategy selection for new weapon system training, and (3) utilization of sub-population specific instructional strategies.

The present report describes an extension of the Aptitude by Treatment Interaction (ATI) approach to REDEYE engagement training, a confirmatory analysis of the effects of aptitude specific instructional strategies across aptitude group on REDEYE refresher training, and exploratory analyses of the relationships between cognitive, perceptual, and affective measures of individual differences and REDEYE, CHAPARRAL, and VULCAN training performance. The present effort was performed also by Canyon Research Group, Inc., under contract MDA 903-79-C-0270 with ARI.

The research accomplished under Army Project 2Q762722A791 was responsive to the US Army Air Defense School at Ft. Bliss.

Joseph Zeidner

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Technical Director

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Major William Hink of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) Field Unit at Fort Bliss, Texas, Ms. Donna Danowski Olson and Dr. Michael J. Kelly, both of Canyon Research Group, Inc., supported our data collection efforts for various portions of either the REDEYE and/or the CHAPARRAL/VULCAN studies. Dr. Robert A. Smith of the University of Southern California assisted during the statistical analysis, particularly during the exploratory phases of the study.

We are also indebted to Major Hink for his valuable assistance in arranging for all on-site support and subjects at Forts Bliss, Carson, Bragg, Riley, and Hood.

BRIEF

Requirement:

To investigate the relationships between existing population specific aptitude patterns and training performance for experienced REDEYE gunners and for CHAPARRAL and VULCAN trainees in Advanced Individual Training.

Procedure:

The program was accomplished in two steps, the REDEYE study and the CHAPARRAL/VULCAN (C/V) Training Analysis. The REDEYE study included two different phases of analysis (confirmatory and exploratory). The confirmatory phase of the REDEYE study was conducted using an extension of the basic Aptitude by Treatment Interaction (ATI) approach in which REDEYE refresher training courses emphasizing four different instructional strategies were compiled. Three of the instructional strategies were designed in accordance with a "preferential" or "compensatory" model and matched strategy characteristics to the predominant aptitude characteristics of specific aptitude profile groups identified in earlier research. REDEYE gunners at four locations received refresher training, performance and written testing on REDEYE engagement tasks immediately and 30 days after training, and aptitude testing. Performance testing consisted of engaging Film 10 (difficult) targets and Film 12 (easy to difficult) targets with the REDEYE weapon. The written test involved aircraft type identification, proportion of aircraft to range ring, and fire/no fire decision for each of 18 aircraft images. The aptitude testing consisted of measures of the three aptitude profile groups and additional measures to expand on the relationship between REDEYE performance and aptitude.

The C/V training analysis included analyzing existing CHAPARRAL and VULCAN Advanced Individual Training (AIT) and collecting and analyzing AIT performance data and trainee aptitude data. Exploratory analyses of the C/V and REDEYE data included factor analyses and canonical correlation analyses.

Findings:

For the REDEYE confirmatory analysis, aptitude profile and instructional strategy affected performance on Film 12 targets but not Film 10 targets immediately after training. REDEYE gunners with Profile 2 (anxious, 2-dimensional ability) performed significantly better than those with Profile 3 (field dependent, low intelligence) and Strategy 3 (Practice) resulted in in significantly better performance than Strategy 1 (Independent Study). For the Range-Ring Profile written test, both immediate and retention test performance was significantly affected by Aptitude Profile. The Profile 1 group (field independent, high intelligence) on both the immediate and retention tests and the Profile 2 group on the immediate test performed better than gunners with Profile 3.

For the REDEYE exploratory analysis, seven factors, accounting for almost 67% of the total variance, were found to characterize REDEYE gunners in units. Based on canonical correlation analyses, five factors predicted REDEYE engagement performance. The results of the canonical correlation analysis supported the existence of the aptitude profiles established previously.

Exploratory analyses of CHAPARRAL AIT data identified seven factors which characterized men who completed CHAPARRAL AIT and which accounted for 61% of the total variance. Three factors predicted CHAPARRAL AIT performance. Profile 3 was the only REDEYE sample aptitude profile combination which generalized to the CHAPARRAL sample.

Exploratory analyses of VULCAN AIT data identified seven factors characterizing men completing VULCAN AIT. These factors accounted for 54.9% of the total variance. Four of the factors predicted VULCAN AIT performance. Of the aptitude profile combinations identified in the REDEYE sample, Profiles 2 and 3 generalized to the VULCAN sample.

Utilization of Findings:

The results of this research support the need for the following development:

(1) The methodology of building and implementing instructional strategies appropriate to aptitude characteristics of a specific population should be tested using larger samples and more precise controls and performance measures.

(2) The contribution of the additional variables identified in the exploratory analyses of the REDEYE, CHAPARRAL and VULCAN sample to instructional strategy development and effective training should be determined.

(3) Relationships among affective variables, training climate measures, training effectiveness, and strategy development for team tasks as compared to individual tasks should be investigated.

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CHAPTER I

SUMMARY AND CONCLUSIONS

Military Problem

The technical objective of the research program was "to expand on current, successful research efforts in the application of population specific instructional strategies by determining the generalizability of present categories of trainee population characteristics and by analyzing training specifications of existing Short Range Air Defense (SHORAD) weapons systems as a function of existing population characteristics and specified instructional strategies." Existing SHORAD weapons systems consist of REDEYE, CHAPARRAL, and VULCAN. This objective is in keeping with the U.S. Army's concern to be more responsive to the limits of the abilities of existing populations. If successful, personnel who might otherwise be excluded from training for air defense jobs could have the opportunity to succeed when trained according to methods that more closely match their individual aptitude patterns.

The successful efforts referred to above concerned training on REDEYE target acquisition, tracking and engagement decision-making using the REDEYE Guided Missile System. REDEYE is man-portable and can be shoulder-fired by a single individual. CHAPARRAL uses larger heat-seeking missiles mounted on a tracked vehicle and cannot be successfully operated without the efforts of several team members working together. Both REDEYE gunners and CHAPARRAL crewmen are trained within the same MOS (16P).

VULCAN is an air defense gun system that is mounted on a tracked vehicle or on a vehicle which can be towed. Like CHAPARRAL, it requires a full crew for efficient operation. There were indications from Air Defense School personnel at Fort Bliss that VULCAN and CHAPARRAL crewmen were completing Advanced Individual Training (AIT) without sufficient knowledge or skills to be able to perform individual tasks upon arrival to the unit.

Research Problem

Given the above situation, the investigators were asked to provide refresher training to REDEYE sections using those strategies found to be successful under the previous contract. This was done in order to test further the relative effectiveness of the earlier instructional strategies. In addition, the generalizability of the aptitude profiles upon which the instructional strategies were based, was to be tested within both REDEYE, CHAPARRAL, and VULCAN sample populations.

CHAPARRAL and VULCAN AIT performance data were to be analyzed as a function of the previously identified aptitude profiles and of any deviations from those profiles--if they existed. Particular attention was to be paid to the identification of possible areas of training difficulty and to the determination of areas in which changes in instructional strategies, matched to aptitude patterns of CHAPARRAL and/or VULCAN crewmen, could be made. Special emphasis was to be given to complex procedural tasks which were thought to be performed under temporal stress.

Approach

A two-phase approach was planned to accomplish the goals of the program. Each phase was originally intended to follow the successful completion of the previous phase. In practice, it was not possible for all of the field work to occur within the preferred time frame or sequence. Nevertheless, the approach will be described in the sequence that was originally planned.

The first phase was the REDEYE Study. Within that study, there were two different phases of data analysis (confirmatory and exploratory). Exploratory analyses were not conducted until after the completion of the confirmatory analyses. The REDEYE Study activities included analyzing current U.S. Army REDEYE refresher training, refining the instructional strategies used in earlier research and developing one new strategy, expanding the aptitude testing battery for the aptitude profile formation, improving the discrimination of aptitude profile groups from that achieved in earlier research, conducting refresher training at four different sites and analyzing the performance data (from both training and retention) as a function of the aptitude patterns that were exhibited in the sample population.

The second phase was the CHAPARRAL/VULCAN Training Analysis. Activities during the CHAPARRAL/VULCAN Analysis included analyzing existing soldier manuals, Programs of Instruction (POIs), Training Extension Course (TEC) lessons and other AIT related materials provided by the Air Defense School, observing selected portions of AIT classes for CHAPARRAL (16P) and VULCAN (16R) trainees, interviewing CHAPARRAL/VULCAN instructors concerning AIT and unit training, administering a slightly expanded aptitude test battery to a sample of 16P and 16R trainees, collecting and analyzing AIT performance data as it related to the aptitude patterns in the population, and suggesting possible changes for instructional strategies that could be related to the aptitude patterns.

Results

Phase I resulted in the confirmation of the existence of three aptitude profiles for REDEYE gunners that had been identified in earlier research (Hebein, 1978; Sullivan et al., 1978). The profiles are: (1) analytic thinking and high intelligence, (2) highly anxious with high two-dimensional perceptual ability, (3) global thinking and low intelligence. A fourth group included all men who could not qualify for any of the identified profiles. The results of a factor analysis suggested other variables important to the underlying structure of aptitude patterns in the REDEYE sample.

Instructional strategies, designed in accordance with a "preferential" or "compensatory" model (Salomon, 1972), matched strategy characteristics to the predominant aptitude characteristics of each profile group. An experiment was performed to test the interaction between instructional strategy and aptitude profile. Exploratory canonical correlation analyses suggested relationships between aptitude patterns and task performance.

Analysis of the results from the experiment and the exploratory work produced the following findings:

- There was a significant difference (.025) between Film 12 immediate performance posttest scores of the aptitude profile groups. Profile 2 performance scores were significantly better than were Profile 3 performance scores.

- On Film 12 immediate performance, men who received Strategy 3 (Practice) performed significantly better than men who received Strategy 1 (Independent Study).

- On written tests, main effects for aptitude profile revealed that Profile Group 1 performed significantly better than Profile Group 3. In some cases, Profile 2 also performed significantly better than Profile 3.

- Although general ability had a powerful influence on REDEYE performance, it did not emerge as a clearcut factor to characterize existing REDEYE gunners. Instead, a more specialized and non-verbal intellectual ability (spatial-analytic ability) was the most important factor.

- When the masking effects of general ability were taken into consideration, the best predictor of REDEYE performance was the ability to work under stress.

- An important factor which emerged to characterize this population was the "happy-go-lucky, venturesome, outgoing" factor. This factor was also within the top three predictors for REDEYE performance. Elements of this factor also proved to be important in both the CHAPARRAL and VULCAN samples.

- The results of the exploratory analyses confirmed the existence of the aptitude profiles established for the first part of the REDEYE study.

Phase II resulted in the following findings:

- Intellectual ability emerged as a specialized non-verbal ability (analytic ability) in the CHAPARRAL sample. However, it split into both a general factor and a specialized one (spatial-analytic) in the VULCAN sample.

- The "ability to work under stress" factor was the most important factor in surviving VULCAN training, but it was not as predictive of performance as was the "anxiety" factor or the "outgoing, happy-go-lucky" factor.

- The "ability to work under stress" factor was one of the three most important factors to characterize those who complete CHAPARRAL training, yet it did not predict CHAPARRAL performance at all.

- Even after taking into consideration the masking effects of general ability, the best predictor of CHAPARRAL performance was the analytic factor.

Conclusions

- The aptitude profile combinations identified in the REDEYE sample were not completely generalizable to either CHAPARRAL or VULCAN.

- Profile 3 was an important profile to all three tasks and was generalizable. Profile 2 was generalizable to REDEYE and VULCAN only. Profile 1 was meaningful in the context of REDEYE only.

- Profiles were apparently learned and reinforced by the nature of the task and the training environment. REDEYE profiles were more pronounced after individuals had been in the task, than while they were learning the task. (Compare to the original study: Hebein, 1978; Sullivan et al., 1978.)

- All samples had many factors in common which varied in both strength and in relative predictive ability.

- The three greatest predictors of successful completion of training, regardless of sample, were "spatial-analytic/analytic/general ability," "ability to work under stress," and "anxiety." Although they vary in importance from sample to sample, they were always the first three in the factor analysis.

- The one obvious difference between REDEYE and the other two tasks is that REDEYE is an individual task and the other two are team tasks. VULCAN requires a team of four and CHAPARRAL has a team of five. There is no other obvious difference in the task components. Levels of visual, tactile, and sequential discrimination seem similar. In the individual task, ability to perform training tasks was more influenced by the "ability to work under stress" than in team tasks.

- "Anxiety" was a less important predictor with experienced individual task performers than with team task trainees.

- The most frequent personality factors influencing both training and training performance were the happy-go-lucky and conscientious dimensions from the Cattell 16PF. At least one of these survived into the canonical analysis in every case.

- The "ability to work under stress" and "anxiety" separated into two distinct factors in all three samples.

CHAPTER II

INTRODUCTION AND BACKGROUND

Overview

The technical objective of the research program was "to expand on current successful research efforts in the application of population specific instructional strategies by determining the generalizability of present categories of trainee population characteristics and by analyzing training specifications of existing SHORAD weapons systems as a function of existing population characteristics and specified instructional strategies."

There has been (Tallmadge & Shearer, 1971) and there is now (Bloedorn, 1979; Federico, 1978; Hebein, 1978; Mikos, 1980; Sullivan et al., 1978) a growing body of literature which seeks to explain and/or to recommend a methodology that will help to explain interactive effects between different learner characteristics and alternative instructional methods as they relate to task performance in a military setting. The current effort grew out of earlier successful contract work which provided the impetus for this extension. The contractor's three-phase series of studies (Hebein, 1978; Sullivan et al., 1978) made a beginning with respect to the use of a viable methodology for the design and implementation of alternative instructional strategies using a variation of the aptitude x treatment interaction (ATI) approach.

In that series of studies, the relationships between specific aptitude profiles, instructional strategies designed to match those profiles, and acquisition of the REDEYE missile engagement task were investigated. Research about single aptitudes and single features of instructional strategies was synthesized to develop unique strategies which combined elements of several methods in order to match to the predominant characteristics of the identified profiles.

At the completion of that research program, it was recommended (1) that an attempt be made to isolate other combinations of aptitudes (profiles) which might explain differences in performance, (2) that the existence of the identified profiles be confirmed with a larger sample size and in other parts of the Army trainee population, and (3) that a similar study be conducted with a task that would be somewhat different than the REDEYE engagement task.

The present study was designed to follow those recommendations as an extension of the earlier work. Because of the complex nature of the approach and because of the differences between the various phases of this study, a separate explanation will be given for each phase to clarify the purposes and to focus the contributions of that phase to the overall purposes of the entire research program.

In this study, compared to the earlier contract work (Hebein, 1978; Sullivan et al., 1978), there were some changes aimed at improving the capability for discriminating soldier aptitude profile patterns and at increasing the generalizability of this approach to ATI research. The use of an expanded aptitude test battery during the field portions of the research program contributed towards improved aptitude profile discrimination. The extension to refresher training from initial training and the extension to team as well as individual tasks for other Air Defense systems contributed to increased generalizability for the approach.

If it could be said with confidence that this approach worked, there would then be a useful model with which to generate instructional strategies that would be related to both critical performance tasks and to characteristics of those who must perform those tasks. In addition, there would be a reliable way to categorize people based on unique aptitude profiles. With such information in hand, military trainers would be better able to improve the quality and effectiveness of all levels of Army training.

ATI Research

ATI is an approach to research, not an area of research in and of itself, which holds particular promise. If it is successful, students could be differentially assigned to alternative instructional treatments based upon empirical evidence regarding the match of individual characteristics with designated instructional strategies (Berliner & Cahen, 1973; Cronbach & Snow, 1977). It is implicit in ATI research that there is no one best way to instruct the majority of people. The whole movement for individualized instruction is a testimonial to the intuitive sense that the concept implies.

If trainer developers can tailor-make instructional methods to match particular aptitude profiles, then soldiers or trainees who might not do as well in traditionally selective programs could now have the opportunity to acquire the material more completely. ATI applications will not reduce individual differences; instead they will help to capitalize on them for the benefit of the learners.

It would be redundant to repeat an exhaustive review of ATI literature in this report. The reader is referred to the earlier contract studies already cited and to Mikos (1980) for thorough discussions of the state-of-the-art in ATI research and how it relates to the present approach, which is an extension of the basic ATI model.

Instructional Strategy Development

Sufficient documentation that gives a rationale for and explains the exact nature of instructional strategies or treatments has often been lacking in educational and training research. To design treatments for use in instructional research or practice is no easy task, and there is a paucity of literature on the specification of treatments. Carrier (n.d.) synthesized an interesting review on the topic, giving many practical suggestions on how to conceptualize treatments. She pointed out that the major criticism of instructional research has to do with this basic lack of understanding about what constitutes treatments. An effort was made in this study to answer that criticism.

Eight different treatment dimensions were identified and manipulated to a greater or lesser degree in the strategies developed for this effort. It was not an all-encompassing list but these dimensions represented probably the most salient features of any treatment. The eight features were (not necessarily in order of importance): group vs. individual instruction, presentation modes, practice, motivation (which included social orientation and social interaction), feedback (a special case of reinforcement), pacing, sequence of presentation modes, and structure. See Mikos (1980) for a detailed discussion of the literature concerning each feature, and Appendix A for a more detailed explanation of the values for each dimension that were utilized in this study. The descriptions for the strategies given in the present report supersede those documented by Sullivan et al. (1978) and are an extension of the earlier work. These descriptions are also discussed in Chapter III.

There are several sets of variables that can enter into the design and development of instructional strategies. Any instructional strategy could be classified over a host of different dimensions, some of which refer to the presentation itself and others of which refer to the content of the presentation. There are other variables that relate to the kinds of skills and knowledges that are necessary to perform the task. Still other variables, which are always present in the situation, are those that describe the individual learner characteristics. When thinking about all these treatment, task, and individual variables, one can easily see that even though they are not part of an exhaustive list, any cross-product would result in an unmanageable universe.

In the search for some practical application, some organized restrictions must be placed on each set of variables and combinations thereof. For this research, the set of individual variables were limited to some degree by the particular tasks studied. The variables that describe the kind of information to be learned were limited somewhat by the choice of tests in the aptitude battery. The treatment variables were limited by the research uncovered on instructional strategies for people with the particular aptitudes of interest in this study. The design of the strategies included primarily those manipulable features that received support in the literature for people with varying levels of the aptitudes.

Since the aptitude profiles consisted of more than one aptitude, there was a greater chance to locate research on strategies that related to at least part of the profile. In addition, the research located encompassed several dimensions of the instructional strategies allowing for more representativeness of treatment in a field situation. Most research methods tend to maximize the effect of the variable being measured by randomizing other variables. While that may be good research, it limits generalizability considerably.

Postman (1961, p. 71) said that "theoretical progress continues to come through eclectic accretion." The present combination of dimensions approach (for both treatments and aptitudes) can be categorized as eclectic accretion. It also coincides with the ideas of Gagne and White (1978), who have found many examples of improved retention and transfer when combinations of memory structures (networks or propositions, intellectual skills, images, and episodes) are utilized instead of a single structure.

In Hebein (1978) and Sullivan et al. (1978), materials were developed and implemented that either capitalized on high abilities characterizing those with a particular aptitude profile or that compensated for or remediated the low abilities characterizing soldiers with a different profile. Such preferential, compensatory and/or remedial treatments were fashioned after the model by Salomon (1972) and heed the advice of Cronbach and Snow (1977) to coordinate several capitalization and compensation devices within treatments.

In the early studies and the present study, the investigators also utilized the "task first" approach of Rhetts (1974) both to choose aptitude measures and to determine appropriate instructional strategies. Rhetts' approach is in concert with the idea of process analysis, advocated by Cronbach and Snow (1977), and with that of Fleishman (1972, 1975) who has worked out a taxonomy of instructional situations for psychomotor tasks. The taxonomy considers a multitude of dimensions, including the stimulus properties of the task, instructor characteristics, the instructional displays, and the conditions of practice and reinforcement.

Instructional Strategies and Aptitudes

The general thrust of instructional strategy development for the various phases of this study began by synthesizing information from the instructional design literature and available research concerning the design and prescription of specific strategies. The goal was to establish instructional strategies tailored to each aptitude profile identified for the confirmatory portion of the REDEYE Study. Particular strategies for particular levels of the following aptitudes were reviewed: cognitive style, spatial ability, general mental ability, and anxiety. While existing theory and research may not have totally definitive and truly generalizable results, there are some guidelines that appeared to work to a reasonable degree in this study and in the earlier series of studies (Hebein, 1978; Sullivan et al., 1978).

Numerous references about instructional strategies for the various aptitudes were consulted. Thorough discussions of these sources have already been documented elsewhere (Hebein, 1978; Mikos, 1980; Sullivan et al., 1978). For the global/analytic dimension of cognitive style, a sampling of the most pertinent literature includes: Eagle, Goldberger & Breitman (1969); Goodenough (1976); Grieve & Davis (1971); Guerrieri (1978); Retzke (1976); Rosenberg, Mintz, & Clark (1977); Witkin et al. (1962); and Witkin et al. (1977).

Carrier & Clark (1977), Clark (1978), Cronbach & Snow (1977), Frandsen & Holder (1969), Gauverin (1967a, 1967b), and Hancock (1975) were among the sources synthesized to develop strategies related to variations in spatial ability. Concerning instructional strategies and general mental ability, the reader is referred to Allen (1975), Bialek, Taylor & Hauke (1973), Cronbach & Snow (1977), Hebein (1978), Snow (1976, 1977), and Taylor, Montague & Hauke (1970). Of particular value when developing strategies to account for anxiety were: Cronbach & Snow (1977), Gaudry & Spielberger (1971), Sieber, O'Neill & Tobias (1977), Snow (1977), and Spielberger (1966).

The references cited, if consulted, will provide a wealth of suggestions to trainer developers concerning appropriate strategies to use for learners with varying levels of these aptitudes. The most thorough discussion of these references, and others, can be read in Mikos (1980).

CHAPTER III

REDEYE STUDY

REDEYE is a man portable, shoulder fired, infrared-seeking guided missile system designed to provide air defense for forward combat elements and other assets against low altitude hostile aircraft (TRASANA, 1977). Recent studies by the U.S. Army (TRASANA, 1976, 1977) indicate that REDEYE gunner proficiency is deficient in several areas at the completion of Advanced Individual Training (AIT). In addition, skill in these tasks declines quite rapidly after initial training and air defense unit proficiency in these same tasks is generally quite low.

Given the above situation, the original hypothesis for earlier contract studies (Hebein, 1978; Sullivan et al., 1978), as it related to <u>initial</u> training of REDEYE employment and engagement, was that an analysis of the cognitive processes and/or the perceptual processes operating during target acquisition, tracking, and engagement decision making would provide a reasonable basis upon which to structure alternative instructional strategies. For this study, that original hypothesis was extended to refer to <u>refresher</u> training on the same task.

Based on a review of the research and a process analysis of the task to include the 1978 series of studies under contract, certain psychological factors were identified that related to criterion performance. These included intellectual ability, cognitive style, two dimensional perception, and the personality factor of anxiety. The implications for instruction for people with differing levels of these factors were then studied and synthesized to develop alternative instructional strategies that were hypothesized to interact with the trainees' characteristics with respect to successful/unsuccessful performance on this complex procedural psychomotor learning task.

The purpose of the (Phase I) REDEYE study was to investigate the effects of selected instructional strategies matched to learner aptitude profiles which predict criterion performance on a complex procedural psychomotor task during refresher training. This was done to extend, validate, and improve earlier contract research. This time the actual target population was used rather than one that was only similar to it.

The approach taken here closely parallelled that used in the 1978 series of studies, except that all aspects of the research were refined with a view toward improvement and increased generalizability. This was accomplished by taking a two-pronged approach to the analysis. The first was confirmatory and the second was exploratory. For the former, the refresher REDEYE study was expected to confirm the existence of those aptitude profiles that had been identified earlier and to improve upon the discrimination of the profiles to some extent. For the latter, it was expected that considerable improvement in the discrimination of aptitude profiles might be achieved through the analysis of measures in the expanded test battery and their relations to criterion performance.

In this chapter, both the confirmatory and exploratory analyses are presented and explained. For a more detailed discussion of the confirmatory portion of the study and the theoretical rationale upon which it was based, see Mikos (1980). For a more complete understanding of how this research has evolved from its inception, see Hebein (1978) and Sullivan et al. (1978).

Current REDEYE Refresher Training

Refresher training for REDEYE gunners is supposed to be conducted at regular intervals so that the level of unit proficiency can be optimal. It was learned early in this study that the quality and quantity of REDEYE refresher training was vastly different from one Continental United States (CONUS) unit to another. The level of refresher training often seemed to be a function of the personality of the company commander, the squad leader or, perhaps, even the base commander of a given military post. More often than not, even when there was a Moving Target Simulator (MTS) available for training, most units did not receive the amount of practice recommended by TRASANA (1977) to maintain acceptable unit proficiency.

Regardless of the amount or kind of refresher training that was conducted, there appeared to be no real standard that was universally operable--at least not at the four sites at which the study was conducted. Even Ft. Bliss, where the Air Defense School is located, did not have a clearly identifiable refresher REDEYE training program. Ft. Bragg appeared to be the only site where a consistent program of refresher training was available.

It was not the purpose of this research to evaluate any current REDEYE refresher training. It was necessary to analyze existing REDEYE refresher training, though, in order to conduct the research. Because of the investigators' observations about current refresher U.S. Army training, the results of this study may have even more important implications than originally expected. The length of time for the refresher training conducted for any of the strategies in this study was relatively short. This would appear to be an advantage, given that present Army practices typically devote little time to refresher training.

Methodology

This section describes the population for the study, the measuring instruments for the aptitudes that determined the aptitude profiles, the aptitude profiles themselves, the strategies developed, the learning task, the instrumentation and field procedures for the study, the research design, and the statistical analysis of the data.

The Population

The sample population consisted of 102 military personnel who were in the 16P MOS (Military Occupational Specialty) as air defensemen, specifically as REDEYE gunners. The target population was the entire population of REDEYE gunners in the U.S. Army. With few exceptions, all of those in the sample had already had Advanced Individual Training (AIT) or its equivalent, in the performance of the REDEYE task. All were slated to have REDEYE refresher training.

The sample was taken from REDEYE gunners at Ft. Carson, Colorado, Ft. Bragg, North Carolina, Ft. Riley, Kansas, and Ft. Hood, Texas. Each fort was to provide 20 subjects, with the exception of Fort Riley, which was to provide 40 subjects in 2 groups of 20 each. For various reasons (e.g., security clearance problems, equipment failure, and Company Commanders' orders), training could be conducted and complete data on both independent and immediate dependent measures could be collected for only 87 of the 102 men in the sample. The others had to be eliminated from the study (Appendix B).

Retention data on written and performance measures were to be collected on the same 87 subjects approximately 30 days after the training data were collected. In the final analysis there were 61 subjects from whom both training and retention data were collected: 20 of the 21 from Ft. Carson, 13 of the 16 from Ft. Bragg, 14 of the 16 from the first group at Ft. Riley, 0 of the 14 from the second group at Ft. Riley, and 14 of the 20 from Ft. Hood.

Measuring Instruments

Three of the measuring instruments used in the study were identical to those used by Hebein (1978) and Sullivan et al. (1978) in their previous research that identified the aptitude profiles of this study for the first time. The Group Embedded Figures Test (GEFT) was used to measure the global and analytic dimensions of cognitive style (Witkin et al., 1971). The Cattell Sixteen Personality Factor Questionnaire (16PF) (Cattell, Eber, & Tatsuoka, 1970) was chosen to measure the personality factors of anxiety and general intelligence level. Factor B measures intelligence and Factor Q4 was a measure for anxiety. The third test was the test of Spatial Relations for Two Dimensions, from the Multiple Aptitude Tests (Segel & Raskin, 1955/1959). This test measures the ability to see and understand the arrangement elements of a visual stimulus pattern when the examinee's body is the primary frame of reference.

In addition to the four measures just named, there were six other tests in the battery administered to the soldiers. All of the 6 "extra" tests in the battery were to be thoroughly analyzed after the confirmatory portion of the study was completed. Only those tests from the "extra" tests in the battery, which could be considered alternate measures of the four original measures used for the profile formation, were included in this phase of analysis.

Since the original measures for anxiety and for intellectual ability from the 16PF were based on only six and eight items respectively, and in spite of the demonstrated validity and reliability of the 16PF, it was reasoned that it might be wise to get an additional measure based on a larger set of items for each construct. For this reason, the State-Trait Anxiety Inventory (STAI) (Spielberger et al., 1970) was administered for anxiety. The Thurstone Test of Mental Alertness (Thurstone & Thurstone, 1952) was the additional measure for general ability.

The STAI is considered one of the best standardized measures of anxiety, if not the best, as the reliabilities are nearly as high as one would expect for intelligence scales (Dreger; in Buros, 1978). For the confirmatory portion of the analysis, the score for the trait anxiety scale was used as an alternate measure of Q4 from the 16PF.

The Thurstone Test of Mental Alertness (TMA) was chosen because it has a testing time of only 20 minutes and can be administered to a group. Besides being a test of general ability, "it is designed to measure the capacity of an individual to acquire new knowledge and skills and to use these in problem solving. It assesses the ability to respond quickly and accurately to question situations of alternating problem types" (Thurstone & Thurstone, 1968). The test yields a language score, a quantitative score and a total score. For the confirmatory analysis, the total score on the TMA was used as an alternate measure of FB from the 16PF.

Two measures were used in the battery for the purpose of checking their relationship with field-dependence/independence. These were Closure Speed and Closure Flexibility. The Closure Speed test was designed to measure Thurstone's "first closure factor," which "is defined as the ability to perceive an apparently disorganized or unrelated group of parts as a meaningful whole, i.e., the capacity to construct a whole picture from incomplete or limited material" (Thurstone & Jeffrey, 1966, p. 1). It may also be a component of cognitive style (Ekstrom et al., 1976).

The other test, Closure Flexibility, is designed to measure Thurstone's "second closure factor," which "is defined as the ability to hold a configuration in mind despite distraction. It is the capacity to see a given configuration (diagram, drawing or figure) which is 'hidden' or embedded in a larger, more complex drawing, diagram, or figure" (Thurstone & Jeffrey, 1965, p. 1). Ekstrom et al. (1976) think that Closure Flexibility too is related to "field-independence." Because of its high correlation with the GEFT in this study (.77), it was used as an alternate measure for field independence/dependence.

The fifth "extra" test was the Pursuit subtest from the MacQuarrie Test for Mechanical Ability (MacQuarrie, 1925/1953). This is one of a series of subtests to measure aptitudes which underlie successful performance on a wide variety of jobs of a mechanical nature. This particular subtest is somewhat related to a factor called spatial scanning, which is defined as speed in exploring visually a wide or complicated spatial field (Ekstrom et al., 1976; MacQuarrie, 1925). For the confirmatory analysis, the Pursuit Test was used as an alternate measure for the Two-Dimensional Spatial Relations Test because of the significant correlation between the two measures.

The last test of the battery was the Press Test. The Press Test (Baehr and Corsini, 1965) was adapted from the early Stroop Test (Thurstone & Mellinger, 1953) which measured interference in serial verbal reactions. The Press Test has a word naming score, a color-naming score, and a color-naming with distraction score. It is designed to measure the ability to work under stress.

Aptitude Profile Groups

Four aptitude profile groups were identified, based on the results of the aptitude measures that were administered to the sample. High and low scores on the measures used to identify those who fit particular aptitude profiles were operationally defined as those that were plus or minus .6 standard deviation units from the mean. These included approximately the top or bottom 27% of scores for each measure.

Individuals with Aptitude Profile 1 were those who scored high on either the GEFT (greater than or equal to 10) or on Closure Flexibility (greater than or equal to 60), <u>and</u>

they scored high (greater than or equal to 5) on FB (Intelligence) of the 16PF or high (greater than or equal to 51) on the Total Thurstone. Such individuals can be described as field-independent (analytic) and of high general intelligence.

The group with Aptitude Profile 2 included all those who scored high on either the Two-Dimensional Perception portion of the MAT or on the MacQuarrie Pursuit Test <u>and</u> scored high on Factor Q4 (tense-relaxed; i.e., anxiety level) of the 16PF or on the Trait scale of the STAI. Individuals in this group can be characterized as being above average in two-dimensional perceptual or spatial ability and as being generally anxious persons who are more likely than not to be tense and to perceive a situation (like the REDEYE task) as threatening, psychologically dangerous, or frightening for them. Operationally, those who qualified for Profile 2 scored greater than or equal to 15 on the Two-Dimensional Perceptual Test or greater than or equal to 24 on the Pursuit Test while also scoring either greater than or equal to 6 on Q4 of the 16PF or greater than or equal to 45 on the Trait Scale of the STAI.

The criteria for Aptitude Profile 3 membership was as follows: low scores on either the GEFT (less than or equal to 4) or on Closure Flexibility (less than or equal to 22) <u>and</u> on Factor B of the 16PF (less than or equal to 3) or on the Total Thurstone (less than or equal to 29). Such individuals are characterized as being field-dependent (global) and of low general intelligence.

Any individual who did not meet the criteria for membership in one of the identified groups was placed in Aptitude Profile Group 4. This group represented soldiers with varying combinations of the measured aptitudes and can be considered comparable to a general trainee population. High or low scores on a measure for only one of the constructs needed for membership in one of the other profile groups was not enough to warrant inclusion into that profile group. It was the <u>combination</u> of aptitudes that determined a profile and not any one aptitude alone.

It was possible for the same person to qualify for membership in Profile Group 1 and Profile Group 2 at the same time. If that happened, the individual was assigned to Group 2 because it was decided that the high anxiety should be considered directly. It was also possible to qualify for both Profile 2 and Profile 3 simultaneously. If that happened, the soldier was assigned to Profile 3. It was decided that the low intelligence level and social orientation of the global individual was more critical to consider than were the characteristics of Profile 2. There was no possibility for anyone to qualify for both Aptitude Profiles 1 and 3.

For the training portion of this study, there were eight soldiers who had both Profile 1 and 2. There were four men who qualified for both Profile 2 and 3. For the reasons described already, the former were assigned to Profile 2 and the latter were assigned to Profile 3. The final tally for each Profile included 16 with Profile 1, 14 with Profile 2, 36 with Profile 3, and 21 with Profile 4. In the retention portion of the study, 5 of the 8 who qualified for both Profile 1 and 2 were lost, while 1 of the 4 who qualified for both Profile 2 and 3 was lost. The final count for the retention group included 14 with Profile 1, 5 with Profile 2, 28 with Profile 3, and 14 with Profile 4.

Instructional Strategies

Based on specific research related to the instruction of learners with varying levels of the identified aptitudes and on specific instructional design principles that have been identified in the literature, 3 different treatments, one for each aptitude profile, fashioned after Hebein (1978) and Sullivan et al., (1978) were developed. What follows is a general description of each strategy. See Appendix A for a detailed description, in outline form, of each strategy. In each of the detailed descriptions, the variations for the eight treatment dimensions are discussed. See Table 1 for a summary of the major features of each strategy.

Strategy 1 was designed specifically for people who are characterized by the combination of aptitudes that made up Aptitude Profile 1. As a result of the literature review on field-independent subjects and on learners of high general ability, Treatment 1 was designed as self-paced independent study. It included both printed and visual information in a self-paced packet. This was followed by mental practice in the form of observation of others and actual physical practice if and when the student thought he was ready and wanted it before testing. There was little or no extrinsic feedback with intrinsic motivation of learners inherent in the strategy.

Strategy 2 was designed specifically for people who have been shown to have Aptitude Profile 2. Based on the research for individuals high in two-dimensional spatial ability, predominantly visual materials were used with a minimum of printed matter. The training began with a short (19 minute) videotape called "Introduction to REDEYE," that highlighted the parts of the weapon, its capabilities, the sequence of steps for engagement and a small amount of Range Ring Profile information, among other things.

TABLE 1. TABLE OF STRATEGY CHARACTERISTICS

Features	Strategy 1	Strategy 2	Strategy 3	Strategy 4
Group Vs. Individual Instruction	Individual	Group	Group	Group
Presentation Modes	Simulator Print Model Visual	Videotape Simulator Discussion Print Visual Diagrams Live Demo	Videotape Simulator	Videotape Visuals Diagrams Print Simulator Lecture Discussion
Sequence of Presentation Modes	Print Model Student Options: Visuals Simulator Mental Imagery	Videotape Visual/Diagrams Diagrams Discussion Visual Visual/Print Discussion Visual Print Discussion Simulator Live Demo Visual Discussion During Visual Simulator	Videotape Simulator	Videotape Visual With Lecture Discussion Visual With Lecture Print Visual With Lecture Print Simulator

TABLE 1 -- Continued

Features	Strategy 1	Strategy 2	Strategy 3	Strategy 4
Pacing	Individual	Group	Group	Group
Motivation (Including Social Atmosphere)	Intrinsic	Extrinsic Easy Quizzes Supportive Climate Peer Group	Extrinsic Competition Accent on Dis-Approval More Than Approval	Extrinsic
Structure	Of Materials: Yes Of Environment: No	Of Materials: Yes Of Environment: Yes	Of Materials: Hardly Applicable Of Verbal Information: very much Of Environment: Socially-no Mechanically-yes	Of Materials: Yes, but not as much as #2 Of Environment: Yes
Practice	Mental / Actual: Self-Paced; At Discretion of Individual	Distributed Actual -- More than #4; Less than #3	Main Method of Instruction	Limited Actual At the End of Training

TABLE 1 -- Continued

Features	Strategy 1	Strategy 2	Strategy 3	Strategy 4
Feedback	Individual Provides Own Feedback	Immediate, Corrective, Supportive and Continual in Both Written & Practice	Immediate Thru Practice: Mini-Mal Corrective Information	Immediate on Both Tests and Practice; More Neutral Than #2 or #3

The printed information was limited to a few key words, especially for attention directing, since attention directing during task performance is particularly advantageous for highly anxious students. The visuals were sequential and varied from simple to complex. The learning materials were structured in order to deal with anxiety. The soldiers alternated between classroom instruction and instruction in the simulator. A demonstration and a brief chance to handle the weapon, before having to perform with it and before more classroom instruction with visual formats, was provided in order to keep the anxiety level reduced to a minimum. Small quizzes dependent on the visual materials and constructed for success were given. These were intended to capitalize on the high spatial ability while at the same time compensate for high anxiety. Actual practice followed the end of the last visual presentation, during which frequent reinforcement and feedback was given in a supportive fashion--all in an effort to keep the anxiety down. If an individual was not doing well in practice, he was told what was wrong, that it was all right to make a mistake, and what could be done to correct any errors. It was expected that the supportive reinforcement/feedback from the investigator would engender similar supportive peer group interaction during practice. This was the case in the earlier studies and in this one, so that a friendly, non-threatening competition was present.

Strategy 3 was designed specifically for people with Aptitude Profile 3--those low in general ability who are field-dependent. Because of the research that recommends active response for low ability trainees and the indications that field-dependent individuals favor interactive teaching methods, virtually the entire strategy relied on practice of the specific task with instructor and peer feedback. There was no print and all information was presented verbally, in small steps, at a simple level. There were very few visuals and no quizzes. Because global individuals are likely to rely on others' opinions to guide them and favor interpersonal and social contact in learning, the entire group remained together during the treatment. The peer group influence was encouraged and was allowed to generate into fierce competition that could become abusive and negative when trainees made mistakes during practice--this because the field-dependent individual is said to be positively affected by negative reinforcement. Instructor feedback was generally negative or non-supportive and no effort was made to explain what may have been done wrong by a trainee unless he specifically asked. Then, only the specific question was answered and nothing else.

Strategy 4 was, in a sense, a control group for treatment in the study and was not specifically designed for soldiers with this "default" profile. It consisted of a synthesis of the current regular refresher training for

REDEYE gunners as it is presently "supposed to be" held by the Army. It was discovered during the course of the study that a good deal of refresher REDEYE training is simply not conducted, which helped to explain the low unit proficiency that TRASANA (1977) found. The instructional strategy relied on lecture as the main method of instruction, in the form of a live script that accompanied a slide set. There were some print support materials. The presentation of the material was structured and repetitious with a good deal of verbal information, much of it extraneous, presented with each slide. The training began with the same videotape that was presented to Profile Group 2, followed by the verbally loaded lecture/script and a test of the course material. A limited amount of practice was given as the final instructional step.

Learning Task

According to Rhetts (1974), it is only after the relevant aspects of the task in question have been identified, that one can identify what individual difference measures or characteristics are related to performance on the task. The missile engagement task in this study involved a series of procedural steps which are documented in an earlier report (Sullivan et al., 1978) and will not be repeated here.

This learning task was a complex procedural psychomotor task that demanded that the soldier acquire the knowledge and skills to successfully perform a missile engagement task with an M49 Tracking Head Trainer (the training model for the REDEYE Guided Missile System) while in the Moving Target Simulator (MTS). In order to reach criterion, the skills that were necessary were: (a) visual recognition, (b) visual discrimination, (c) rule application, (d) eye-hand coordination, (e) tracking, (f) reaction time, (g) response orientation, and (h) rate control. All of these skills were used in order to successfully perform the task--and all were documented more specifically in the earlier report (Sullivan et al., 1978).

Instrumentation

The REDEYE Moving Target Simulator (MTS) and the Tracking Head Trainer (THT), as shown in Appendix C, are used to simulate tactical air defense engagements for training gunners.

> The MTS projects the images of hostile aircraft against a natural sky background with 3-channel sound effects. Twelve reels of film are used with 20 target presentations per reel. Reels 1 through 10 contain progressively more difficult presentations.

> The velocity of the aircraft may be up to 650 knots. Reels 11 and 12 contain aircraft of all performance categories, and are representative of the variety of targets to be engaged by the tactical REDEYE Weapon System. Detailed descriptions of the target aircraft types and flight parameters for each film reel are confidential (TRANSANA, 1977, p. 2-1) [sic].

In addition, an infrared (IR) spot is superimposed on each moving target for the same length of time as would be detectable if it were the heat source of a real target. The IR can be detected by the IR sensor in the THT just as it would be in an actual weapon, allowing the gunner to track the target.

The THT is a full-scale model of the REDEYE weapon system that is ballasted to simulate the weight of the fully loaded REDEYE Weapon System (about 28 pounds). The THT simulates the operating characteristics of the weapon system from activation to firing. Just as in a tactical situation, the gunner using the THT has only 31 seconds from the time of activation to complete a successful firing sequence and launch. Otherwise the battery coolant unit will run out of life which would create loss of IR and would prevent a successful launch. The THT looks and feels almost exactly like the REDEYE Weapon except for a compressor actuator assembly (gas pump handle) mounted on the launch tube, a performance indicator assembly that is under the gyro activator coils and a few other smaller items. The performance indicator gives a visual indication of sequential errors made by a gunner during an engagement sequence (TRASANA, 1977).

The combination of the MTS and the THT is a very sophisticated, realistic, and effective simulation device. If a gunner completes the firing sequence successfully, a "beep" tone sounds signifying a "hit." If an error in the sequence was made, which was not corrected before pulling the trigger, a "turkey-call" tone sounds signifying "error" at the moment the gunner pulls the trigger.

By looking at the performance indicator panel before resetting the battery, the gunner (and the instructor) can see which step or steps in the sequence were performed correctly and incorrectly. Once the gunner has pulled the trigger, he cannot go back to retrace any steps. Before then, he can make corrective actions in response to feedback from the system, at any stage of the sequence, as long as he does so within the 31 second life of the battery coolant unit.

By recording the precise performance on each try for a launch and by setting values on each part of the sequence, a score for each try can be obtained. A try consists of all actions from one trigger pull to the next trigger pull, or if the trigger is never pulled, from the time a target first appears on the screen to when it disappears completely, not to return. There is a time lag between targets, when none are projected. This is necessary so that the mirror system that projects the IR spot can position itself for the next target. See Appendix C for the point values used in scoring the films during performance testing for this study.

Field Procedures

The experiment was conducted at five different times, one for each scheduled group of 20 subjects over a two-month period by the investigators and several assistants. The order for the locations was: Ft. Carson, Ft. Bragg, Ft. Riley, Ft. Hood, and Ft. Riley again. The procedures at each site were essentially the same with some notable exceptions that are detailed, by site, in Appendix B. The discussion of the "typical" experimental situation is now presented.

A military officer accompanied the investigators and assistants to all sites and served as the instructor for Strategy 4. In addition, the officer handled all on-site coordination.

The soldiers were tasked for two consecutive days of training by their commanders. They were tasked for another training day to follow 30 days after the first two-day session. Training was conducted with each group of 20 men independently in time and place (except for the two groups at Ft. Riley) from the other groups. The groups at Riley were put through the training separately in time from one another.

On the first day for each group, the men were randomly assigned to treatment. The training was conducted according to the specifications already developed for each treatment and documented under "Instructional Strategies." The time required for the training varied from one strategy to another, but all training was accomplished within 4 hours or less. Performance testing in the simulator was done individually or two at a time and took approximately two to three hours total, depending on how well the equipment was working. Each individual soldier experienced testing for only a few minutes in the simulator on two different occasions. Scoring for both performance measures was tightly controlled to insure accurate measurement.

During performance testing, each soldier received two passes on Film 10 and was encouraged to attempt as many hits as possible on each pass, as long as time allowed. The targets on Film 10 were of constant speed, all fast, with considerable evasive action. After every soldier had completed his turn on Film 10, the same procedures were followed with Film 12. The targets on Film 12 represented the full range of targets that can be engaged by the REDEYE Weapon System, both in performance category, speed, and possible evasive action.

After all had completed the performance testing, the entire group was given two pencil and paper instruments which took approximately 20-30 minutes to complete. The first was given while still in the simulator and was a measure of State Anxiety (Form X-1 of the STAI) with special instructions that asked for their anxiety state while operating the THT in the MTS. This was collected with the intention of using it during the exploratory analysis phase to refine the formation of profiles for the future. A written test on the Range Ring Profile (RRP) information was then given in an adjoining classroom. The RRP test consisted of 18 drawings of aircraft within range rings. Each drawing called for three different responses--aircraft size and type, proportion of aircraft to range ring, and a "fire/no fire" decision based on the target being within the engagement envelope. After that, the men were dismissed for the day.

The next day, aptitude tests were administered that were intended to discriminate the aptitude profile groups. Total testing time, including directions and all breaks for each group was approximately three hours. The testing was done in the morning and the men were dismissed as soon as they finished the last test. The order of administration for the aptitude tests was determined by means of a random number table.

Approximately one month later, retention data was collected on both the performance (Films 10 and 12) and the written (Range Ring Profile) portions of the task. During the interval between the training/testing period and the retention testing none of the subjects participated in any other REDEYE refresher training nor did they get any practice with a THT in the MTS.

Design of the Study

The research design for the confirmatory analysis phase was a "Post Test Only-Control Group Design" (Campbell & Stanley, 1963) with some subjects from all aptitude profile groups (theoretically) being placed in all four strategy groups. The basic design was extended in that there were two posttests for each dependent variable: one immediately following training and the other approximately one month later for retention. It had been originally intended that a crossed design be used that would guarantee complete random assignment from each aptitude profile to each treatment group. This was not possible because of subject availability for training occurring simultaneously with availability for the testing designed to identify the aptitude profiles. Instead, subjects were randomly assigned to strategy groups (from the total sample population). Without randomization to the fully crossed design, this confirmatory portion of the study is best categorized as quasi-experimental research. It was a 4 x 4 factorial design.

Experimental Variables

The confirmatory phase was designed to measure the interaction between two independent variables: aptitude profile groups and instructional strategies. There were four different aptitude profile groups whose characteristics were defined by scores on a specific set of aptitude measures. There were also four strategies, each designed to match one of the aptitude profile groups.

The exploratory phase was designed to investigate the relationships between individual aptitudes in greater detail in an effort to better explain the profiles. It was also designed to determine what, if any, other composite aptitude profiles could be identified that would improve the prediction for criterion performance over the aptitude profiles used during the confirmatory phase of the analysis.

Dependent Variables

The three dependent variables from the training portion of the study were the individual scores on the two performance tests, Film 10 and Film 12, and the score on the written test (Range Ring Profile). There were three additional dependent variables for retention that were collected approximately 30 days after training at each fort. They were identical tests to those administered during the training portion of the study except for when they were given. They could be called Film 10 Retention (Film 10R), Film 12 Retention (Film 12R), and Range Ring Profile (written) Retention (RRPR).

Statistical Analysis

The data collected for the confirmatory portion of this study were analyzed using multiple regression analyses. According to Cronbach and Snow (1977), it is the preferred method of statistical analysis for ATI studies. Furthermore, in the case of unequal cell frequencies in factorial designs with categorical variables, the multiple regression approach is called for in order to appropriately partition variance that is confounded by correlations between the independent variables and their interactions (Kerlinger & Pedhazur, 1973). The a priori ordering approach, with effect coding, (Kerlinger & Pedhazur, 1973, pp. 193-196) was used to set up the regression analysis. The stepwise solution with the following hierarchical ordering was used: all interaction terms were submitted for analysis first, followed by all coded vectors for aptitude profile at the next inclusion level, and then all coded vectors for instructional strategy at the last inclusion level.

For the exploratory analysis, no categorical aptitude profile variable was used. Instead, the individual aptitude measures from the entire test battery were submitted to a series of factor analyses which were intended to explain the underlying structure upon which the aptitude profiles were based. In addition, several canonical correlation analyses were performed in order to investigate the relationships between the set of dependent variables and the set of independent variables. The end result of canonical analysis is to learn how the composite of the independent variables is most related to the composite of the dependent variables.

No particular hypotheses were generated to be subjected to data confirmation in this exploratory phase of analysis (or in the exploratory analyses of CHAPARRAL and VULCAN data --Chapter IV). Because of this, and because of the small number of data points in each sample (REDEYE n = 61; CHAPARRAL n = 67; VULCAN n = 61), it would have been inappropriate to perform any further analyses such as redundancy analyses (Lindeman, Merenda, & Gold, 1980; Smith, 1980).

Twenty-eight independent variables were submitted to the first factor analysis. These included all measures listed under "Measuring Instruments" with the exception of the measure for the Total Thurstone test. The principal component solution (principal factoring without iteration) produced an orthogonal factor matrix which was rotated by the varimax method. The number of factors was unrestricted at first. Using the same factoring and rotation methods, the same variables were submitted to other factor analyses in which the number of factors was restricted to four, five, and seven factors. The results of a scree analysis (Cattell, 1966) helped to determine how to restrict the number of factors to be extracted. Simple structure analyses were then performed on each solution in order to determine the most meaningful solution.

The total Thurstone was eliminated from the analysis because it provided duplicate information that was already available from the two subtest scores (Quantitative and

Language). Also, if the Total Thurstone had been retained for the factor analysis, it would have produced a singular matrix, which is undesirable for some methods of factor analysis. Since this was an exploratory analysis it was quite possible that more than one method of factor analysis or of rotation of factors would be used. If there was a singular matrix, a full range of exploratory analyses would not be possible. By eliminating the Total Thurstone from all factor analyses, one could be confident that all analyses were based on exactly the same data.

All analyses were performed using versions H and M, release 8.0, of the Statistical Package for the Social Sciences (SPSS) (Nie, Hull, Jenkins, Steinbrenner, & Bent, 1975). For the confirmatory analyses, Alpha was set at .05, and significant main effects were tested by Fisher's Least Significant Difference (LSD) Procedure, (Kirk, 1968; Nie et al., 1975). The Fisher's LSD procedure was chosen because it is exact for unequal group sizes. For the exploratory factor analyses, interpretations were made after the completion of both a scree analysis and several simple structure analyses, all of which were done by hand. Principles of logic were applied to determine the final interpretation of factors. This interpretation took into consideration the differences in factor structure for different numbers of restricted factors, but placed special emphasis on the seven factor solution.

Analysis and Results

This section presents a descriptive summary of the data, the results of the multiple regression analyses, the factor analyses, and the canonical correlation analyses. First the analysis and results for the confirmatory phase of the effort is presented. Following that will be the analysis and results of the exploratory phase.

Confirmatory Analysis

Analysis. The performance test (Films 10, 12, 10 Retention, and 12 Retention) and the written test (Range Ring Profile and Range Ring Profile Retention) scores were analyzed by aptitude profile group, instructional strategy group, and aptitude profile x instructional strategy interaction cell. Table 2 reports the number of soldiers, means, standard deviations, and ranges for all of the dependent measures by aptitude profile. In this table, the named statistics are reported for the 61 soldiers from whom there was complete data for both training and retention. In addition, the same table reports the information on all but retention testing for the 87 soldiers from whom there was complete training data, regardless of the availability of retention data. The same data: number of soldiers, means, standard deviations, and ranges are presented in Table 3 for instructional strategy groups.

TABLE 2

PERFORMANCE AND WRITTEN TEST MEANS, STANDARD DEVIATIONS, AND RANGES FROM TRAINING AND RETENTION FOR APTITUDE PROFILES

Dependent Measures	Aptitude Profile 1				Aptitude Profile 2			
	N	X̄	SD	Range	N	X̄	SD	Range
Film 10[a]	16	6.81	3.23	9	14	6.71	4.56	14
Film 10[b]	14	7.36	3.05	9	5	6.60	4.83	13
Film 10 Retention[b]	14	7.64	2.56	6	5	8.20	1.79	4
Film 12[a]	16	11.19	5.78	23	14	15.00	9.20	33
Film 12[b]	14	11.07	6.15	23	5	16.80	7.69	20
Film 12 Retention[b]	14	10.29	5.20	20	5	8.40	2.30	5
RRP[a,c]	16	38.88	6.47	27	14	38.79	3.95	15
RRP[b]	14	39.29	6.83	27	5	39.80	5.17	13
RRP[b] Retention	14	41.21	2.61	9	5	39.20	4.66	13

Dependent Measures	Aptitude Profile 3				Aptitude Profile 4			
	N	X̄	SD	Range	N	X̄	SD	Range
Film 10[a]	36	5.86	3.27	10	21	6.67	4.46	18
Film 10[b]	28	5.54	3.29	10	14	5.79	4.68	18
Film 10 Retention[b]	28	5.89	3.70	10	14	6.71	3.24	10
Film 12[a]	36	9.36	6.12	29	21	12.76	7.50	29
Film 12[b]	28	7.93	5.15	20	14	11.50	7.50	29
Film 12 Retention[b]	28	11.50	5.30	25	14	10.00	4.82	21
RRP[a,c]	36	32.44	6.41	26	21	33.29	5.75	24
RRP[b]	28	33.18	5.37	21	14	35.14	4.52	18
RRP[b] Retention	28	33.82	5.36	24	14	37.79	6.22	25

[a]From the sample of 87 soldiers for whom there was complete training data regardless of availability of retention data.

[b]From the sample of 61 soldiers for whom there was complete data for both training and retention.

[c]Range Ring Profile Written Test

TABLE 3

PERFORMANCE AND WRITTEN TEST MEANS, STANDARD DEVIATIONS, AND RANGES FROM TRAINING AND RETENTION FOR INSTRUCTIONAL STRATEGY GROUPS

Dependent Measures	Strategy 1				Strategy 2			
	N	$\bar{X}$	SD	Range	N	$\bar{X}$	SD	Range
Film 10[a]	21	7.29	4.81	18	24	6.08	3.08	10
Film 10[b]	15	7.07	4.96	18	16	5.81	2.90	10
Film 10 Retention[b]	15	6.73	3.22	10	16	7.38	3.05	8
Film 12[a]	21	11.76	10.23	37	24	10.00	4.52	20
Film 12[b]	15	8.40	8.03	33	16	9.50	4.93	20
Film 12 Retention[b]	15	10.00	4.81	21	16	10.44	3.93	15
RRP[a,c]	21	32.57	6.93	25	24	37.00	5.55	27
RRP[b]	15	33.87	6.85	25	16	38.13	3.28	11
RRP[b] Retention	15	35.93	6.65	27	16	37.88	3.52	11

Dependent Measures	Strategy 3				Strategy 4			
	N	$\bar{X}$	SD	Range	N	$\bar{X}$	SD	Range
Film 10[a]	22	7.14	3.36	13	20	4.90	3.43	10
Film 10[b]	14	6.14	3.35	11	16	5.44	3.52	10
Film 10 Retention[b]	14	7.36	2.84	8	16	5.31	3.75	10
Film 12[a]	22	13.59	7.69	25	20	10.40	4.75	17
Film 12[b]	14	12.93	7.91	25	16	10.19	4.83	17
Film 12 Retention[b]	14	12.43	6.31	20	16	9.81	4.82	20
RRP[a,c]	22	35.09	5.98	25	20	34.40	7.34	28
RRP[b]	14	35.36	5.40	20	16	34.81	7.51	28
RRP[b] Retention	14	37.14	4.35	15	16	36.50	7.89	25

[a]From the sample of 87 soldiers for whom there was complete training data regardless of availability of retention data.

[b]From the sample of 61 soldiers for whom there was complete data for both training and retention.

[c]Range Ring Profile Written Test

Tables 4 through 12 summarize the data for the aptitude profile x treatment cells for each test. Tables 4 and 5 report the descriptive information on Film 10 for the 87 cases and the 61 cases respectively. Table 6 presents the information for Film 10 Retention. The descriptive data for Film 12 and Film 12 Retention for 87, 61, and 61 subjects respectively, is presented in Tables 7 through 9. Finally, Tables 10 through 12 complete the descriptive interaction cell reports giving the data on the Range Ring Profile Training and Retention tests.

Multiple regression analyses were performed to determine if significant interaction or main effects existed for aptitude profile groups and instructional strategy groups on both immediate and retention performance and written posttests. For the three immediate posttests only, separate analyses were performed for each of the following: (a) all subjects for whom there was complete training data, regardless of the availability of retention data ($N = 87$), and (b) all those for whom there was complete data for both immediate and retention posttests ($N = 61$). The regression summary tables include the following information: (a) the proportion of variance explained by each factor, the interactions between factors, and the residual, (b) the respective sums of squares, (c) degrees of freedom, (d) mean squares, (e) the observed values of F, and (f) the probability levels for significance.

Table 13 summarizes the results of the multiple regression analyses of aptitude profile, treatment, and interactions for the immediate and retention performance posttests of Film 10 for $N = 87$, $N = 61$ and $N = 61$ respectively. None of the observed values of F were significant at the .05 level. Consequently, no further analyses of Film 10 data were warranted.

Table 14 contains the results of the multiple regression analyses of aptitude profile, instructional strategy, and interactions for the immediate and retention performance tests of Film 12 for $N = 87$, $N = 61$ and $N = 61$ respectively. For the 87 subjects, none of the values of F were significant at the .05 level but the observed F value for Profile, 2.345, approached significance. Since none of the values were significant, no further analyses were appropriate. When the same analysis was performed on the 61 subjects who had both immediate and retention scores, there were significant effects ($p \leq .05$) for both instructional strategy and aptitude profile, but not for their interaction on immediate performance data. Since strategy and profile were significant, further analyses were performed to isolate where the significant differences were occurring. In the analysis of the retention data the interaction and the main effects were not significant and no further analyses of the retention data were conducted.

TABLE 4

FILM 10 PERFORMANCE TEST MEANS AND STANDARD DEVIATIONS FOR APTITUDE PROFILE X INSTRUCTIONAL STRATEGY CELL ($\underline{N}$ = 87)

Aptitude Profile Groups		Instructional Strategy Groups 1	2	3	4	Row Totals
1	$\bar{X}$	7.25	4.60	7.80	9.00	6.81
	SD	3.77	2.88	3.11	1.41	3.23
	n	4	5	5	2	16
2	$\bar{X}$	8.25	8.50	7.80	1.67	6.71
	SD	6.95	0.71	2.17	2.08	4.56
	n	4	2	5	3	14
3	$\bar{X}$	5.60	5.54	6.67	5.67	5.86
	SD	4.04	2.99	3.57	3.39	3.27
	n	5	13	9	9	36
4	$\bar{X}$	7.88	8.50	6.33	4.00	6.67
	SD	5.19	3.00	5.86	3.03	4.46
	n	8	4	3	6	21
Column Totals	$\bar{X}$	7.29	6.08	7.14	4.90	6.37
	SD	4.81	3.08	3.36	3.43	3.76
	n	21	24	22	20	87

TABLE 5

FILM 10 PERFORMANCE TEST MEANS AND STANDARD DEVIATIONS FOR APTITUDE PROFILE X INSTRUCTIONAL STRATEGY CELL ($\underline{N}$ = 61)

Aptitude Profile Groups		Instructional Strategy Groups 1	2	3	4	Row Totals
	$\bar{X}$	7.25	5.25	8.75	9.00	7.36
1	SD	3.77	2.87	2.63	1.41	3.05
	$\underline{n}$	4	4	4	2	14
	$\bar{X}$	9.50	8.00	5.00	1.00	6.60
2	SD	6.36	0.0	0.0	0.0	4.83
	$\underline{n}$	2	1	1	1	5
	$\bar{X}$	4.75	5.56	5.71	5.75	5.54
3	SD	4.11	3.05	3.50	3.62	3.29
	$\underline{n}$	4	9	7	8	28
	$\bar{X}$	7.80	7.00	3.00	4.40	5.79
4	SD	6.61	4.24	1.41	3.21	4.68
	$\underline{n}$	5	2	2	5	14
Column	$\bar{X}$	7.07	5.81	6.14	5.44	6.10
Totals	SD	4.96	2.90	3.35	3.52	3.71
	$\underline{n}$	15	16	14	16	61

TABLE 6

FILM 10 RETENTION TEST MEANS AND STANDARD DEVIATIONS
FOR APTITUDE PROFILE X INSTRUCTIONAL STRATEGY CELL ($\underline{N}$ = 61)

Aptitude Profile Groups		Instructional Strategy Groups 1	2	3	4	Row Totals
1	$\bar{X}$	7.25	7.50	7.50	9.00	7.64
	SD	3.20	2.89	2.89	0.0	2.56
	n	4	4	4	2	14
2	$\bar{X}$	9.00	9.00	9.00	5.00	8.20
	SD	0.0	0.0	0.0	0.0	1.79
	n	2	1	1	1	5
3	$\bar{X}$	4.50	7.22	7.14	4.00	5.89
	SD	4.12	3.42	3.13	3.82	3.70
	n	4	9	7	8	28
4	$\bar{X}$	7.20	7.00	7.00	6.00	6.71
	SD	2.77	4.24	4.24	4.06	3.24
	n	5	2	2	5	14
Column Totals	$\bar{X}$	6.73	7.38	7.36	5.31	6.67
	SD	3.22	3.05	2.84	3.75	3.28
	n	15	16	14	16	61

TABLE 7

FILM 12 PERFORMANCE TEST MEANS AN STANDARD DEVIATIONS
FOR APTITUDE PROFILE X INSTRUCTIONAL STRATEGY CELL (N = 87)

Aptitude Profile Groups		Instructional Strategy Groups 1	2	3	4	Row Totals
1	$\bar{X}$	7.00	10.80	16.40	7.50	11.19
	SD	3.56	3.96	6.19	3.54	5.78
	n	4	5	5	2	16
2	$\bar{X}$	17.25	12.00	16.00	12.33	15.00
	SD	13.28	2.83	9.77	7.64	9.20
	n	4	2	5	3	14
3	$\bar{X}$	5.80	9.46	11.56	9.00	9.36
	SD	6.37	5.65	7.97	4.18	6.12
	n	5	13	9	9	36
4	$\bar{X}$	15.13	9.75	11.10	12.50	12.76
	SD	11.17	0.50	6.08	4.18	7.50
	n	8	4	3	6	21
Column Totals	$\bar{X}$	11.76	10.00	13.59	10.40	11.43
	SD	10.23	4.52	7.69	4.75	7.16
	n	21	24	22	20	87

TABLE 8

FILM 12 PERFORMANCE TEST MEANS AND STANDARD DEVIATIONS
FOR APTITUDE PROFILE X INSTRUCTIONAL STRATEGY CELL (N = 61)

Aptitude Profile Groups		Instructional Strategy Groups 1	2	3	4	Row Totals
1	$\bar{X}$	7.00	11.00	17.00	7.50	11.07
	SD	3.56	4.55	6.98	3.54	6.15
	n	4	4	4	2	14
2	$\bar{X}$	11.00	14.00	29.00	19.00	16.80
	SD	2.83	0.0	0.0	0.0	7.69
	n	2	1	1	1	5
3	$\bar{X}$	3.50	8.22	9.29	8.63	7.93
	SD	4.73	5.67	5.25	4.31	5.15
	n	4	9	7	8	28
4	$\bar{X}$	12.40	10.00	9.50	12.00	11.50
	SD	12.18	0.0	7.78	4.47	7.60
	N	5	[illegible]	2	5	14
Column Totals	$\bar{X}$	8.40	9.50	12.93	10.19	10.20
	SD	6.03	4.93	7.91	4.83	6.57
	n	15	16	14	16	61

TABLE 9

FILM 12 RETENTION PERFORMANCE TEST MEANS AND STANDARD DEVIATIONS FOR APTITUDE PROFILE X INSTRUCTIONAL STRATEGY CELL (N = 61)

Aptitude Profile Groups		Instructional Strategy Groups 1	2	3	4	Row Totals
1	$\bar{X}$	8.00	11.00	13.25	7.50	10.29
	SD	2.45	4.55	7.85	3.54	5.20
	n	4	4	4	2	14
2	$\bar{X}$	8.50	10.00	5.00	10.00	8.40
	SD	2.12	0.0	0.0	0.0	2.30
	n	2	1	1	1	5
3	$\bar{X}$	11.00	10.44	14.14	10.63	11.50
	SD	2.16	4.56	6.04	6.46	5.30
	N	4	9	7	8	28
4	$\bar{X}$	11.40	9.50	8.50	9.40	10.00
	SD	7.96	0.71	2.12	2.61	4.82
	n	5	2	2	5	14
Column Totals	$\bar{X}$	10.00	10.44	12.43	9.81	10.62
	SD	4.81	3.93	6.31	4.82	4.97
	n	15	16	14	16	61

TABLE 10

RANGE RING PROFILE WRITTEN TEST MEANS AND STANDARD DEVIATIONS FOR APTITUDE PROFILE X INSTRUCTIONAL STRATEGY CELL ($\underline{N}$ = 87)

Aptitude Profile Groups		Instructional Strategy Groups 1	2	3	4	Row Totals
1	$\bar{X}$	36.25	39.20	38.60	44.00	38.88
	SD	11.21	3.70	4.93	4.24	6.47
	n	4	5	5	2	16
2	$\bar{X}$	36.75	38.00	38.80	42.00	38.79
	SD	2.87	4.24	3.78	5.29	3.95
	n	4	2	5	3	14
3	$\bar{X}$	29.80	35.92	30.44	30.89	32.44
	SD	5.50	6.26	5.59	6.58	6.41
	n	5	13	9	9	36
4	$\bar{X}$	30.38	37.25	37.00	32.67	33.29
	SD	5.80	6.40	2.65	4.80	5.75
	n	8	4	3	6	21
Column Totals	$\bar{X}$	32.57	37.00	35.09	34.40	34.85
	SD	6.93	5.55	5.98	7.34	6.53
	n	21	24	22	20	87

TABLE 11

RANGE RING PROFILE WRITTEN TEST MEANS AND STANDARD DEVIATIONS FOR APTITUDE PROFILE X INSTRUCTIONAL STRATEGY CELL ($\underline{N}$ = 61)

Aptitude Profile Groups		Instructional Strategy Groups 1	2	3	4	Row Totals
1	$\bar{X}$	36.25	40.25	39.00	44.00	39.29
	SD	11.21	3.30	5.60	4.24	6.83
	$\underline{n}$	4	4	4	2	14
2	$\bar{X}$	37.50	35.00	41.00	48.00	39.80
	SD	2.12	0.0	0.0	0.0	5.17
	$\underline{n}$	2	1	1	1	5
3	$\bar{X}$	30.75	36.67	32.29	31.25	33.18
	SD	5.85	2.35	4.57	6.94	5.37
	$\underline{n}$	4	9	7	8	28
4	$\bar{X}$	33.00	42.00	36.00	34.20	35.14
	SD	4.53	2.83	2.83	3.35	4.52
	$\underline{n}$	5	2	2	5	14
Column Totals	$\bar{X}$	33.87	38.13	35.36	34.81	35.57
	SD	6.85	3.28	5.40	7.51	6.06
	$\underline{n}$	15	16	14	16	61

TABLE 12

RANGE RING PROFILE WRITTEN RETENTION TEST MEANS AND STANDARD DEVIATIONS FOR APTITUDE PROFILE X INSTRUCTIONAL STRATEGY CELL ($\underline{N}$ = 61)

Aptitude Profile Groups		Instructional Strategy Groups 1	2	3	4	Row Totals
1	$\bar{X}$	41.25	41.25	41.00	41.50	41.21
	SD	3.77	1.50	3.56	0.71	2.61
	n	4	4	4	2	14
2	$\bar{X}$	36.00	38.00	40.00	46.00	39.20
	SD	4.24	0.0	0.0	0.0	4.66
	n	2	1	1	1	5
3	$\bar{X}$	32.50	35.56	34.71	31.75	33.82
	SD	3.70	2.60	3.95	8.56	5.36
	n	4	9	7	8	28
4	$\bar{X}$	34.40	41.50	36.50	40.20	37.79
	SD	9.29	2.12	2.12	2.77	6.22
	n	5	2	2	5	14
Column Totals	$\bar{X}$	35.93	37.88	37.14	36.50	36.87
	SD	6.65	3.52	4.35	7.89	5.80
	n	15	16	14	16	61

TABLE 13

SUMMARY OF THE MULTIPLE REGRESSION ANALYSES FOR FILM 10

Depend. Meas.	Variable	Prop. of Variance (R sq. change)	SS	df	Mean Square	F	p
Film 10 (N=87)	Profile x Strategy	.12357	150.289	9	16.988	1.202	ns
	Profile	.02662	32.376	3	10.792	< 1	ns
	Strategy	.03876	47.141	3	15.714	1.131	ns
	Residual	.81105	986.430	71	13.893		
	Total	1.00000	1,216.236	86			
Film 10 (N=61)	Profile x Strategy	.10174	83.970	9	9.330	< 1	ns
	Profile	.06429	53.066	3	17.887	1.212	ns
	Strategy	.03843	31.722	3	10.574	< 1	ns
	Residual	.79554	656.651	45	14.922		
	Total	1.00000	825.409	60			
Film 10R (N=61)	Profile x Strategy	.08691	56.095	9	6.233	< 1	ns
	Profile	.08382	54.100	3	18.033	1.564	ns
	Strategy	.02523	16.285	3	5.283	< 1	ns
	Residual	.80404	518.963	45	11.533		
	Total	1.00000	645.443	60			

TABLE 14

SUMMARY OF THE MULTIPLE REGRESSION ANALYSES FOR FILM 12

Depend. Meas.	Variable	Prop. of Variance (R sq. change)	SS	df	Mean Square	F	p
Film 12 (N=87)	Profile x Strategy	.08773	386.824	9	42.980	< 1	ns
	Profile	.07957	350.845	3	116.948	2.345	ns
	Strategy	.02956	130.338	3	43.446	< 1	ns
	Residual	.80314	3,541.256	71	49.768		
	Total	1.00000	4,409.264	86			
Film 12 (N=61)	Profile x Strategy	.10435	270.438	9	30.487	< 1	ns
	Profile	.14982	388.279	3	129.426	3.595	.025
	Strategy	.12072	312.863	3	104.288	2.897	.05
	Residual	.62511	1,620.059	45	36.001		
	Total	1.00000	2,591.639	60			
Film 12R (N=61)	Profile x Strategy	.10348	153.598	9	17.066	< 1	ns
	Profile	.04585	68.056	3	22.685	< 1	ns
	Strategy	.00308	4.572	3	1.524	< 1	ns
	Residual	.84759	1,258.104	45	27.956		
	Total	1.00000	1,484.104	60			

Post hoc comparisons were performed using Fisher's Least Significant Difference (LSD) Procedure, adjusting for the compounding of the comparisonwise error rate (Kirk, 1968). According to the adjustment, only comparisons that had a *t* probability of .01 or less would be considered significant at the .05 level. Any contrasts with a *t* probability greater than .01 but less than or equal to .05 could be said to approach significance. See Table 15 for a summary of these comparisons following significant main effects for Film 12.

The results of the multiple regression analyses of aptitude profile, instructional strategy, and interactions for the immediate and retention Range Ring Profile written posttests are summarized in Table 16. There were no significant interaction or strategy effects on the RRP written tests. However, there were significant main effects for aptitude profile at the .05 level in all three analyses. Because of the significant main effects for profile, further analyses were conducted, again using the adjusted LSD method. Table 17 presents a summary of the *post hoc* comparisons following significant aptitude profile effects on all RRP written tests.

Results. The analysis of the results of the confirmatory phase of the REDEYE study can be summarized in the following manner:

1. There were no significant interactions between aptitude profile groups and instructional strategy groups on either the immediate or retention tests for Film 10, one of the two performance tests. In addition, there were no significant main effects for either profile or strategy on either of the measures. These results were observed for either the full sample population of 87 men or for the 61 who completed both immediate and retention testing.

2. There were no significant interactions between aptitude profile groups and strategy groups on the other performance test--Film 12--for either the immediate or retention posttests. Again, this was the case for either size sample.

3. There was a significant difference (.025) between Film 12 immediate performance posttest scores of the aptitude profile groups for the sample of 61 subjects only. Further analyses indicated that men with Profile 2 performed significantly better than those with Profile 3. Those with Profile 2 also performed better than subjects with Profiles 1 or 4 but the differences in these cases only approached significance.

TABLE 15

POST HOC LSD[a] COMPARISONS BETWEEN MEANS FOLLOWING SIGNIFICANT MAIN EFFECTS ON FILM 12 (N = 61)

Dependent Variable			t probabilities			
Film 12			Profile 3	Profile 1	Profile 4	Profile 2
Count	Mean					
28	7.9286	Profile 3				
14	11.0714	Profile 1	.125			
14	11.5000	Profile 4	.102	.887		
5	16.8000	Profile 2	.001*	.024	.034	
61	10.1967	Total				

Film 12			t probabilities			
			Strategy 1	Strategy 2	Strategy 4	Strategy 3
Count	Mean					
15	8.4000	Strategy 1				
16	9.5000	Strategy 2	.378			
16	10.1875	Strategy 4	.212	.736		
14	12.9286	Strategy 3	.005*	.070	.134	
61	10.1967	Total				

[a]Fisher's Least Significant Difference Test adjusted for the compounding of the comparison-wise error rate. Since alpha was set at .05 for the entire experiment, any t probability that is .01 or less would indicate significance at the .05 level.

*$p < .05$

TABLE 16

SUMMARY OF THE MULTIPLE REGRESSION ANALYSES
FOR THE RANGE RING PROFILE WRITTEN TEST

Depend. Meas.	Variable	Prop. of Variance (R sq. change)	SS	df	Mean Square	F	p
	Profile x Strategy	.09816	359.958	9	39.995	1.195	ns
RRP (N=87)	Profile	.19634	719.990	3	239.997	7.168	.001
	Strategy	.05726	209.976	3	69.992	2.091	ns
	Residual	.64824	2,377.133	71	33.481		
	Total	1.00000	3,667.057	86			
	Profile x Strategy	.14269	314.334	9	34.926	1.229	ns
RRP (N=61)	Profile	.20449	450.475	3	150.158	5.285	.005
	Strategy	.07246	159.623	3	53.208	1.873	ns
	Residual	.58036	1,278.479	45	28.411		
	Total	1.00000	2,202.910	60			
	Profile x Strategy	.11062	223.115	9	24.791	< 1	ns
RRPR (N=61)	Profile	.25233	508.937	3	169.646	6.398	.005
	Strategy	.04549	91.751	3	30.584	1.153	ns
	Residual	.59156	1,193.151	45	26.514		
	Total	1.00000	2,016.954	60			

TABLE 17

POST HOC LSD[a] COMPARISONS BETWEEN MEANS FOLLOWING SIGNIFICANT RRP APTITUDE PROFILE EFFECTS

Range Ring Profile Test (N = 87)			t probabilities			
			Profile 3	Profile 4	Profile 2	Profile 1
Count	Mean					
36	32.4444	Profile 3				
21	33.2857	Profile 4	.136			
14	38.7857	Profile 2	.001*	.035		
16	38.8750	Profile 1	.001*	.014	.783	
87	34.8506	Total				

Range Ring Profile Test (N = 61)			Profile 3	Profile 4	Profile 1	Profile 2
Count	Mean					
28	33.1786	Profile 3				
14	35.1429	Profile 4	.067			
14	39.2857	Profile 1	< .001*	.106		
5	39.8000	Profile 2	.007*	.174	.864	
61	35.5738	Total				

Range Ring Profile Retention Test (N = 61)			Profile 3	Profile 4	Profile 2	Profile 1
Count	Mean					
28	33.8214	Profile 3				
14	37.7857	Profile 4	.018			
5	39.2000	Profile 2	.019	.519		
14	41.2143	Profile 1	< .001*	.146	.658	
61	36.8689	Total				

[a]Fisher's Least Significant Difference Test adjusted for the compounding of the comparison-wise error rate.
*$p < .05$

4. There was a significant difference (.05) between the Film 12 immediate performance posttest scores of the different strategy groups for the sample of 61, but not for that with 87. Further analyses revealed that those who received Strategy 3 performed significantly better than men who received Strategy 1.

5. There were no significant interaction or main effects for instructional strategy or aptitude profile in either sample on the Film 12 performance retention test.

6. No significant interactions between aptitude profile and instructional strategy group were observed on either the immediate or retention written tests (Range Ring Profile Tests) for either sample size. Nor were there any significant strategy effects on either test.

7. Significant main effects for aptitude profile were observed for both samples on the immediate written tests and on the retention written test (.05). For $\underline{N}$ = 87, further analyses revealed that both Profiles 1 and 2 performed significantly better than Profile 3. The same two profiles' posttest scores were better than the Profile 4 test scores, but the differences in these instances only approached significance. For $\underline{N}$ = 61, analyses indicated that for either test, Profile Group 1 performed significantly better than Profile Group 3. On the immediate posttest, the performance of Profile 2 was also significantly better than that of Profile 3. On the retention test Profile 2 and 4 approached being significantly better than Profile 3.

8. The immediate test and retention test performance data were not compared statistically for any of the three dependent measures. Averaged over the main effects, the retention test mean scores were higher than the immediate scores on film 10 (6.67 vs 6.10), on Film 12 (10.62 vs 10.20) and on the RRP written test (36.87 vs 35.57). In general, within aptitude profile and instructional strategy for the dependent measures there was a tendency for mean posttest scores to regress toward the grand mean, i.e., the larger immediate mean test scores showed a decrease on retention test and the smaller immediate test scores showed an increase on retention test. The aptitude profile and strategy effects on Film 12 suggest a possible differential effect of aptitude and strategy on acquisition as compared with retention. For the Film 12 immediate

test data, the Aptitude Profile 2 mean was greater than the Aptitude Profile 3 mean and the Strategy 3 mean was greater than the Strategy 1 mean. However, for the retention data, neither aptitude profile nor strategy effects were significant. The largest improvement in mean score from the Film 12 immediate test to the retention test occurred for Aptitude Profile 3 (7.93 to 11.50 (N=28)).

Discussion. Based on the analysis of the data, the results have been summarized and several conclusions have been drawn. However, it must be pointed out that the interpretation of the data was made complex by the fact that there was not complete random assignment (i.e., to a fully crossed design). While random assignment to strategy group was achieved, it cannot completely substitute for the increased control and power that would have been present had there been random assignment from aptitude profile groups to strategy groups. A careful inspection of the cell sizes (Tables 4 - 12) will reveal the effect that this lack of randomization had on the distribution of cases in the study. The most serious imbalance occurred with Aptitude Profile 2 subjects, especially for the retention data. For retention, some cell sizes for Profile 2 have only one case, which is totally unacceptable if one wants to have confidence to generalize. Nevertheless, this occurred and the results and conclusions must be looked at in light of these conditions.

Another occurrence that may limit the generalizability of any conclusions from the confirmatory analysis is now presented. Possible implications of this occurrence must be considered when interpretations of the data are made.

The number of soldiers who qualified for Profile 2 was much smaller than anticipated. In the earlier research Hebein, 1978; Sullivan et al., 1978), the only group for whom there were few cases was Profile 1. There had been no shortage of Profile 2 people and there was no reason to suspect that a shortage in this group would occur in this study. Related to the number of people who qualified for Profile Group 2, was the actual make-up of their aptitude pattern. Eight of the fifteen soldiers who were analyzed in the Profile 2 group also qualified for membership in Group 1. This left only seven people with Profile 2 whose aptitude profile was uncontaminated by that of any other profile. Recall that there were four people with Profile 3 that also had Profile 2. This means that of all the people who qualified for Profile 2, more of them had duplicate qualifications with another profile than had Profile 2 alone. This did not happen in the earlier contract research and further complicates the interpretation of conclusions about Profile 2.

Exploratory Analysis

Analysis. For the sake of economy, all exploratory analyses were performed on the subset of 61 cases, for whom there was complete training and retention data. If there were differences between the full sample of 87 and the 61, these differences were not explored. The advantage of using the 61 case sample was that complete data on all cases were available. A sample size of only 61 is not large enough to allow strong inferences to be made concerning the issues investigated. Nevertheless, a look at the data may provide insights that will both help to explain any underlying structure to the data and that will point toward promising hypotheses for future studies.

Results of the exploratory analyses are speculative and should be viewed with caution. The later discussion (in Chapter IV) of similar analyses on CHAPARRAL and VULCAN samples should be considered as a partial replication of the exploratory REDEYE analyses even though there was not an experimental study for any of the CHAPARRAL/VULCAN (C/V) groups. The results of the three similar exploratory analyses for the three sample populations may provide stronger support for inferences concerning performance according to aptitude patterns than would the REDEYE analysis alone. If this proves to be the case, a clear direction for research in this area may be revealed.

The tests for the entire aptitude battery (including those used for aptitude profile formation and those used for exploratory purposes) were scored for all soldiers. Both immediate and retention performance and written tests were also scored. Shown on Table 18 is a summary of the variable names and labels used for the REDEYE sample. A summary of the means, standard deviations, and number of cases on which each measure was based is presented in Table 19.

A series of factor analyses were performed in order to investigate the underlying structure of the aptitude variables. As stated already, all measures except the Total Thurstone were submitted to the factor analyses. The correlation matrices upon which the factor analyses and subsequent canonical correlation analyses were based are presented in Appendix D.

The first factor analysis included twenty-eight independent variables from the aptitude test battery and the number of factors was unrestricted. A summary of the eigenvalues, percent of variance explained, and cumulative percent of variance for both significant and nonsignificant factors is presented in Table 20. The factor matrix, before rotation by the varimax method, is presented in Table 21. It yielded eight factors with an eigenvalue greater than one. Also in Table 21 is the rotated factor matrix,

TABLE 18

SUMMARY OF INDEPENDENT AND DEPENDENT VARIABLES COLLECTED FROM REDEYE GUNNERS AT TIME OF REFRESHER TRAINING

Variable Name	Variable Label	Extended Label
V1	Age	
V2	Word	From the Press Test
V3	Color	From the Press Test
V4	Wintc	From the Press Test (Color naming with distraction)
	(Note:	V2-V4 purport to measure the ability to work under stress.)
V5	Clflex	Closure Flexibility
V6	Clspd	Closure Speed
V7	LTH	Language Thurstone
V8	QTH	Quantitative Thurstone
V9	TTH	Total Thurstone
V10	GEFT	Group Embedded Figures Test
V11	Pursuit	From MacQuarrie Test
V12	State	State Anxiety
V13	Trait	Trait Anxiety
V14	2dim	Two Dimensional Spatial Relations
V15	FA	Reserved/Outgoing
V16	FB	Less Intell/More Intell
V17	FC	Affected by feelings/Emotionally Stable
V18	FE	Humble/Assertive
V19	FF	Sober/Happy-go-lucky
V20	FG	Expedient/Conscientious
V21	FH	Shy/Venturesome
V22	FI	Tough-minded/Tender-minded
V23	FL	Trusting/Suspicious
V24	FM	Practical/Imaginative
V25	FN	Forthright/Astute
V26	FO	Self-Assured/Apprehensive
V27	Q1	Conservative/Experimenting
V28	Q2	Group-dependent/Self-sufficient
V29	Q3	Undisciplined Self-conflict/ Controlled
V30	Q4	Relaxed/Tense
V33	Film 10	Film 10 (Fast, Constant Speed Targets)
V34	Film 12	Film 12 (Variable Speed, Mixed Target-Types)
V35	MTS ANX	State Anxiety for MTS Performance
V36	RRP	Range Ring Profile Written Test
V37	Film 10R	Film 10 Retention
V38	Film 12R	Film 12 Retention
V39	RRPR	Range Ring Profile Retention

TABLE 19

SUMMARY OF MEANS AND STANDARD DEVIATIONS
FOR REDEYE INDEPENDENT AND DEPENDENT VARIABLES

VARIABLES..	LABELS..	MEAN	STANDARD DEV	CASES
V2	WORD	69.1311	17.6233	61
V3	COLOR	67.3279	15.4366	61
V4	WINTC	57.7213	12.5699	61
V5	CLFLEX	41.0984	34.2241	61
V6	CLSPD	9.2951	5.0641	61
V7	LTH	22.7377	11.3415	61
V8	QTH	18.0656	9.0477	61
V10	GEFT	7.4590	5.6112	61
V11	PURSUIT	18.9672	7.7416	61
V12	STATE	37.3934	8.9838	61
V13	TRAIT	38.0656	8.8164	61
V14	2DIM	12.0655	6.0549	61
V15	FA	6.6557	2.5356	61
V16	FB	3.6393	1.7704	61
V17	FC	6.6066	2.2381	61
V18	FE	6.1311	2.1329	61
V19	FF	6.8852	2.4090	61
V20	FG	7.6885	2.0211	61
V21	FH	7.0000	2.5820	61
V22	FI	5.1639	1.8365	61
V23	FL	7.1311	1.7746	61
V24	FM	5.4754	1.7186	61
V25	FN	5.5410	2.1492	61
V26	FO	5.2623	2.5942	61
V27	Q1	7.0492	2.0447	61
V28	Q2	4.9344	2.2425	61
V29	Q3	7.3770	2.1304	61
V30	Q4	4.8197	2.1409	61
V33	FILM 10	6.0984	3.7090	61
V34	FILM 12	10.1967	6.5722	61
V35	MTS ANX	37.3770	9.2793	61
V36	RRP	35.5738	6.0593	61
V37	FILM 10R	6.6721	3.2798	61
V38	FILM12R	10.6230	4.9738	61
V39	RRPR	36.8689	5.7979	61

TABLE 20

SUMMARY STATISTICS FOR ALL FACTORS IN UNROTATED FACTOR ANALYSIS OF 61 REDEYE CASES

VARIABLE	VALUE USED IN DIAGONAL	FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
V2	1.00000	1	6.37241	22.8	22.8
V3	1.00000	2	3.29173	11.8	34.5
V4	1.00000	3	2.29571	8.2	42.7
V5	1.00000	4	2.01157	7.2	49.9
V6	1.00000	5	1.81316	6.5	56.4
V7	1.00000	6	1.61085	5.8	62.1
V8	1.00000	7	1.32918	4.7	66.9
V10	1.00000	8	1.16845	4.2	71.0
V11	1.00000	9	0.96265	3.4	74.5
V12	1.00000	10	0.91889	3.3	77.8
V13	1.00000	11	0.80196	2.9	80.6
V14	1.00000	12	0.74333	2.7	83.3
V15	1.00000	13	0.70103	2.5	85.8
V16	1.00000	14	0.52222	1.9	87.7
V17	1.00000	15	0.50909	1.8	89.5
V18	1.00000	16	0.45871	1.6	91.1
V19	1.00000	17	0.38855	1.4	92.5
V20	1.00000	18	0.36868	1.3	93.8
V21	1.00000	19	0.32960	1.2	95.0
V22	1.00000	20	0.26642	1.0	95.9
V23	1.00000	21	0.24105	0.9	96.8
V24	1.00000	22	0.22527	0.8	97.6
V25	1.00000	23	0.17800	0.6	98.2
V26	1.00000	24	0.16116	0.6	98.8
V27	1.00000	25	0.14118	0.5	99.3
V28	1.00000	26	0.07826	0.3	99.6
V29	1.00000	27	0.06996	0.2	99.9
V30	1.00000	28	0.04087	0.1	100.0

TABLE 21

FACTOR MATRICES (UNRESTRICTED) FOR REDEYE DATA ($\underline{N}$=61)

FACTOR MATRIX USING PRINCIPAL FACTOR, NO ITERATIONS

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	COMMUNALITY
V2	0.71783	0.00553	-0.36296	0.41919	0.07779	0.00741	0.02510	-0.04076	0.83116
V3	0.70135	0.06182	-0.45066	0.35994	0.27133	0.07559	0.04953	0.01330	0.91031
V4	0.76876	-0.08492	-0.27172	0.35676	0.19297	0.09731	0.05024	-0.03570	0.79117
V5	0.74420	0.19442	0.33504	-0.09990	-0.02320	0.00762	-0.24451	0.12085	0.76685
V6	0.59929	0.26591	0.31817	0.27690	-0.24667	-0.04586	0.11554	-0.09545	0.69317
V7	0.84840	-0.07530	0.04918	-0.10831	0.04681	-0.05652	0.14802	-0.06125	0.77434
V8	0.83007	0.03876	0.03649	-0.10560	0.19126	0.04574	0.16979	-0.09412	0.77920
V10	0.79536	0.10386	0.29714	-0.27093	-0.01910	-0.04009	-0.10975	0.03814	0.85091
V11	0.68311	0.25008	0.04278	0.29326	0.27644	-0.13137	-0.05727	0.11687	0.73761
V12	0.02239	0.52170	0.19573	0.34294	-0.27135	0.32321	-0.18511	0.05107	0.64377
V13	-0.38173	0.77795	0.01516	0.04174	-0.06869	-0.02127	0.07701	0.22767	0.74053
V14	0.46511	0.72591	0.24869	-0.09080	-0.33230	-0.02337	-0.26639	0.53021	0.81952
V15	-0.40699	-0.38305	0.19447	0.35206	0.33675	0.28758	0.13406	0.08621	0.67515
V16	0.64012	-0.11601	-0.04458	-0.48657	0.00696	0.04977	-0.08880	-0.11729	0.68457
V17	0.19655	-0.59864	-0.09978	0.10752	-0.20644	0.15360	-0.12966	-0.05958	0.50270
V18	-0.02926	0.17311	-0.48800	-0.38892	0.19206	0.21453	0.27638	0.38996	0.73159
V19	-0.03119	-0.29497	0.49808	0.20112	0.12510	0.30150	0.21446	0.01260	0.52425
V20	0.10630	0.01222	0.11851	-0.03143	0.33828	-0.65904	-0.14139	-0.03829	0.54629
V21	0.14695	-0.56402	0.26709	0.08939	0.21334	0.31364	0.01366	0.19255	0.60152
V22	-0.03331	-0.31626	-0.03802	0.15466	-0.02221	-0.61773	0.40934	0.19988	0.71609
V23	0.30980	0.20773	0.05003	-0.52576	0.23960	0.27503	0.37361	0.15554	0.71488
V24	0.14827	-0.14680	-0.35756	0.38369	-0.50348	0.33448	0.02047	0.44467	0.76438
V25	-0.21988	0.30815	-0.63760	-0.14413	0.12166	0.15460	-0.01659	0.08423	0.61660
V26	-0.21217	0.00305	0.34136	0.11791	0.29116	0.01873	0.15059	-0.01104	0.66704
V27	0.24786	-0.27100	0.11824	-0.18907	-0.46936	0.29651	0.36134	-0.16657	0.65127
V28	0.23061	0.21981	-0.23476	-0.04346	-0.56841	-0.16777	0.38955	-0.31409	0.71016
V29	0.01417	-0.54765	0.21488	-0.14209	-0.08773	-0.29438	0.22360	0.40678	0.67731
V30	-0.27858	0.46733	0.29899	0.26380	-0.00135	-0.01086	0.47458	-0.00085	0.68033

VARIMAX ROTATED FACTOR MATRIX

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8
V2	0.86729	0.12675	-0.15482	-0.09161	-0.04987	-0.02870	0.04211	0.15956
V3	0.92189	0.08745	-0.11842	-0.06516	0.13824	-0.06598	-0.06389	0.08373
V4	0.83343	0.14349	-0.18841	0.07337	0.00515	-0.03429	0.02925	0.06146
V5	0.28518	0.82425	-0.02124	0.02804	-0.10839	-0.11532	-0.04282	-0.00280
V6	0.40274	0.49113	0.25529	-0.01040	-0.34941	-0.03280	0.30308	0.09927
V7	0.55144	0.56370	-0.19869	0.01237	0.02735	0.14406	0.24513	-0.17684
V8	0.60397	0.53411	-0.09501	0.05177	0.12326	0.03853	0.19115	-0.25339
V10	0.28264	0.85829	-0.05162	-0.04581	-0.00949	-0.03123	0.08474	-0.14610
V11	0.69713	0.41076	0.20804	0.01842	-0.04340	0.08307	-0.14322	-0.00117
V12	0.03051	0.15834	0.41996	-0.01294	-0.20857	-0.52088	0.04172	0.35309
V13	-0.23618	-0.05770	0.69810	-0.28651	0.16502	-0.16592	-0.12973	0.20099
V14	-0.00152	0.76823	0.03422	-0.05026	0.00673	-0.01773	-0.07984	0.46786
V15	-0.06545	-0.46410	0.05293	0.67178	-0.04310	0.02173	-0.13977	0.00366
V16	0.19954	0.85463	-0.42707	-0.11028	0.19919	-0.03339	0.16832	-0.27176
V17	0.11087	-0.05111	-0.59322	0.22325	-0.16477	0.01571	0.17155	0.17095
V18	0.03909	-0.06120	0.03235	-0.12513	0.83835	0.02031	-0.02052	0.07675
V19	-0.01373	0.01938	0.38763	0.68324	-0.15153	0.01783	0.16035	-0.06436
V20	0.08843	0.15432	0.04355	-0.20194	-0.22758	0.43158	-0.42728	-0.31835
V21	0.07128	0.07295	-0.30654	0.70041	0.01803	0.06990	-0.02852	0.02356
V22	0.08274	-0.16006	0.02545	-0.02848	-0.09770	0.81352	0.03289	0.09862
V23	0.00865	0.38804	0.14482	0.11464	0.63536	-0.01428	0.20638	-0.27957
V24	0.20758	-0.06238	-0.16747	-0.07068	0.00426	0.11365	0.13880	0.80746
V25	0.05325	-0.32970	0.03140	-0.38294	0.52065	-0.24224	-0.14782	0.07683
V26	-0.05235	0.02613	0.74432	0.05549	-0.00345	-0.14915	-0.15581	-0.19998
V27	-0.05432	0.17149	-0.21467	0.17237	0.01626	0.00074	0.73915	0.03875
V28	0.15165	0.02806	0.04065	0.51718	-0.07491	0.09414	0.66512	0.07433
V29	-0.20982	0.13845	-0.23223	0.10079	0.03926	0.66413	0.04250	0.15588
V30	-0.05417	-0.14735	0.77860	0.08205	-0.06020	0.05240	0.19064	0.00389

TRANSFORMATION MATRIX

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8
FACTOR 1	0.68295	0.67270	-0.22438	-0.02242	-0.00676	0.02306	0.17076	-0.02139
FACTOR 2	0.05817	0.21098	0.75007	-0.47535	0.12614	-0.37470	-0.08503	0.00016
FACTOR 3	-0.35954	0.47285	0.34338	0.53420	-0.44645	0.05926	0.04614	-0.19724
FACTOR 4	0.50702	-0.37861	0.26675	0.23156	-0.53111	-0.04620	-0.11753	0.42045
FACTOR 5	0.31765	-0.13455	0.12806	0.32501	0.28423	0.34820	-0.59563	-0.56663
FACTOR 6	0.01732	-0.05956	-0.06647	0.49489	0.34082	-0.73781	0.26858	0.11890
FACTOR 7	0.17526	-0.21211	0.40474	0.17520	0.33086	0.46506	0.62575	-0.11168
FACTOR 8	-0.10911	0.26339	0.11555	0.23088	0.44298	0.30075	-0.35943	0.66044

followed by the transformation matrix. The latter indicates the correlations between factors. A scree analysis suggested that the number of factors should be restricted.

Separate factor analyses were performed restricting the number of factors to four, five, and seven. Simple structure analyses were performed on each restricted varimax rotated factor matrix. These analyses revealed that the matrix restricted to seven factors appeared to provide the most meaningful solution. The seven factor solution came closest to meeting Thurstone's five rule criteria for simple structure, as summarized by Kerlinger (1973). Both the unrotated and the rotated matrices for the seven factor solution are presented in Table 22, along with the transformation matrix for the factors.

For purposes of analysis, positive or negative loadings of .5 or greater were considered high loadings, those between .2 and .5 were considered substantial loadings, and those less than .2 were considered as zero or near zero loadings. The rotated factor matrix becomes easier to interpret if the variables that load on each factor are listed in rank order according to magnitude. Such a listing is presented in Table 23. In order to save space, only the loadings of ±.3 or greater are shown on the table. If there were other loadings between .2 and .3, a note to that effect appears.

For clarity purposes, both the variable name (from the computer printout) and the associated label is presented in Table 23. Variables that have two names separated by a slash (e.g. relaxed/tense) list the descriptor for the low score on the measure first, followed by the descriptor for the high score. If there is any difficulty in understanding a variable label, refer to Table 18 for an extended label. Tentative names for the first six factors are given. A description and discussion of each of the seven factors follows.

The first factor is best called "spatial-analytic." Some would argue that the factor is primarily a general ability factor. However, the three highest loadings represent tests that are not designed as strict general ability measures. Rather, the GEFT and the Closure Flexibility test measure the ability to disembed simple forms from complex forms. This is alternately called analytic ability or field independence. The problems on these tests seem to require that learners utilize what might be called spatial skills. The two dimensional perception test, which is the only variable that cleanly loads on this factor alone, is definitely a spatial test. Only <u>after</u> these more spatial tests, do the more formal general ability tests show up.

TABLE 22

FACTOR MATRICES (RESTRICTED TO SEVEN FACTORS) FOR REDEYE DATA ($\underline{N}$=61)

FACTOR MATRIX USING PRINCIPAL FACTOR, NO ITERATIONS

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	COMMUNALITY
V2	0.71783	0.00553	-0.36296	0.41919	0.07779	0.00741	0.02510	0.82950
V3	0.70135	0.06182	-0.45066	0.35994	0.27133	0.07559	0.04953	0.91015
V4	0.70876	-0.08492	-0.27172	0.35676	0.19297	0.09731	0.05024	0.75990
V5	0.74420	0.19442	0.33504	-0.09900	-0.02220	0.00762	-0.24451	0.77424
V6	0.50929	0.26591	0.31617	0.27690	-0.24667	-0.04564	0.11554	0.68406
V7	0.84890	-0.07530	0.04918	-0.10831	0.04681	-0.05652	0.14802	0.76774
V8	0.83007	0.03676	0.03649	-0.10566	0.19126	0.04574	0.16479	0.77034
V10	0.79996	0.18386	0.29714	-0.27093	-0.01910	-0.04009	-0.10975	0.84945
V11	0.68311	0.25008	0.04278	0.29326	0.27644	-0.13137	0.05727	0.71397
V12	0.02239	0.52170	0.16573	0.34294	-0.27135	0.32321	-0.18511	0.64095
V13	-0.38173	0.72795	0.01516	0.04174	-0.06869	-0.02127	0.07701	0.68670
V14	0.48511	0.22591	0.24869	-0.09080	-0.33230	-0.02337	-0.26639	0.53839
V15	-0.40699	-0.38305	0.19447	0.35206	0.33675	0.28758	0.13406	0.68821
V16	0.64012	-0.11601	-0.04458	-0.48657	0.00696	0.04977	-0.08880	0.67237
V17	0.19655	-0.59664	-0.09978	0.10752	-0.20644	0.15360	-0.12966	0.49915
V18	-0.02926	0.17311	-0.46800	-0.38892	0.19206	0.21453	0.27638	0.57952
V19	-0.00119	-0.29497	0.49808	0.20112	0.12510	0.30150	0.21446	0.52809
V20	0.10430	0.01222	0.11851	-0.03143	0.33828	-0.65904	-0.14139	0.59482
V21	0.14695	-0.56482	0.26789	0.08939	0.21334	0.31364	0.01366	0.56445
V22	-0.03331	-0.31626	-0.03802	0.15466	-0.02221	-0.61773	0.40934	0.67614
V23	0.30980	0.20773	0.05003	-0.52576	0.23960	0.27503	0.37361	0.69069
V24	0.14827	-0.14680	-0.34756	0.38369	-0.50348	0.03448	0.02047	0.56565
V25	-0.21988	0.30815	-0.63780	-0.14413	0.12166	0.15460	-0.01659	0.60959
V26	-0.21217	0.60305	0.34136	0.11791	0.29116	0.01873	0.15059	0.64692
V27	0.24786	-0.27100	0.13824	-0.18907	-0.46936	0.29651	0.36134	0.62852
V28	0.23061	0.21961	-0.23479	-0.04346	-0.56841	-0.16777	0.38955	0.66151
V29	0.01417	-0.54765	0.21488	-0.14209	-0.08773	-0.29438	0.22360	0.51084
V30	-0.27858	0.46733	0.29899	0.26380	-0.00135	-0.01086	0.47458	0.68033

VARIMAX ROTATED FACTOR MATRIX

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7
V2	0.17330	0.86725	-0.15283	-0.08235	-0.07106	-0.02240	0.10795
V3	0.09514	0.92823	-0.12360	-0.08795	0.10086	-0.07877	-0.00995
V4	0.17499	0.82783	-0.18382	0.08089	0.02722	-0.02492	0.04764
V5	0.82435	0.25991	-0.03333	0.04849	-0.01237	-0.12752	-0.08515
V6	0.58971	0.36112	0.27195	0.07772	-0.22272	0.01353	0.27051
V7	0.61209	0.50147	-0.17627	0.07381	0.23025	0.20103	0.10796
V8	0.56974	0.55299	-0.07325	0.10322	0.33764	0.09528	0.02897
V10	0.87284	0.23735	-0.04771	-0.00295	0.16646	-0.00877	-0.03448
V11	0.41520	0.68946	0.19950	0.01885	-0.00995	0.06206	-0.14872
V12	0.17559	0.04867	0.39083	-0.01877	-0.31844	-0.58187	0.18117
V13	-0.12132	-0.20092	0.66686	-0.35436	-0.01554	-0.25197	-0.00319
V14	0.67118	0.03334	-0.02876	-0.12856	-0.17036	-0.16479	0.11515
V15	-0.50816	-0.03780	0.03876	0.83013	-0.08649	-0.01538	-0.12122
V16	0.56906	0.15060	-0.40707	-0.07112	0.39284	0.02610	0.00861
V17	-0.02013	0.11393	-0.59838	0.24181	-0.16978	0.03064	0.22131
V18	-0.23137	0.08095	-0.01106	-0.27272	0.65512	-0.10480	0.06905
V19	0.02546	-0.02772	0.09042	0.71413	-0.03540	0.02700	0.08085
V20	0.18092	0.06929	0.06065	-0.16760	-0.12905	0.46913	-0.53738
V21	0.01206	0.08256	-0.32822	0.66831	0.03664	0.02234	-0.03565
V22	-0.16638	0.09774	0.02475	-0.03363	-0.14997	0.77973	0.08177
V23	0.29733	0.04278	0.13872	0.07611	0.75511	-0.03709	0.06196
V24	-0.12789	0.28411	-0.22606	-0.17110	-0.35760	-0.04129	0.50952
V25	-0.41016	0.09131	0.01083	-0.48152	0.33083	-0.30000	-0.03981
V26	0.02261	-0.06334	0.74649	0.06418	0.05659	-0.14516	-0.23824
V27	0.23693	-0.09686	-0.18649	0.24950	0.17660	0.06781	0.65588
V28	0.15986	0.10844	0.12732	-0.41547	0.02840	0.19543	0.62957
V29	0.05397	-0.18663	-0.26065	0.25305	-0.02441	0.57483	0.10048
V30	-0.12271	-0.06061	0.78808	0.10777	-0.03370	0.05496	0.16738

TRANSFORMATION MATRIX

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7
FACTOR 1	0.70953	0.64714	-0.21750	0.01768	0.12573	0.04789	0.10978
FACTOR 2	0.21145	0.05478	0.74390	-0.48587	0.08763	-0.38786	-0.06863
FACTOR 3	0.51008	-0.40106	0.35299	0.61749	-0.22473	0.09478	-0.11654
FACTOR 4	-0.31084	0.54560	0.25527	0.24156	-0.68604	-0.07416	0.07767
FACTOR 5	-0.20366	0.31091	0.13048	0.28381	0.39389	0.05459	-0.77863
FACTOR 6	-0.11296	0.02775	-0.08667	0.64949	0.31576	-0.76796	0.29572
FACTOR 7	-0.20204	0.14913	0.43012	0.20388	0.44777	0.48994	0.51952

TABLE 23.

RANK ORDER OF FACTOR LOADINGS FOR REDEYE DATA OF TABLE 22.

Factor	Variable	Description	Loading
FACTOR 1	V10	Geft	.87
	V5	Clfl x	.82
	V14	2dim	.67
	V7	LIH[b]	.61
	V6	Clspd	.59
	V8	QIH[b]	.57
	V16	Less Intell/ More Intell	.57
	V15	Reserved/ Outgoing	-.51
	V11	Pursuit	.42
	V25	Forthright/ Astute	-.41
	V23	Trusting/ Suspicious	.30
		(Two other variables loaded between .2 and .3)	
FACTOR 2	V3	Color[a]	.93
	V2	Word[a]	.87
	V4	Wintc[a]	.83
	V11	Pursuit	.69
	V8	QIH[b]	.55
	V7	LIH[b]	.50
	V6	Clspd	.37
		(Four other variables loaded between .2 and .3)	
FACTOR 3	V30	Relaxed/Tense	.79
	V26	Self assured/ Apprehensive	.75
	V13	Trait Anxiety	.67
	V17	Affected by Feelings/ Emotionally Stable	-.59
	V16	Less Intell/ More Intell	-.41
	V12	State Anxiety	.40
	V21	Shy/Venturesome	-.33
		(Four other variables loaded between .2 and .3)	
FACTOR 4	V19	Sober/Happy-go-lucky	.71
	V21	Shy/Venturesome	.67
	V15	Reserved/ Outgoing	.64
	V25	Forthright/ Astute	-.48
	V28	Group Dependent/ Self-sufficient	-.42
	V13	Trait Anxiety	-.35
		(Four other variables loaded between .2 and .3)	
FACTOR 5	V23	Trusting/ Suspicious	.76
	V18	Humble/Assertive	.66
	V16	Less Intell/ More Intell	.39
	V24	Practical/ Imaginative	-.36
	V8	QIH[b]	.34
	V25	Forthright/ Astute	.33
	V12	State Anxiety	-.32
		(Two other variables loaded between .2 and .3)	
FACTOR 6	V22	Tough minded/ Tender-minded	.78
	V29	Undisciplined Self conflict/ Controlled	.57
	V12	State Anxiety	-.56
	V20	Expedient/ Conscientious	.47
	V25	Forthright/ Astute	-.30
		(Two other variables loaded between .2 and .3)	
FACTOR 7	V27	Conservative/ Experimenting	.66
	V28	Group Dependent/ Self sufficient	.63
	V20	Expedient/ Conscientious	-.54
	V24	Practical/ Imaginative	.51
		(Three other variables loaded between .2 and .3)	

[a] V2-V4 are three separate measures from the same test, all of which purport to measure the ability to work under stress.

[b] LIH and QIH are both measures of intelligence--for language and quantitative aspects respectively

There is a general ability character to this first factor, but it is secondary to the "spatial-analytic" dimension already discussed. What general ability is present in this factor is manifested in a complex way that seems to include at least three major areas of intelligence (language, mathematical, and spatial). The spatial aspects are clearly the most important in this factor.

With respect to general ability measures, both sections of the Thurstone Test of Mental Alertness and Factor B of the 16PF (Less Intelligent/More Intelligent) have their highest loadings on the spatial-analytic factor. These loadings are positive. But, it is interesting to note that these three primary general ability measures have substantial loadings (between .2 and .5) on two and sometimes three other factors in the terminal solution. At the same time, Closure Flexibility and the GEFT have substantial loadings on only one other factor other than Factor 1. This suggests that the GEFT and Closure Flexibility appear to measure the same thing and that this something is more independent of other factors than are traditional measures of general ability themselves. Personality factors with high positive loadings on the spatial-analytic factor include "reserved," "forthright," and "suspicious," to go along with high intelligence.

The second factor is clearly a stress related factor which might be called the "ability to work under stress." This factor, with three variables cleanly loading on it and only it, can be more clearly defined than was Factor 1. V2 to V4 (from the Press Test) were all designed to measure the ability to work under stress. They required performance under the pressure of an extremely short time limit. They have the highest positive loadings on this factor and have zero or near zero loadings on every other factor. These three measures can be said to be factorially "pure." At first glance, it appears that general ability confounds the factor, since the positive loadings for both language and quantitative intelligence measures (V7 and V8) are almost as high in Factor 2 as they are in the "spatial-analytic" factor. An alternative explanation to this interpretation suggests something quite different. The nature of the Thurstone Test of Mental Alertness, from which V7 and V8 came, has a time-pressure character to it. While the test does measure intelligence, the short time limit and the continually alternating question types adds a stressful aspect to the test. This aspect may be quite independent of the abilities it would take to correctly answer the questions if such pressure were not part of the testing situation. Therefore, it is quite reasonable to suggest that the high positive loadings of the Thurstone test mean general ability on the "spatial-analytic" factor but ability to work under stress on this factor. In other words, it could be that different aspects of the same test are being separated out into the two factors.

The Pursuit Test (V11) had the second highest loading on Factor 2. It shares the time pressure aspect of the measures already named for this factor and also shares some relationship with Factor 1. However, the same argument as for V7 and V8 could be made for V11 with respect to general ability and the ability to work under stress. Other variables which load on the factor, that have a time pressure character to them, are closure flexibility, closure speed, and the GEFT. The argument advanced for V7, V8 and V11 could apply to these measures as well.

Trait anxiety has a fairly high negative loading on this Factor 2 and suggests that low anxiety goes hand in hand with the ability to work under stress. This makes intuitive sense. The only other measure with an appreciable loading on this factor is V24 which suggests that imaginative people have the ability to work under stress. This too makes intuitive sense. All in all, Factor 2 as the "ability to work under stress" is a fairly "neat and clean" factor.

The third factor is almost as clearly defined as Factor 2. This third factor could be called "anxiety". The four highest loadings on this factor are all intertwined with anxiety. V30 has the highest loading on this factor and is factorially "pure" because it loads on no other factor. The positive loading suggests high anxiety because of its descriptor "tense." A high score on this measure was one of the original criteria in Sullivan et al. (1978) to denote high anxiety. It was used again in this series of studies.

The "apprehensive" dimension of V26, high trait anxiety (V13), and the "affected by feelings" dimension of V17 all have very high loadings on this factor and support the definition of the factor as "anxiety". State anxiety and the "shy" dimension of V21 also have reasonably high loadings on this factor and make sense for the factor. There is also a fairly high negative loading for intelligence (V16 from the 16PF) which is not as easily explained.

The loading on V16, as well as the loadings on V6 (Closure Speed) and V11 (Pursuit) suggest a possible but inconsistent relationship with Factor 1 (Spatial-Analytic) and with general ability. The complex relationships between anxiety and general ability are well documented (Cronbach & Snow, 1977; Gaudry & Spielberger, 1971, Sieber et al., 1977; Snow, 1976). Consequently, it is not surprising that some confounding between the factors shows up in this factor analysis. The only other measure with an appreciable loading on the anxiety factor is V24. The negative loading suggests that a practical orientation fits a high anxiety tendency better than would an imaginative orientation.

For Factor 4 the only measures with high or appreciable loadings are those that can be classified as personality characteristics, The highest loading is for V19 (Sober / Happy-go-lucky). It is the "happy-go-lucky" dimension that loads highly on the factor. In addition, V19 loads on no other factor so it is factorially "pure." The next highest loading was for V21 and represents the "venturesome" dimension of the variable. This dimension of V21 did not load on any other factor but the other dimension of the variable (shy) did have a reasonably high loading on the "ability to work under stress" factor. Since each end of the continuum for each measure from the 16PF represents a different personality characteristic, it could be argued that appreciable positive and negative loadings for the same variable, on different factors, represent totally different traits and not just "more" or "less" of the same trait. If this interpretation is accepted, then a variable that has only one appreciable or high positive loading (on one factor) and only one appreciable or high negative loading (on a different factor) could still be considered factorially "pure." Such was the case with V21 and with V15, the variable with the next highest loading on Factor 4.

The high positive loading on Factor 4 for V15 indicated that the "outgoing" dimension of the variable is factorially "pure." The other dimension of this variable (reserved) loaded with a high negative loading on the "spatial-analytic" factor. In both cases, the particular dimension of the variable loaded on one and only one factor.

The three personality characteristics just named with high loadings on Factor 4 (happy-go-lucky, venturesome, and outgoing) all had loadings within .07 of one another and were factorially "pure." The detailed descriptions of these dimensions, as described in the test administration manual (Manual for the 16PF, 1972, pp. 17-22) suggest some common threads that appear to be emerging in this factor. Apparently, there is a carefree, emotionally expressive, and easy-going nature to this factor. At the same time, there is spontaneity--even to the point of impulsiveness and/or boldness.

Appreciable but not high loadings on this factor were also observed for the "forthright" dimension of V25, the "group-dependent" dimension of V28 and for trait anxiety. The group-dependent dimension loads <u>only</u> on Factor 4, but the forthright dimension loads on both the "spatial-analytic" factor and on Factor 6. Trait anxiety loads on the "ability" to work under stress" factor and also on Factor 6. A negative loading for trait anxiety suggested that low trait anxiety accompanies the easy-going, carefree, and other characteristics that are par of the factor. The "forthright" person could be said to be unreserved, unguarded, or unrestrained. He is "very easily pleased and content with what comes, and is natural and spontaneous" (Manual for the 16PF, 1972, p. 21). The "group-dependent" person "likes and depends on social approval and admiration... and may be lacking in individual resolution (Manual for the 16PF, p. 22)."

It might be said that someone with a great deal of Factor 4 was unconcerned by and possessed a casualness toward danger. He would be able to forge ahead in the face of danger in a good-natured way--almost as if he were oblivious to the danger or didn't really care about it. Yet, he would still like social approval and admiration for being this way. It is in this sense that he might be called group-dependent. The lack of individual resolution that characterizes the group-dependent person can be explained by the rest of the factor in that a person with this factor is so spontaneous and impulsive that action occurs without the need for any firm resolve. Other personality dimensions with smaller loadings on Factor 4 (between .24 and .27) are: Imaginative, Experimenting, Controlled, and Humble.

It should be noted that Factor 4 is the only factor which has zero or near zero loadings for all of the intellectual ability measures (general or specialized). Therefore, in this solution, it is the only factor that is truly unconfounded by any form of general ability. A careful inspection of the simple structure analysis suggests that this factor is quite independent of the other factors, yet it is difficult to define with one or two words. The component features of the factor have been described and some discussion has been presented to tie together the various dimensions of the factor into a meaningful representation. However, an obvious name for this factor (or any of the factors that follow) is not available. As a result, (in almost all cases throughout this report) if a factor does not have an obvious name but it does have one or more factorially "pure" personality dimensions loaded onto it, it will be called by the name(s) of the factorially "pure" dimensions. In the case of Factor 4, it would be called the "happy-go-lucky, venturesome, outgoing" factor. However, if a factor does not have any factorially "pure" dimensions, it will be called by its factor number alone. In all cases, each factor will be described.

Factor 5 could be called the "assertiveness" factor. It had two measures with high loadings: the "suspicious" dimension of V23 and the "assertive" dimension of V18. Suspiciousness also loaded somewhat highly on the "spatial-analytic" factor. The loading on Factor 5 for suspiciousness was clearly the highest. The "assertive" dimension loaded only on Factor 5 so it can be said to be factorially "pure." The Manual for the 16PF (p. 20) explained the "suspicious" dimension as "mistrusting and doubtful..., deliberate in actions, unconcerned about other people, a poor team member." The "assertive" dimension, described on page 18, characterizes a person as "self-assured, independent-minded..., a law unto himself..., authoritarian (managing others), and disregard[ing] authority."

Other personality measures with loadings on Factor 5 between .32 and .39 included the "practical" dimension of V24, the "astute" dimension of V25, and state anxiety. Measures of intellectual ability with loadings in the same range were the "more intelligent" dimension of V16 and the quantitative portion of the Thurstone Test of Mental Alertness. Again, according to the Manual for the 16PF (p. 20) the practical person is "anxious to do the right things," is "subject to the dictation of what is obviously possible... is concerned over detail, [and is] able to keep his head in emergencies." On page 21 of the manual, the astute person is characterized as "shrewd... often hardheaded and analytical... [with] an intellectual, unsentimental approach to situations, an approach akin to cynicism." Low state anxiety was associated with this factor. Other measures with low loadings +.23 and -.22 respectively) were the language scale of the Thurstone and the Closure Speed Test.

The sixth factor might be named the "tender-minded, conscientious" factor. The description given for the "tender-minded" dimension of V22 in the manual suggests a person who is dependent and sensitive, has high and often unpredictably changing standards, and who is difficult to please. This type of person "tends to slow up group performance, and to upset group morale by unrealistic fussiness (p. 20)." The loading of .78 for the "tender-minded" dimension of V22 on this factor was the only loading at all for the variable. As a result, it can be said to be factorially "pure."

No other variable has a loading approaching the magnitude of that for "tender-minded" on Factor 6. However, the "conscientious" dimension of V20 does cleanly load on the factor with an appreciable but not high loading of .47. The Manual for the 16PF (1972, p. 19) describes a person with this dimension as "exacting in character, dominated by a sense of duty, persevering, responsible, ..., and moralistic... [with an] inner 'categorical imperative' ..." The descriptions for the two factorially "pure" dimensions for Factor 6 are quite compatible with one another and depict a unified representation of the factor.

The only other variable with a reasonably clean loading on this factor is the "controlled" dimension of V29. It loaded on only one other factor (the "happy-go-lucky, venturesome, outgoing" factor), but that loading was less than .3. A "controlled" person is described in the manual

(p. 22) as having "strong control over his emotions and general behavior," as "evidenc[ing] what is commonly termed 'self-respect' and regard for social reputation. He sometimes tends, however, to be obstinate." Such comments complement the notions of dependent and sensitive suggested by "tender-mindedness." Other measures which load less cleanly on this factor include: state and trait anxiety (both negatively but with state anxiety of much greater magnitude), forthrightness, language Thurstone (positively), and self-sufficiency.

The seventh factor can only be called Factor 7, and its interpretation is difficult. Not until the third measure (in order of the magnitudes of the loadings) is there a factorially "pure" variable--the "expedient" dimension of V20. The loading on "expediency" is considerably less than loadings for other measures on other factors in almost all cases. In addition, the highest loading for Factor 7 is lower than the highest loading for each of the other factors. Nevertheless, in Factor 7, there are four measures with loadings of .5 or greater on Factor 7, which is more variables with high loadings than for some other factors already identified. Hopefully, the discussion just presented will help to explain why the factor cannot be even tentatively "named" and why it was still important enough to retain in the solution.

For Factor 7, the "experimenting" dimension of V27 loaded first but it has appreciable loadings of between .2 and .3 on both the "spatial-analytic" and the "happy-go-lucky, venturesome, outgoing" factors. The "self-sufficient" dimension of V28 loaded next highly but it also loaded with .2 on the "tender-minded, conscientious" factor. The "imaginative" dimension of V24 loaded almost cleanly with a coefficient of .51 but it did have another loading (.28) on the "ability to work under stress" factor. Closure speed, emotionally stable, and self-assured each had loadings of between .22 and .27 on Factor 7.

Following the completion of all factor analyses, the independent and dependent variables were submitted to canonical correlation analysis. The independent variables were entered as the first set with the dependent variables as the second set. There were no significant canonical correlations between pairs of canonical variates. However, it was suspected that general ability masked the effects of other variables crucial to the performance of the REDEYE task. (See the factor analysis discussion on pages 57-65 with particular reference to page 60, lines 13, 14, 15.) A summary of the canonical correlation analysis is presented in Table 24. The summary table includes the following information: (a) the magnitudes of the eigenvalues, (b) the canonical correlations, (c) Wilk's lambda, (d) chi-square values, (e) the degrees of freedom, (f) the probability

TABLE 24

SUMMARY OF CANONICAL CORRELATION ANALYSIS OF REDEYE DATA
BEFORE CONSIDERING THE MASKING EFFECTS OF GENERAL ABILITY ($\underline{N}$=61)

- - - - - - - - - - - - - - - - C A N O N I C A L   C O R R E L A T I O N - - - - - - - - - -

NUMBER	EIGENVALUE	CANONICAL CORRELATION	WILK S LAMBDA	CHI-SQUARE	D.F.	SIGNIFICANCE
1	0.72811	0.85341	0.01045	191.56992	174	0.172
2	0.68740	0.82909	0.03846	136.83937	140	0.560
3	0.53206	0.72942	0.12304	88.00070	108	0.921
4	0.48375	0.69552	0.26293	56.10564	78	0.971
5	0.37506	0.61242	0.50932	28.31662	50	0.994
6	0.18501	0.43013	0.81499	8.59249	24	0.998

NO CANONICAL CORRELATION FOUND AT THE 0.050 LEVEL OF SIGNIFICANCE.
THE FIRST (NON SIGNIFICANT) CANONICAL CORRELATION IS PRINTED BELOW.

COEFFICIENTS FOR CANONICAL VARIABLES OF THE FIRST SET

	CANVAR 1
V2	-0.13253
V3	-0.43948
V4	0.65476
V5	0.50734
V6	0.03537
V7	-0.13190
V8	-0.11106
V10	-0.44753
V11	0.44915
V12	0.26273
V13	-0.05221
V14	0.00357
V15	0.10572
V16	0.66985
V17	-0.14105
V18	0.22475
V19	0.05747
V20	0.17043
V21	0.03171
V22	-0.25728
V23	-0.25028
V24	0.05615
V25	0.29955
V26	0.29089
V27	0.16171
V28	0.07678
V29	0.38359
V30	-0.38312
V35	0.00676

COEFFICIENTS FOR CANONICAL VARIABLES OF THE SECOND SET

	CANVAR 1
V33	0.25608
V34	-0.01449
V36	0.39507
V37	-0.69048
V38	0.74777
V39	0.59227

levels for significance, and (g) two matrices of standardized canonical variate coefficients, one for each of the two sets of variables submitted to analysis.

To investigate the masking influence of general ability, a second canonical correlation was performed. This second canonical involved a restricted number of variables (both independent and dependent) as compared to the first analysis. Only those variables were selected which had canonical variate coefficients greater than $|.30|$ in the first analysis. This restriction effectively removed those variables which were not providing independent variance to the canonical correlation. Since this was an exploratory study, $|.30|$ was selected as the lower limit of interest as a coefficient of less than $|.30|$ would suggest small independent contribution to the variance (Smith, 1980).

Nine of the twenty-nine variables of the first set and three of the six variables of the second set met the criterion and were submitted to the second anaysis. In this analysis, a significant canonical correlation of .758 was observed for the first pair of canonical variates ($p < .001$). This indicated that general ability, as a component of several of the factors, confounded the first analysis. A summary of the results of the second canonical correlation analysis is presented in Table 25. The types of information shown in Table 25 are identical to those in Table 24.

For interpretation purposes, the eigenvalues indicate the proportion of variance shared by the pair of canonical variates to which each eigenvalue corresponds. In this case, 57% of the variance is shared by the pair of canonical variates, each of which is a unique combination of the original variables that are part of each respective set. The size of the coefficients for the variables that make up each canonical variate indicates the relative contributions of the original variables to the composition of the variate.

In this analysis, the most important variable to the first variable set was V4 (Color Naming with Distraction from the Press Test), followed in order by V3 (Color Naming), V16 (16PF-FB: Less Intelligent/More Intelligent), V11 (Pursuit), V5 (Closure Flexibility), V25 (16PF-FN: Forthright/Astute), V30 (16PF-FQ4: Relaxed/Tense), V22 (16PF-FI: Tough-minded/Tender-minded), and V10 (GEFT). In the second set, the variable that contributed most to the variate was V39 (Range Ring Profile Written Retention Test), followed by V37 and V36 respectively. V37 was the Film 10 Performance Retention Test while V36 was the immediate Range Ring Profile Written Test.

Each canonical correlation coefficient can be interpreted as a Pearson product-moment coefficient except that the measure of relationship for the former

TABLE 25

SUMMARY OF CANONICAL CORRELATION ANALYSIS OF REDEYE DATA
AFTER CONSIDERING THE MASKING EFFECTS OF GENERAL ABILITY (N=61)

CANONICAL CORRELATION

NUMBER	EIGENVALUE	CANONICAL CORRELATION	WILK S LAMBDA	CHI-SQUARE	D.F.	SIGNIFICANCE
1	0.57470	0.75809	0.31356	62.04672	27	0.000
2	0.14515	0.38098	0.73727	16.30690	16	0.432
3	0.13755	0.37088	0.86245	7.91680	7	0.340

COEFFICIENTS FOR CANONICAL VARIABLES OF THE FIRST SET

	CANVAR 1
V3	-0.47223
V4	0.54788
V5	0.40168
V10	-0.11085
V11	0.40452
V16	0.47008
V22	-0.13486
V25	0.21395
V30	-0.14665

COEFFICIENTS FOR CANONICAL VARIABLES OF THE SECOND SET

	CANVAR 1
V36	0.37791
V37	-0.42514
V39	0.82822

refers to that between the two variates while the latter refers to a relationship between two individual variables.

The next step in the analysis was to calculate canonical variate scores for each individual case in the REDEYE sample. A summary of the means and standard deviations of these standardized scores, grouped by aptitude profile, is presented in Table 26.

At first glance, there are marked differences between the canonical variate scores on both variable sets for those with Aptitude Profile 1 and those with Aptitude Profile 3. To thoroughly inspect these and any other differences, new scores for each of the variables that went into each canonical variate (adjusted for the relative contribution to the variate) should be calculated for each case. To do this would have been beyond the scope of the research for the present contract and could be the subject of further analyses at a later date.

Instead, theoretical and logical considerations were applied to the interpretation of output results from the canonical correlation analysis of Table 25 (see Appendix E). These interpretations were made in light of aptitude profiles wherever possible.

Results. The results of the REDEYE exploratory factor analyses are:

1. There is not a truly general intellectual ability factor that emerges in the REDEYE sample. Rather, the intellectual ability factor that does emerge is more specialized; namely, "spatial-analytic."

2. The underlying factors that characterize men who remain in REDEYE field units well after the completion of AIT training (or equivalent) are, in order of importance: "spatial-analytic," "ability to work under stress," "anxiety," "happy-go-lucky, venturesome, outgoing," "assertiveness," "tender-minded, conscientious," and one unnamed factor. Together, the first four factors explain just under 50% of the total variance while all seven explain almost 67%.

The results of the canonical correlation analyses are:

1. General ability is a crucial factor in REDEYE performance, the effects of which mask other factors, also crucial to performance.

2. While "spatial-analytic" ability appears to best predict who remains in REDEYE units, the results of the canonical analysis suggest that when the

TABLE 26

SUMMARY OF MEANS AND STANDARD DEVIATIONS OF CANONICAL VARIATE SCORES BY APTITUDE PROFILE (BASED ON THE SOLUTION OF TABLE 25)

APTITUDE PROFILE	Canonical Variate Score from first set		Canonical Variate Score from second set	
	$\overline{X}$	SD	$\overline{X}$	SD
1 (n = 14)	1.100	.819	.726	.538
2 (n = 5)	.484	.770	.399	1.170
3 (n = 28)	-.607	.685	-.484	.921
4 (n = 14)	-.059	.773	.099	.999

masking effects of general ability are taken into consideration, "the ability to work under stress" best predicts REDEYE performance, particularly for retention. The "spatial-analytic" component is the next best predictor of performance, followed by the "happy- go-lucky, venturesome, outgoing" component the "anxiety" component and finally the "tender-minded, conscientious" component. Elements of no other identified factors (from the earlier factor analysis) were predictive of REDEYE performance. (Appendix E)

3. The results of the canonical correlation analyses support the existence of the aptitude profiles that were established in both the confirmatory phase of the REDEYE study and in the earlier Sullivan et al. (1978) studies. This was demonstrated by the distribution of the canonical variate scores across aptitude profiles and by the fact that at least one of the two measures for each construct that made up each aptitude profile survived into the second canonical correlation analysis. The measures which were used to establish aptitude profiles during the confirmatory analysis, which were also a part of the significant canonical variate pair, were: V5 (Closure Flexibility), V10 (GEFT), V11 (Pursuit), V16 (16PF- FB), and V30 (16PF-FQ4).

4. The presence of two "ability to work under stress" variables (V3 & V4) in the final canonical analysis suggests that the ability to work under stress may be as important to aptitude profiles as are the other components of the aptitude profiles.

CHAPTER IV

CHAPARRAL AND VULCAN TRAINING ANALYSIS

CHAPARRAL is a self-propelled, short-range, surface-to-air, infrared seeking guided missile system which provides air defense to forward combat elements against low altitude air threats. The CHAPARRAL weapon system consists of a launching station (M54) mounted on an unarmored, full-tracked vehicle (M730). The launching station can be removed and used independently of the M730 carrier. In either configuration, the missile launch station carries 12 missiles, four on the launch rails and eight in storage compartments. The CHAPARRAL squad, consisting of five men: a squad leader, senior gunner, prime mover driver, and two gunners, is needed to operate the system. Within any given unit qualified CHAPARRAL crewmen should be able to expertly perform the duties of their own assigned duty position as well as those of all other squad positions (FM 44-3, 1977; FM 44-4, 1971).

VULCAN is an air defense gun system that is used to counter low-altitude air threats. It is effective against high-performance aircraft, slower fixed-wing aircraft, and helicopters that are within its range capabilities. It can also be used to provide ground fires under certain conditions. VULCAN comes in two versions: the Self-Propelled (SP) VULCAN and the Towed VULCAN. Both versions consist of a 6-barrel, 20-mm Gatling-type gun (cannon) with variable firing rate capability, an onboard Range-Only Radar (ROR) system that provides information for the fire control system, and a mount appropriate to the particular version of the weapon. The SP VULCAN's cannon is mounted on a full-tracked M741 carrier, while the towed VULCAN gun system is mounted on an M42 gun carriage, which, in turn, is typically attached to a two-wheel trailer carriage. The towed version is usually moved by a 1 1/4 ton truck, the M561 Gama Goat, but can also be moved by other vehicles. The towed VULCAN carries less ready-to-fire ammunition than the SP VULCAN. Either VULCAN gun system is manned by a squad of four men: a squad leader, senior gunner, prime mover driver, and gunner. As with the CHAPARRAL system, qualified VULCAN crewmen in any given unit should be able to expertly perform all of the duties of their own and all other squad positions (FM 44-3, 1977; FM 44-100, 1970).

CHAPARRAL or VULCAN squads are similarly organized into platoons with four squads per platoon. A CHAPARRAL or VULCAN battery, in turn, consists of three platoons. An air defense artillery (ADA) CHAPARRAL/VULCAN (C/V) battalion consists of two SP VULCAN batteries and two CHAPARRAL batteries along with all the other logistical and administrative support normally attached to an ADA battalion.

The purpose of the C/V analysis was to identify areas of training difficulty in current Advanced Individual Training (AIT) programs, to analyze current AIT performance data as a function of population specific aptitude patterns, and to synthesize both sets of information in order to be able to suggest possible population specific instructional strategy applications for some of the critical tasks that C/V crewmen must perform.

If the aptitude patterns in the CHAPARRAL and VULCAN samples which best explained AIT performance were the same or similar to the aptitude profiles identified in the REDEYE Study, there would then be some support for the generalizability of those profiles across tasks. If this occurred, it would suggest that the instructional strategies designed for REDEYE gunners with the different aptitude profiles might also be applicable to CHAPARRAL and VULCAN crewmen who had the same profiles.

However, if the already identified aptitude profiles did not exist in the CHAPARRAL and VULCAN samples, then it would be necessary to investigate the relationships between aptitude measures from the entire test battery and the various kinds of C/V AIT performance. The results of such an investigation would theoretically point toward other aptitude profiles that would be empirically related to criterion performance specific to CHAPARRAL and VULCAN. Research on instructional strategies for people with varying levels of the aptitudes for the "new" profiles would then be synthesized in order to suggest unique strategies for C/V trainees who had these newly-suggested profiles.

Current Advanced Individual Training (AIT)

The general consensus from the instructors interviewed at the Air Defense School at Fort Bliss, Texas was that individuals completing AIT for CHAPARRAL (16P) or VULCAN (16R) could not perform the duties at all squad positions expertly, nor were they expected to do so. In fact, in most cases, all C/V trainees were never even given the opportunity to practice duties at every position, let alone become proficient at every position. Indeed, the function of C/V AIT is apparently to set the foundations of knowledge in the MOS and not to perfect squad level performance. There are many differences of opinion though, on just how much (or little) "ought" to be expected for AIT performance.

Some C/V AIT instructors had previously been squad leaders in the field. As squad leaders responsible for the efficient operation of a fire unit and the training of other squad members, these AIT instructors had expected that their new squad members would have had more knowledge and skill at each squad position than was evident when the men had reported for duty, from AIT. As AIT instructors, these same men stated that it was impossible to train new AIT trainees to the proficiency level that would be necessary to maintain an acceptable unit proficiency in the field. They indicated that only the squad leader in each unit could provide enough individual assistance to squad members to allow expert proficiency at each position to be reached by all squad members.

These instructors recognized the difficulties inherent in both AIT and unit level training because they were experienced in both. They also conceded that today's AIT candidate is more difficult to train than was yesterday's, and that many tasks that are most critical to efficient CHAPARRAL or VULCAN performance were not emphasized enough in AIT. These same tasks, if they were practiced in AIT, were often not evaluated by the same high standards as they would be if they were being tested in a field unit. Sometimes, they were not evaluated at all in AIT.

Emphasis for the present research was to be given to the identification of complex procedural tasks performed under temporal stress and to the determination of their significance to weapon system effectiveness. According to the AIT instructors interviewed, and from selected observations of AIT made by the investigators, critical procedural tasks that must be performed under time pressure are not present in current AIT. The emphasis for such critical tasks in AIT is on safety and knowledge of the procedure(s) rather than on performance according to the timed unit level standard.

Temporal stress appears to be critical--but not in AIT. Temporal stress apparently does not enter into the performance equation until the AIT graduate reaches his first assignment in the field. This lack of experience in performing critical procedural team tasks under a time pressure could be the reason for the low level of unit proficiency in the field. The new squad members are faced with a new demand that had previously been optional. Not only do they have to do everything right and safely, (as in AIT), but they also have to do it within a time limit (now that they are attached to a field unit). When behaviors that are taught do not match the behaviors that are expected, it is not surprising that many people do not meet the expectations. Perhaps some level of time pressure should be placed on AIT students for at least some of the critical tasks so that such pressure is not totally new when they reach their first unit assignment.

There was general agreement among all AIT instructors that these complex procedural tasks performed under a time pressure were the most important determiners of weapon system effectiveness. Yet, this very important component was left out of AIT training, almost completely.

Prerequisite to performing these complex tasks under time pressure, a soldier has to know a vast amount of cognitive information about the weapon system. If he does not know the various parts to his equipment and how each one functions, he would find it difficult to carry out any one of a number of complex procedures. It was clear that the cognitive demand placed on C/V crewmen was greater than that placed on REDEYE gunners, at least in some areas.

In CHAPARRAL AIT, emphasis is placed on learning:

- the components that make up the system
- visual aircraft recognition
- how to pre-energize and energize the launch station
- how to perform maintenance on the various components of the system
- how to load and unload missiles
- how to maintain effective communications
- how to do map reading
- how to track and engage aircraft while in the mount
- how to execute squad drills

The last item noted above is considered the most important one to know how to do, yet it is the only one that is considered optional during AIT training. There is seldom enough time during AIT to be able to practice squad drills Many trainees never practice squad drills until they reach their first assignment.

In VULCAN AIT training, emphasis is placed on learning:

- the component parts of the system
- visual aircraft recognition
- how to do boresighting and alignment
- how to change radar frequency
- how to operate the vehicle
- how to fire the weapon itself
- how to load and unload ammunition to the storage drum

More "hands-on" practice seemed to be given to loading ammunition than to any other skill area. However, boresighting and changing radar frequency were considered as the two most important performances, with loading almost as important. In addition, actual operation of the vehicle was considered essential for acceptable proficiency.

For both CHAPARRAL and VULCAN, both written and proficiency testing was done, but more confidence seemed to be placed in written testing than in performance testing. Instructors claimed that "hands-on" performance was most important. However, in practice, they seemed to base their judgments about trainees more on written performance than on performance during proficiency testing.

It was also determined that a trainee was seldom failed after proficiency testing if he had "tried hard" and if he was cooperative as a team member--even if he did not meet the established proficiency criteria. This was especially true if he had done well on written testing that covered similar content material. The consensus among AIT instructors suggested that motivation and ability to work on a team were the most important aspects of being a successful C/V crewman. A considerable number of the critical tasks for both weapon systems demands the efforts of more than one person at a time, so team work is essential for acceptable performance.

Methodology

The Population

The samples consisted of several 16P and 16R AIT classes in training at Fort Bliss, Texas, during July and August of 1979. Independent measures were collected on 36 16P men during July and 37 more during August for a total of 73 16P soldiers. By the time all dependent measures had been collected, the number of subjects for whom there was complete (or almost complete) data was 67. These 67 soldiers represented the CHAPARRAL population.

During July 1979, independent measures were collected on 25 16R soldiers. The same measures were collected for 69 other men during August for a total of 94 16R soldiers. By the time all dependent measures for these men had been collected, there was complete (or almost complete) data on only 61 of them. These 61 soldiers represented the VULCAN sample.

For both CHAPARRAL and VULCAN, the number of cases that could be analyzed would vary greatly, depending on which measures might be submitted for analysis. So that all analyses could be performed on the same data, it was decided to utilize only those cases in each of the C/V samples for whom there were complete aptitude test scores, Army dependent measure scores, and rating scale measures (designed by the investigators). Explanations for the various measures follow.

Measuring Instruments for Aptitudes

The same battery of aptitude tests was given to both 16P and 16R trainees. It consisted of all of the measures used in the aptitude battery for the REDEYE Study plus the Guilford-Zimmerman Test of Perceptual Speed. This test is one subtest of the Guilford-Zimmerman Aptitude Survey. It tests the "ability to perceive detailed visual objects quickly and accurately" (Guilford & Zimmerman, 1956, p.2). Independent measures collected from the Army included the

Armed Forces Qualification Test (AFQT) and the 12 raw scores from the Armed Services Vocational Aptitude Battery (ASVAB). See Chapter III for explanations of those measures that are identical to the ones used in the REDEYE Study. See Bloedorn (1979) for explanations of the measures collected from the Army. See Table 27 for a short summary of all independent variables for the 16P and 16R analyses. Included on the table is the variable name used for computer input, the label associated with each variable name, and an extended label that more clearly identifies each variable (when applicable).

Dependent Measures

When faced with the task of identifying dependent measures that would be sensitive to actual differences in written and proficiency performance, and which could accurately measure the competencies thought to be critical for C/V crewmen, the investigators learned that existing C/V dependent measures often did not test the areas of interest independently or objectively. For example, boresighting was considered one of the most important VULCAN crew competencies, but, in a written test of that content, there were also items concerning changing radar frequency, water crossing operations, and the M561 Gama Goat. The data collected from the AIT instructors did not distinguish between subscores on the tests. Consequently, inferences about what might predict success in boresighting would be difficult to make because of the contaminated nature of the written measure concerning it. There were other problems with the performance measures for boresighting (or any other area for VULCAN).

All VULCAN skill performance measures were in the form of proficiency tests. There were four proficiency tests and a final proficiency test. Within each proficiency test were two or three independent subtests. Even though each subtest was independent of any other, the scoring consisted of a somewhat nebulous "go" or "no go" for each subtest. A "go" meant that the trainee performed an entire series of from 15 to 45+ steps correctly (depending on the subtest)--all on the first try. A "no go" meant that a trainee had performed at least one of the 15-45+ steps improperly on the first try. It could have meant that he performed more than one step incorrectly.

There was often no way to determine whether a soldier had performed all of the steps in a long series (except the last one) correctly, or if he had started out wrong, never even knowing how to begin. Although actual proficiency in both cases would be measured as "no go," it is clear that the two levels of performance would be entirely different.

TABLE 27

SUMMARY OF INDEPENDENT VARIABLES COLLECTED FROM 16P AND 16R TRAINEES

Variable Name	Variable Label	Extended Label
V1	Age	
V2	Word	From the Press Test
V3	Color	From the Press Test
V4	Wintc	From the Press Test (Color naming with distraction)
V5	Clflex	Closure Flexibility
V6	Clspd	Closure Speed
V7	LTH	Language Thurstone
V8	QTH	Quantitative Thurstone
V9	TTH	Total Thurstone
V10	GEFT	Group Embedded Figures Test
V11	Pursuit	From MacQuarrie Test
V12	State	State Anxiety
V13	Trait	Trait Anxiety
V14	2dim	Two Dimensional Spatial Relations
V15	FA	Reserved/Outgoing
V16	FB	Less Intell/More Intell
V17	FC	Affected by feelings/Emotionally Stable
V18	FE	Humble/Assertive
V19	FF	Sober/Happy-go-lucky
V20	FG	Expedient/Conscientious
V21	FH	Shy/Venturesome
V22	FI	Tough-minded/Tender-minded
V23	FL	Trusting/Suspicious
V24	FM	Practical/Imaginative
V25	FN	Forthright/Astute
V26	FO	Self-Assured/Apprehensive
V27	Q1	Conservative/Experimenting
V28	Q2	Group-dependent/Self-sufficient
V29	Q3	Undisciplined Self-conflict/Controlled
V30	Q4	Relaxed/Tense
V40	GZPS	Guilford Zimmerman Perceptual Speed
AR1	AFQT	Armed Forces Qualification Test
AR2	GI	General Information
AR3	NO	Numerical Operations
AR4	AD	Attention to Detail
AR5	WK	Word Knowledge
AR6	AR	Arithmetic Reasoning
AR7	SP	Space Perception
AR8	MK	Mathematics Knowledge
AR9	EI	Electronics Information
AR10	MC	Mechanical Comprehension
AR11	GS	General Science
AR12	SI	Shop Information
AR13	AI	Automotive Information

The scoring of proficiency testing was observed in selected instances for both CHAPARRAL and VULCAN at Fort Bliss. From those observations, it was learned that there was a very subjective element present within each testing situation observed--namely, the instructors allowed certain mistakes to be made without recording a "no go" while other mistakes were never allowed. The most critical errors seemed to always result in a "no go," but the less serious errors were seldom documented anywhere on the rating form. Conceivably, two trainees could both receive a "go" for one proficiency subtest, but their actual proficiency would not have been identical. For one of the men the "go" may have been the result of no errors (critical or trivial), while for the other, a "go" could have been the result of 5 out of 30 possible mistakes, none of which were serious enough to cause the trainer to mark "no go." Such ratings were based on the trainer's own subjective opinion of the importance of specific items to overall proficiency. These imprecise measures for proficiency performance existed for both CHAPARRAL and VULCAN, although the situation for the VULCAN tests seemed more serious.

On the CHAPARRAL proficiency tests, the scoring was slightly different, but also difficult to interpret. Each proficiency test consisted of about 20-45 different activities which may or may not have been procedurally connected to one another. If the trainee could perform all of the steps correctly on the first try, he received a score of 100. If he could not get them all right until the second attempt, he received a score of 90. A score of 80 points was given if he got everything right after three tries. If it took four or more tries to get everything right, the soldier received 70 points.

As with VULCAN proficiency testing, there was seldom a way to distinguish between different levels of proficiency with the available measures. Soldiers who each received identical scores of 90 could have had very different levels of expertise on their first attempt. First attempt written and proficiency performance had been of principal interest because that level of performance would have had the clearest implications for possible changes in instructional strategies. It was not possible to get precise first attempt measures. Because precise measures of performance were not an integral part of AIT training, it was realized that it could be very difficult to pinpoint the exact areas of training difficulty. Nevertheless, every effort was made to utilize the available performance measures in as judicious a way as possible.

In addition, a series of rating scales were developed that were intended to provide dependent measures on some of the other critical areas identified as important by the AIT instructors. The rating scales included measures for motivation, ability to work as a team member, decisiveness, ability to work under stress, verbal ability, and overall performance. Explanations of each scale and exact copies of the forms are presented in Appendix F. The rating scales were fashioned after those in Kelly, Wooldridge, Hennessy, Vreuls, Barnebey, Cotton, and Reed (1979). It had been intended that two different supervisors complete a rating form on each trainee--his drill sergeant and one AIT instructor. In practice, only the drill sergeants completed the forms.

For CHAPARRAL, drill sergeants rated almost all soldiers in the sample. This was not true for VULCAN. At least one drill sergeant refused to complete the forms and data on ratings for VULCAN trainees were collected on only 61 of the 88 men from whom all other independent and dependent measures had already been collected. Since the same rater did not fill out every form, it was necessary to calculate Z scores for each rater's ratings so that all of the ratings would be on a common metric. Therefore, it was the Z score ratings and not the raw score ratings themselves that were submitted to analyses.

All dependent measures for CHAPARRAL and VULCAN were to be collected by personnel at the Army Research Institute Field Unit at Fort Bliss. Originally, the investigators requested certain specific measures from the set of available dependent measures and certain others that might actually be available. These measures and the actual measures that were collected are documented in the next two sections of this report.

<u>CHAPARRAL Measures</u>. Based on the analysis of CHAPARRAL (16P) AIT training, certain written and performance/proficiency test scores were requested for each trainee. These were to be collected from measures that were known to exist in current AIT training. A listing of these tests, noting which ones were requested by the investigators, which ones were actually collected, and which were submitted to the first canonical correlation analysis is presented in Table 28. The variable names used for computer input are also listed on the table (if applicable). Some other measures were requested which were not identified positively as in existence, but which some AIT instructors indicated did, in fact, exist. These were:

- A final written test score
- A score for a "hands-on" driving test
- A score for a "hands-on" test of target engagement and employment.

It should be noted that as different phases of analysis progressed, some measures that were collected would be dropped from the analysis. In some cases, several measures

TABLE 28. SUMMARY OF EXISTING DEPENDENT MEASURES FOR CHAPARRAL (16P)

Variable Name For Computer Input	Variable Label	Extended Label	Requested	Actually Collected From All Classes	Submitted During First Canonical Correlation Analysis
Written Tests:					
WC1	MAPW	Map Reading	✓	✓	✓[a]
WC2	COMMOW	Communications	✓	✓	✓[a]
WC3	M730W	M730 Carrier/Communications	✓	✓	✓[a]
WC4	GENSUBW	General Subjects	✓	✓	✓[a]
Performance/ Proficiency Tests:					
	2A	M54 Location and Nomenclature of Components			
PC1	2B	Non-panel Controls and Indicators	✓	✓	
	2C	Master Control Panel and Indicators		✓	
	2D	Mount Panel Controls and Indicators		✓	
PC2	2E	M54 System Energizing	✓	✓	
	2F	PM Check on M54 Launching Station	✓		
	3A	Missile Unpacking and Packing	✓	✓	
PC3	3B	Preparation of Launch Rail and Missile Loading and Unloading	✓	✓	
	3C	Missile Checkout Procedure	✓	✓	
WC5	EOC CHAP	End of Course Final Proficiency Test	✓	✓	✓
	VACR	Visual Aircraft Recognition	✓		

[a]This individual measure of written performance was not submitted independently of every other written measure. It was submitted as part of a written composite that was intended to take the place of the nonexistent final written test.

were aggregated into a composite which was then submitted for analysis. Since there was no final written test for CHAPARRAL performance, it was decided to create a written composite which consisted of the sum of the four CHAPARRAL measures shown in Table 28.

VULCAN Measures. Based on the analysis of VULCAN (16R) AIT training, certain written and performance/ proficiency test scores were requested for each trainee. Some of these were to be collected from measures that were known to exist in current AIT training. A summary of these existing VULCAN dependent measures, noting which ones were requested, which ones were actually collected, and which ones were submitted to the first canonical correlation analysis is presented in Table 29. The variable names used for computer input are included on this table, if applicable. Since both written and proficiency tests for VULCAN consisted of more than one content area per test, the various content areas, per test, are now listed, with number of questions per content area where known. These are presented so that the difficulties of making inferences about precise areas of training difficulty can be more easily understood. First is the information about the written VULCAN tests.

Written VULCAN #1 (first week of AIT--total of 40 questions):

- General Subjects (10 questions)
- Controls & Indicators (10 questions)
- Operating the M163 SP VULCAN (15 questions)
- Chassis Trouble-shooting (5 questions)

Written VULCAN #2 (second week--total of 40 questions):

- Preventive Maintenance Checks and Services (PMCS) (15 questions)
- Corrective Action (5 questions)
- Auxiliary Power Unit (APU) (5 questions)
- Daily Armament System Checks (10 questions)
- Mount Trouble Shooting (5 questions)

Written VULCAN #3 (third week--total of 20 questions):

- Ammunition (5 questions)
- Sight Current Generator (5 questions)
- Towed VULCAN (M167) Emplacement (5 questions)
- M167 Interrupter (5 questions

Written VULCAN #4 (fourth week)--total of 30 questions):

- Boresighting (10 questions)
- Changing Radar Frequency (10 questions)
- Water Crossing Operations (5 questions)
- M561 Gama Goat (5 questions)

TABLE 29. SUMMARY OF EXISTING DEPENDENT MEASURES FOR VULCAN (16R)

Variable Name For Computer Input	Variable Label	Extended Label	Requested	Actually Collected From All Classes	Submitted During First Canonical Correlation Analysis
Written Tests:					
		Map Reading	✓		
WV1		Written Vulcan #1		✓	
WV2		Written Vulcan #2		✓	
WV3		Written Vulcan #3		✓	
WV4		Written Vulcan #4	✓[a]	✓	
WV5		Written Vulcan #5		✓	
WV6		Final Written Vulcan Test	✓	✓	✓
Proficiency Tests:					
	1A	Preventive Maintenance (PM) on Auxiliary Power Unit (APU)	✓	✓	✓[b]
	1B	PM Checks and Services (PMCS)	✓	✓	✓[b]
	1C	Daily Armament Checks	✓	✓	✓[b]
	2A	Boresighting	✓	✓	✓[b]
	2B	Changing Radar Frequency	✓	✓	✓[b]
	3A	Towed Emplacement		✓	✓[b]
	3B	Fire Interrupter		✓	✓[b]
	4A	Loading for SP Vulcan	✓	✓	✓[b]
	4B	Loading for Towed Vulcan	✓	✓	✓[b]
		Final Proficiency Test - Part 1	✓		
		Final Proficiency Test - Part 2	✓		
		Final Proficiency Test - Part 3	✓		
	VACR	Visual Aircraft Recognition	✓		

[a] Part of this test was requested (i.e., the sections on boresighting and changing radar frequency).

[b] This individual measure of proficiency was not submitted independently of every other proficiency measure. It was submitted as part of the proficiency composite score explained in the body of this manuscript.

Written VULCAN #5 (fifth week)--total of 25 questions):

- Communications (5 questions)
- M163 Ammmunition Load (10 questions)
- Ammunition Storage System (5 questions)
- M167 Ammunition Load (5 questions)

Final Written VULCAN Test--100 questions (included content from all of the five written tests outlined).

The following describes the VULCAN proficiency tests.

Proficiency Test #1

- APU
- PMCS Checklist #______
- Daily Armament System Check #______

Proficiency Test #2

- Boresighting
- Changing Radar Frequency

Proficiency Test #3

- Towed Emplacement
- Fire Interrupter

Proficiency Test #4

- M163 Load
- M167 Load

Final Proficiency Test

- (to be determined)
- (to be determined)
- (to be determined)

A count of the various proficiency subtests yields 12 different measures. Because of the vague nature of each measure, it was decided that (1) none of the three subtests for final proficiency would be utilized in the data analysis, and (2) the remaining nine subtest measures would be aggregated into one proficiency composite measure. This composite would be based on the total number of "go's" across the remaining subtests. Operationally, this meant that the highest score a person could get on the proficiency composite measure was nine--one "go" for each subtest.

As with the CHAPARRAL dependent measures, some measures requested for VULCAN were not positively identified as existing, although there were indications that they might have existed. These measures were:

- "Hands-on" test of target engagement and employment
- "Hands-on" driving test.

No measures for target engagement and employment or for driving were made available.

Statistical Analysis

Before any other analysis was undertaken, a count was made of the numbers of soldiers who possessed the various Aptitude Profiles that had been identified in the REDEYE sample. This was done separately for both the CHAPARRAL and VULCAN samples. The exact same criteria for membership in each Profile Group was applied here as was applied in the REDEYE study. The criteria were explained in Chapter III and will not be repeated here. Because of the large number of soldiers in the C/V samples who had the default profile (i.e., they could not be categorized), the analysis progressed according to the pattern that occurred for the exploratory REDEYE analysis.

The data collected were analyzed using factor analyses and canonical correlation analyses. The individual aptitude measures from the test battery were submitted to the factor analyses in order to investigate the underlying structure of abilities in the C/V samples and to compare the structure of abilities between the three samples. The aptitude measures collected from the Army (AFQT and ASVAB) were not included in the factor analyses because these scores were not available for the REDEYE sample. All factor analyses for the three samples could then be based on essentially the same variables.

Twenty-nine independent variables were submitted to the first factor analysis for each sample (i.e., C/V). The perceptual speed test was the only measure in the C/V samples that had not been in the REDEYE analysis. As with the REDEYE analysis, the principal component solution (principal factoring without iteration) produced an orthogonal factor matrix which was rotated by the varimax method. The number of factors was unrestricted in the first analysis. A scree analysis was performed to help suggest how to restrict the number of factors to be extracted. Separate factor analyses were performed, using the same factoring and rotation methods on the same variables but restricting the number of factors to four, five, seven, and eight for VULCAN and to four, five, and seven for CHAPARRAL. Simple structure analyses were then performed on each solution in order to determine the most meaningful one. The final solution for each sample was interpreted independently of any solution for the other sample and then again in light of the solutions for the other two samples.

Again, paralleling what transpired in the REDEYE exploratory analyses, two separate canonical correlation analyses were conducted for VULCAN and two for CHAPARRAL. The first included all twenty-nine variables from the factor analyses for the first set in the canonical analysis with selected variables for the second set (dependent). The dependent measures for each of the analyses will be explained under the "Analysis" section of this chapter. A second canonical correlation analysis was performed after the one just outlined, for both C/V. In each case, the second canonical analysis was based on the first one and was intended to take into consideration the masking influence of general ability.

Analysis and Results

This section presents a descriptive summary of the raw score data including the distribution of the CHAPARRAL and VULCAN samples on the "original" aptitude profile categories. The results of the factor analyses and canonical correlation analyses are also summarized. First will be a discussion on the aptitude profiles. After that will be the CHAPARRAL analysis and results, and finally, the VULCAN analysis and results. A discussion of the summaries, conclusions, and recommendations for future research, sensitive to comparisons between results from all three samples, will be presented in the last chapter of this report.

Aptitude Profiles

All aptitude test measures were scored for both CHAPARRAL and VULCAN soldiers. Based on those scores, a count was taken to see how many men fit the original aptitude profiles that had been identified in the REDEYE studies. A summary of the number of people who fit each aptitude profile for REDEYE, CHAPARRAL, and VULCAN samples is presented in Table 30.

One of the purposes of the C/V analyses was to see if the same or similar aptitude profiles existed in the C/V population as exist in the REDEYE sample. The data of Table 30 helps to achieve this purpose. The table shows the total number of soldiers in each sample (*N*), the number of soldiers with each profile (*n*), and the percentage of the total *N* for a particular sample who had each profile. A quick look at the totals shows that the patterns in the C/V samples are not the same as were found in the REDEYE group.

TABLE 30

SUMMARY OF APTITUDE PROFILE MEMBERSHIP BY SAMPLE

SAMPLE	Profile 1		Profile 2		Profile 3		Profile 4	
	n	% of N	n	% of N	n	% of N	n	% of N
REDEYE (N=87)	16	18.4%	14	16.1%	36	41.3%	21	24.1%
CHAPARRAL (N=67)	6	9.0%	6	9.0%	30	44.7%	25	37.3%
VULCAN (N=61)	2	3.3%	11	18%	22	36.1%	26	42.6%

The differences in profile distribution suggest that the training environment itself has some effect on the development of the profile. All REDEYE, CHAPARRAL, and VULCAN trainees are selected from the same population and there was no reason to expect such wide variance in profile distribution. It should be noted that the REDEYE population had been in the task for about a year and that the other two groups had not yet finished training.

It is quite clear that the frequency of Profile 3 is independent of the task and represents a fairly constant portion of the population. In a sense then, Profile 3 could be said to be generalizable. Profiles 1 and 2 disperse very differently for CHAPARRAL than they do for either REDEYE or VULCAN and Profile 1 loses significance for VULCAN. This has more meaning when one compares the results of all REDEYE, CHAPARRAL, and VULCAN analyses (see Chapter V). The components which contribute to Profile 1, Spatial-analytic, are the least important in predicting VULCAN training performance.

CHAPARRAL

Analysis. All analyses were conducted on the subfile of cases for whom there were ratings, as well as all other dependent measures and measures from the aptitude-test battery. The ratings were described earlier in this manuscript. It had been expected that the ratings made by drill instructors for different aspects of performance might provide more accurate dependent measures than some of the measures collected by the Army. However, the rating scales themselves appeared to have little variance between scales. Therefore, the overall rating scale (ZR6) was used in lieu of any of the others.

Just as with the REDEYE analysis, the number of cases (67) in this analysis is small. The results of the CHAPARRAL analysis should be considered tentative and exploratory in nature. However, if the analyses of CHAPARRAL data, REDEYE data, and VULCAN data each independently point toward a similar direction, then the small sample sizes will not be as limiting as if there had been only one small sample to begin with. If any similar patterns exist in the three small samples, it would provide support for the patterns that would otherwise have to come from a larger sample.

The tests for the aptitude-test battery were scored for all soldiers. The rating scales were scored too. The measures for ratings were standardized by rater so that all ratings would be on a common metric. Performance and written test scores were collected by the Army. A summary of the means, standard deviations, and number of cases on which each measure was based is presented in Table 31. No summary is included in this table for the ratings because for all of them, the mean was 0 and the standard deviation 1. Refer back to Tables 27-29 for descriptions of each measure.

A series of factor analyses was conducted according to the same procedures outlined for the REDEYE exploratory analysis. These were done in order to investigate the underlying structure of the aptitude variables in this sample population. All measures in the aptitude test battery with the exception of the Total Thurstone were submitted to analysis. The correlation matrix upon which the factor analyses were based is presented in Appendix D.

The number of factors was unrestricted in the first factor analysis. A summary of the eigenvalues, percent of variance explained, and cumulative percent of variance for both significant and nonsignificant factors is presented in Table 32. The factor matrix, before rotation by the varimax method is presented in Table 33. It yielded nine factors with an eigenvalue greater than one. Also in Table 33 is the rotated factor matrix, followed by the transformation matrix. Recall that the latter indicates the correlations between factors. A scree analysis suggested that the number of factors should be restricted.

Separate factor analyses were conducted restricting the number of factors to four, five, and seven. Simple structure analyses were performed on each varimax rotated factor matrix. The results of these analyses, coupled with the simple structure analyses that were made concurrently for REDEYE and VULCAN data, indicated that the matrix restricted to seven factors would provide the most meaningful solution and the one that could be compared most easily with the other solutions for the other samples. This solution adhered to the five principles of simple structure already mentioned earlier in this report. Both the unrotated and the rotated matrices for the seven factor solution are presented in Table 34, along with the transformation matrix for the factors.

The same criteria for interpretation of loadings was applied to the CHAPARRAL data as was applied to the REDEYE data. Positive or negative loadings of .5 or greater were considered high loadings, those between .2 and .5 were considered substantial loadings, and those with less than .2 were considered as zero or near zero loadings.

For easier interpretation of the factors, a hierarchical listing of variables that load on each factor is presented in Table 35. In order to save space, only the loadings of ± .30 or greater are shown on the table. If there were other loadings between .2 and .3, a note to that

TABLE 31

SUMMARY OF MEANS AND STANDARD DEVIATIONS FOR CHAPARRAL INDEPENDENT AND DEPENDENT VARIABLES

VARIABLES..	LABELS..	MEAN	STANDARD DEV	CASES
V2	WORD	60.5224	16.6636	67
V3	COLOR	60.4776	13.2520	67
V4	WINTC	51.2090	12.4408	67
V5	CLFLEX	31.5672	23.8557	67
V6	CLSPD	8.3731	5.3480	67
V7	LTH	17.4328	10.0321	67
V8	QTH	14.6716	7.5986	67
V10	GEFT	5.8209	5.3397	67
V11	PURSUIT	16.6269	7.0514	67
V12	STATE	43.8657	11.3909	67
V13	TRAIT	41.8507	10.3766	67
V14	[illegible]DIM	10.7015	6.4244	67
V15	FA	6.5373	2.2247	67
V16	FB	3.4030	1.5380	67
V17	FC	6.5075	2.6307	67
V18	FE	5.8955	1.9628	67
V19	FF	6.6716	2.0029	67
V20	FG	7.7164	2.2751	67
V21	FH	6.1194	2.3128	67
V22	FI	5.0746	1.8448	67
V23	FL	6.7910	1.8385	67
V24	FM	5.2388	1.7502	67
V25	FN	6.0448	1.6826	67
V26	FO	6.1791	2.3672	67
V27	Q1	6.5373	1.9332	67
V28	Q2	5.3433	1.8303	67
V29	Q3	6.8657	2.0663	67
V30	Q4	5.5224	2.1345	67
V40	GZPS	32.1492	11.3033	67
WC1	MAPW	8.5970	1.3933	67
WC2	COMMOW	90.0000	10.9751	67
WC3	M730W	92.0149	7.3885	67
WC4	GENSUBW	86.1791	10.5067	67
WC5	FOC CHAP	86.6418	11.9464	67
PC1	2B	9.1343	0.8509	67
PC2	2E	9.0896	0.9000	67
PC3	3B	9.1194	0.7076	67

TABLE 32

SUMMARY STATISTICS FOR ALL FACTORS IN UNROTATED FACTOR ANALYSIS OF 67 CHAPARRAL CASES

VARIABLE	VALUE USED IN DIAGONAL	FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
V2	1.00000	1	5.40950	18.7	18.7
V3	1.00000	2	3.32790	11.5	30.1
V4	1.00000	3	2.43786	8.4	38.5
V5	1.00000	4	1.82425	6.3	44.8
V6	1.00000	5	1.65370	5.7	50.5
V7	1.00000	6	1.49648	5.2	55.7
V8	1.00000	7	1.43688	5.0	60.6
V10	1.00000	8	1.33528	4.6	65.2
V11	1.00000	9	1.21469	4.2	69.4
V12	1.00000	10	0.99857	3.4	72.9
V13	1.00000	11	0.95672	3.3	76.2
V14	1.00000	12	0.87958	3.0	79.2
V15	1.00000	13	0.77381	2.7	81.9
V16	1.00000	14	0.70291	2.4	84.3
V17	1.00000	15	0.63342	2.2	86.5
V18	1.00000	16	0.55705	1.9	88.4
V19	1.00000	17	0.52616	1.8	90.2
V20	1.00000	18	0.45639	1.6	91.8
V21	1.00000	19	0.42578	1.5	93.3
V22	1.00000	20	0.34496	1.2	94.5
V23	1.00000	21	0.29929	1.0	95.5
V24	1.00000	22	0.28205	1.0	96.5
V25	1.00000	23	0.25450	0.9	97.3
V26	1.00000	24	0.21429	0.7	98.1
V27	1.00000	25	0.17378	0.6	98.7
V28	1.00000	26	0.13480	0.5	99.1
V29	1.00000	27	0.10958	0.4	99.5
V30	1.00000	28	0.08656	0.3	99.8
V40	1.00000	29	0.05328	0.2	100.0

TABLE 33

FACTOR MATRICES (UNRESTRICTED) FOR CHAPARRAL DATA (N=67)

FACTOR MATRIX USING PRINCIPAL FACTOR, NO ITERATIONS

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	COMMUNALITY
V2	0.61929	-0.01918	0.51743	-0.00347	-0.08046	0.00342	0.01768	0.00032	-0.22129	0.79740
V3	0.69809	0.10801	0.38295	0.14203	-0.09197	-0.30585	0.03753	-0.07475	0.20886	0.81857
V4	0.63919	0.08108	0.46796	0.07268	-0.04222	-0.14767	0.09898	-0.25214	0.16729	0.76436
V5	0.31732	0.42535	0.07752	-0.38097	0.02561	0.37135	0.03504	-0.32183	0.10810	0.68746
V6	0.62130	0.27887	-0.07360	-0.14958	-0.09415	0.05235	0.04164	-0.02453	-0.08670	0.51330
V7	0.44883	0.55131	-0.12814	0.32878	-0.27288	0.19281	-0.02917	0.28213	-0.07519	0.87455
V8	0.51916	0.51752	-0.31963	0.23058	-0.03139	0.16176	-0.09405	0.15047	0.02016	0.75172
V10	0.55065	0.45305	-0.26583	-0.34054	0.70684	0.11428	-0.04802	-0.13142	0.08126	0.77713
V11	0.48911	0.27044	0.12308	0.33328	0.25927	-0.12315	-0.04352	-0.05020	0.05414	0.50867
V12	-0.62607	0.40998	0.11272	0.25816	-0.16012	0.23241	0.04466	-0.25057	-0.17297	0.81368
V13	-0.60417	0.40105	0.18347	0.21123	0.05352	0.71428	-0.12991	-0.22297	-0.01782	0.81696
V14	0.38435	-0.02661	-0.39281	0.18411	0.35280	0.13179	-0.11667	0.35539	0.43531	0.77138
V15	-0.05984	-0.50237	0.27977	0.14960	0.33240	0.42024	-0.06044	0.07221	-0.11199	0.66510
V16	0.35292	0.38603	-0.45729	0.11110	-0.22256	0.02904	-0.00040	0.08391	-0.09872	0.54667
V17	0.46743	-0.52941	-0.06769	-0.27797	0.04001	-0.26208	-0.19263	0.02833	0.09935	0.86751
V18	-0.38077	0.29994	-0.70275	-0.50600	0.27311	-0.13640	0.27958	0.17947	0.14331	0.75510
V19	0.20572	-0.05136	-0.21200	-0.15711	-0.21046	0.42372	0.55160	-0.08925	0.27603	0.72665
V20	0.11886	-0.31862	-0.37423	0.56753	0.04570	-0.10544	0.04038	-0.18367	0.01492	0.63105
V21	0.28637	-0.39944	0.21267	-0.17239	-0.17893	0.41865	0.20179	0.33735	-0.26316	0.77150
V22	-0.05954	-0.03782	0.36152	0.27705	-0.37280	0.08171	0.41009	0.02872	0.37965	0.67141
V23	-0.11967	0.40093	-0.19130	0.13159	-0.08094	-0.49100	0.32308	0.07193	-0.24088	0.54418
V24	0.14447	0.01518	0.15842	-0.08653	0.41873	-0.16618	0.57563	-0.25514	-0.03146	0.66689
V25	-0.10424	0.03888	0.39371	0.29770	0.26191	0.00767	0.04140	0.38714	0.34774	0.55717
V26	-0.43879	0.37531	-0.08855	0.07018	0.30264	-0.02738	-0.01597	-0.15960	0.17321	0.54487
V27	0.07557	0.13045	0.00989	0.15987	0.42348	-0.00895	0.45881	0.33530	-0.45394	0.75656
V28	0.01547	0.38410	0.40472	-0.23931	-0.30886	-0.27283	-0.11715	0.21944	-0.04990	0.60470
V29	0.45376	-0.38085	-0.25949	0.28830	0.01435	0.34899	0.05584	-0.42428	-0.13073	[illegible]
V30	-0.43127	0.41383	0.38707	0.04503	0.07608	0.37188	-0.05026	0.05401	0.12080	[illegible]
V40	0.53244	0.32277	0.33708	-0.02307	0.45911	0.16107	-0.26079	-0.10415	-0.21087	[illegible]

VARIMAX [redacted] FACTOR MATRIX

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9
V2	-0.21795	0.68691	0.09043	0.07112	-0.13663	0.35462	0.09936	-0.03693	-0.13886
V3	-0.28456	0.82150	0.14948	0.34013	-0.05484	-0.11888	-0.02281	0.11186	0.09286
V4	-0.16699	0.82286	0.00717	0.19793	0.00183	-0.01417	-0.00832	0.14679	0.00551
V5	0.10906	0.18712	0.14713	0.76306	-0.12287	0.04447	-0.07293	0.08196	-0.09377
V6	-0.26391	0.30400	0.44155	0.36830	-0.04561	0.37062	0.06935	-0.00235	-0.12029
V7	0.10548	0.22946	0.85958	0.02762	-0.07445	0.07100	0.01645	0.00645	0.07804
V8	-0.00998	0.15899	0.78900	0.23081	0.09087	-0.06614	0.01631	-0.07064	0.18070
V10	-0.20687	0.17178	0.38964	0.71294	-0.02276	-0.16958	0.06080	-0.15090	0.06058
V11	-0.01609	0.53586	0.24412	0.07544	0.17429	-0.39260	0.14321	-0.16466	0.25962
V12	0.84632	-0.16541	0.01210	-0.08301	-0.03737	-0.34428	-0.02111	0.06616	-0.23419
V13	-0.88837	-0.17229	-0.13936	-0.02706	-0.09128	-0.08302	-0.10274	-0.08507	-0.00468
V14	-0.32295	-0.06571	0.31130	0.13543	0.22169	-0.31124	-0.03196	-0.03702	0.70395
V15	0.04819	-0.00864	-0.36083	-0.07535	0.23662	0.63476	0.04920	-0.11033	0.23090
V16	-0.10378	-0.03612	0.69094	0.10952	0.10068	-0.15602	0.01382	0.00892	-0.10216
V17	-0.76230	0.14645	-0.18441	0.02253	0.09631	0.03486	-0.17493	-0.13755	0.01813
V18	0.02725	-0.44088	-0.15622	0.28332	-0.34096	-0.36888	0.33617	0.05603	0.12606
V19	-0.13160	-0.13402	0.12943	0.39071	0.17439	0.13588	0.07040	0.68368	-0.02718
V20	-0.08762	0.07387	0.09470	-0.29615	0.71260	-0.11867	0.03599	0.04208	0.08595
V21	-0.31664	0.01138	0.07819	-0.00974	-0.11220	0.76299	0.12473	0.22408	-0.10862
V22	0.19375	0.27024	-0.06435	-0.21810	-0.06387	0.05213	-0.08178	0.69891	0.10018
V23	0.10747	-0.01985	0.26312	-0.24007	-0.11643	-0.49949	0.43705	0.01697	-0.22586
V24	-0.03858	0.25600	-0.30903	0.76780	0.14201	-0.15413	0.59584	0.14798	-0.00585
V25	0.18725	0.19172	-0.11924	-0.24078	-0.18967	0.38966	0.09979	0.10132	0.82382
V26	0.82135	-0.23202	-0.13421	0.11763	-0.01300	-0.37092	0.06210	-0.10464	0.19961
V27	0.04388	-0.00997	0.15130	-0.08909	0.01310	0.17298	0.82050	-0.10974	0.09134
V28	0.04385	0.76356	0.11772	-0.08776	-0.68481	-0.10770	-0.05560	-0.03688	-0.16384
V29	-0.26075	0.22971	0.07195	0.05846	0.71624	0.38158	-0.02372	-0.00499	-0.19659
V30	0.58146	0.03703	-0.12124	-0.30672	-0.39453	-0.06457	-0.00386	-0.00371	0.17412
V40	0.05973	0.53960	0.14380	0.44311	-0.04183	0.23399	0.15669	-0.49895	0.15167

TRANSFORMATION MATRIX

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9
FACTOR 1	-0.56999	0.59201	0.42291	0.30330	0.16576	0.14817	0.04294	-0.02110	0.04839
FACTOR 2	0.51608	0.12976	0.53352	0.33093	-0.38394	-0.37800	0.14333	-0.00406	0.02729
FACTOR 3	0.25901	0.64634	-0.42583	-0.10188	-0.45150	0.33877	0.01224	0.05353	0.03773
FACTOR 4	0.39578	0.28954	0.28727	-0.54440	0.51801	0.01620	0.02743	0.03836	0.25742
FACTOR 5	0.04668	-0.02142	-0.32495	0.29521	0.21699	-0.02671	0.48255	-0.48827	0.53541
FACTOR 6	0.32634	-0.24047	0.16797	0.42593	0.16026	0.72218	-0.15797	0.19690	0.12257
FACTOR 7	-0.00887	-0.01223	-0.07633	0.08046	0.08988	-0.05634	0.69535	0.69600	-0.10859
FACTOR 8	-0.26713	-0.26417	0.32982	-0.40449	-0.50215	0.27373	0.21461	0.09503	0.46212
FACTOR 9	-0.00606	0.05133	-0.15660	0.17235	-0.01988	-0.34645	-0.43518	0.47590	0.83443

TABLE 34

FACTOR MATRICES (RESTRICTED TO SEVEN FACTORS) FOR CHAPARRAL DATA (N=67)

FACTOR MATRIX USING PRINCIPAL FACTOR, NO ITERATIONS

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	COMMUNALITY
V2	0.61929	-0.01910	0.51743	-0.00347	-0.08046	0.00342	0.01768	0.65843
V3	0.69809	0.10891	0.38295	0.14203	-0.09197	-0.30545	0.03753	0.76943
V4	0.63919	0.06108	0.40796	0.07268	-0.04222	-0.14767	0.09898	0.67280
V5	0.31732	0.42535	0.07752	-0.38052	0.02561	0.37135	0.03504	0.57220
V6	0.62130	0.27882	-0.07360	-0.14488	-0.09415	0.05235	0.04164	0.50488
V7	0.44083	0.55131	-0.12814	0.32678	-0.27288	0.19281	-0.02917	0.73924
V8	0.51916	0.51752	-0.31963	0.23058	-0.03139	0.16176	-0.09405	0.72868
V10	0.55065	0.45305	-0.26583	-0.34054	0.20684	0.11428	-0.04802	0.75325
V11	0.48911	0.22044	0.12306	0.33328	0.25927	-0.12315	-0.04352	0.50100
V12	-0.62607	0.40990	0.11272	0.25816	-0.10012	0.23241	0.04466	0.72097
V13	-0.64437	0.40105	0.16347	0.21123	0.05352	0.21428	-0.12991	0.78693
V14	0.38435	-0.02861	-0.35281	0.16411	0.35280	0.13179	-0.11067	0.45528
V15	-0.05984	-0.50232	0.27977	0.14960	0.33246	0.42024	-0.06044	0.64735
V16	0.35242	0.36603	-0.45729	0.11110	-0.22256	0.02804	-0.00040	0.52995
V17	0.46743	-0.52841	-0.06769	-0.27797	0.04001	-0.26206	-0.19263	0.68694
V18	-0.38092	0.29994	-0.20275	-0.50600	0.27311	-0.13640	0.27958	0.70357
V19	0.20532	-0.05106	-0.21200	-0.15711	-0.21046	0.42372	0.55160	0.64249
V20	0.11846	-0.31002	-0.37420	0.56753	0.06570	-0.10544	0.09038	0.60001
V21	0.28032	-0.39944	0.23267	-0.17239	-0.17893	0.43865	0.20179	0.59054
V22	-0.05954	-0.03282	0.36152	0.27705	-0.37280	0.08171	0.41089	0.52656
V23	-0.11967	0.40093	-0.19130	0.13159	-0.08084	-0.49100	0.32308	0.58696
V24	0.14697	0.01518	0.15842	-0.08653	0.41873	-0.16618	0.57563	0.58871
V25	-0.10424	0.03888	0.39371	0.29770	0.26191	0.00767	0.04140	0.32637
V26	-0.49878	0.37531	-0.08855	0.07018	0.30264	-0.02238	-0.01597	0.49440
V27	0.07557	0.13095	0.00985	0.15487	0.42348	-0.00885	0.45841	0.43807
V28	0.01547	0.38410	0.40472	-0.23831	-0.30846	-0.27283	-0.11715	0.55167
V29	0.45376	-0.36085	-0.25944	0.28630	0.01435	0.04899	0.05584	0.49115
V30	-0.43127	0.41383	0.38207	0.04503	0.07606	0.07166	-0.05026	0.51873
V40	0.53244	0.32277	0.33708	-0.02307	0.45911	0.16107	-0.26079	0.80656

VARIMAX ROTATED FACTOR MATRIX

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7
V2	0.11027	-0.21752	0.72569	-0.14079	0.18414	0.13571	0.02418
V3	0.17000	-0.25389	0.80744	-0.00208	-0.14197	-0.00455	0.06260
V4	0.13989	-0.19523	0.76809	-0.08355	0.01053	0.06178	0.12630
V5	0.54371	0.00879	0.07254	-0.45690	0.18723	0.13132	0.10095
V6	0.56125	-0.27065	0.28721	-0.12584	-0.06445	0.09770	0.03733
V7	0.70178	0.21095	0.31492	0.15105	-0.18042	0.14313	-0.16509
V8	0.80073	0.04612	0.17404	0.18613	-0.12159	-0.05521	-0.04978
V10	0.74780	-0.20009	0.02676	-0.25432	0.00248	-0.15262	0.19416
V11	0.31212	0.00314	0.50301	0.22023	-0.00509	-0.24313	0.20715
V12	-0.06663	0.79556	-0.20052	-0.06665	-0.10957	0.11719	-0.11483
V13	-0.12780	0.82523	-0.21928	-0.13065	0.02375	-0.12908	-0.08487
V14	0.40498	-0.21328	-0.03427	0.35836	0.20127	-0.23029	0.15045
V15	-0.29561	0.03682	0.03136	0.20654	0.71005	0.03142	0.09895
V16	0.61835	-0.07597	-0.02570	0.17003	-0.30670	0.07269	-0.12398
V17	-0.11212	-0.77982	0.14412	0.03730	0.12454	-0.14354	-0.08929
V18	-0.00252	0.06044	-0.49921	-0.44745	-0.24938	-0.10336	0.42144
V19	0.28155	-0.15072	-0.17365	0.01239	0.07791	0.67983	0.20496
V20	-0.02604	-0.11422	-0.02769	0.75946	-0.08335	-0.00614	0.04180
V21	-0.03866	-0.26749	0.14740	-0.06443	0.46266	0.52625	-0.02492
V22	-0.21964	0.26713	0.31017	0.07550	-0.09867	0.54331	0.01125
V23	0.04766	0.15264	-0.01100	0.04009	-0.70693	-0.03356	0.22979
V24	-0.07905	-0.10136	0.14984	-0.05639	-0.05385	0.08250	0.73270
V25	-0.20207	0.33778	0.28379	0.08203	0.16110	-0.12063	0.20695
V26	-0.01304	0.49638	-0.31587	-0.07576	-0.12240	-0.29770	0.19676
V27	0.07882	0.11791	0.06205	0.15103	-0.01570	0.02836	0.62469
V28	-0.01845	0.11882	0.34937	-0.53105	-0.30554	-0.03807	-0.19577
V29	0.14763	-0.36217	0.12469	0.52994	0.12153	0.10978	0.00951
V30	-0.11483	0.62279	0.04851	-0.31591	-0.00462	-0.11803	0.03952
V40	0.43700	0.01275	0.49518	-0.18585	0.38742	-0.37340	0.21396

TRANSFORMATION MATRIX

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7
FACTOR 1	0.56138	-0.50648	0.58270	0.11633	0.10188	0.06074	0.07202
FACTOR 2	0.61140	0.54682	0.09901	-0.35970	-0.36835	-0.16164	0.10368
FACTOR 3	-0.42169	0.28442	0.69763	-0.41016	0.28248	0.06408	0.04937
FACTOR 4	-0.01742	0.45947	0.31931	0.82341	-0.06434	-0.03020	-0.05966
FACTOR 5	0.01379	0.02220	-0.09908	0.08534	0.38133	-0.89147	0.04709
FACTOR 6	0.36982	0.29175	-0.22596	-0.00123	0.73545	0.42113	-0.09378
FACTOR 7	-0.08407	0.01381	-0.02759	0.05582	-0.26182	0.06174	0.98459

TABLE 35

RANK ORDER OF FACTOR LOADINGS FOR CHAPARRAL DATA OF TABLE 34

FACTOR 1

V8	QIH[b]	.80
V10	Gefi	.75
V7	LIH[b]	.70
V16	FB(Low Intell/High)	.62
V6	Elspd	.56
V5	Clflr	.54
V40	Perceptual speed	.44
V14	2 Dim	.40
V11	Pursuit	.31
V15	Reserved/Outgoing	-.30

(Three other variables loaded between .2 and .3)

FACTOR 2

V13	Trait Anxiety	.83
V12	State Anxiety	.80
V17	Affected by Feelings/Emotionally Stable	-.78
V30	Relaxed/Tense	.62
V26	Self assured/Apprehensive	.50
V29	Undisciplined Self conflict/Controlled	-.30
V25	Forthright/Astute	.34

(Eight other variables loaded between .2 and .3)

FACTOR 3

V3	Color[a]	.81
V4	Wintc[a]	.77
V2	Word[a]	.73
V11	Pursuit	.50
V18	Humble/Assertive	-.50
V40	Perceptual Speed	.50
V28	Group Dependent/Self-sufficient	.35
V26	Self assured/Apprehensive	-.32
V7	LIH[b]	.31
V22	Tough-minded/Tender minded	.31

(Four other variables loaded between .2 and .3)

FACTOR 4

V20	Expedient/Conscientious	.76
V28	Group Dependent/Self-sufficient	-.53
V29	Undisciplined Self conflict/Controlled	.53
V5	Clflx	-.46
V18	Humble/Assertive	.45
V14	2 Dim	.36
V30	Relaxed/Tense	.32

(Three other variables loaded between .2 and .3)

FACTOR 5

V15	Reserved/Outgoing	.71
V23	Trusting/Suspicious	-.71
V21	Shy/Venturesome	.46
V40	Perceptual Speed	.39
V16	Low Intell/High Intell	-.31
V28	Group Dependent/Self-sufficient	-.31

(Two other variables loaded between .2 and .3)

FACTOR 6

V19	Sober/Happy go lucky	.68
V22	Tough minded/Tender/minded	.54
V21	Shy/Venturesome	.53
V40	Perceptual Speed	.37
V26	Self Assured/Apprehensive	.30

(Two other variables loaded between .2 and .3)

FACTOR 7

V24	Practical/Imaginative	.73
V27	Conservative/Experimenting	.62
V18	Humble/Assertive	.42

(Seven other variables loaded between .2 and .3)

[a] V2-V4 are three separate measures from the same test, all of which purport to measure the ability to work under stress

[b] LIH and QIH are both measures of intelligence--for language and quantitative aspects respectively

effect is presented. This table is formatted exactly like Table 23 from the exploratory analysis of REDEYE data. If there is any difficulty understanding any of the variable names, refer back to Table 27 for clarification. If there is any difficulty in interpreting the table itself, refer back to the earlier discussion of Table 23 for assistance (Chapter III).

A description and discussion of each of the seven factors will now be presented. Tentative names for six of the factors will also be given. Any comparisons between these and the factors identified in the REDEYE exploratory analysis will be reserved until later in this report.

Factor 1 can be called the "analytic" factor. The only variable which cleanly loads on this and only this factor is the quantitative portion of the Thurstone Test of Mental Alertness. Therefore, it is the only factorially "pure" measure on this factor.

It would be inappropriate though to label the factor as quantitative, because of the analytic nature of that measure itself, and because of the high positive and almost clean loadings for the GEFT (V10) and Closure Flexibility (V5) measures. These two measures clearly tap analytic ability. For both measures, the loading on Factor 1 is not only high and positive, but for each, it is the only positive loading on any factor in the solution.

It could be argued that this factor is a general ability factor because of the high loadings for both scales of the Thurstone test and because of the almost factorially "pure" nature of V16 (FB), the "Less intelligent/More intelligent" measure from the 16PF. It is true that there is confounding with general ability in this factor. Nevertheless, if all loadings are taken into consideration, there is more of an "analytic" character to the factor than there is a general character. The alternating question types on the language Thurstone require analytic ability to be able to understand just what to do. Other measures which have high or appreciable loadings on the factor and which require some analytic ability are V6 (Closure Speed) and V40 (Perceptual Speed). All in all, the best name for the factor remains "analytical." Other measures with loadings between .2 and .4 on this factor were for Two Dimensional Perception, the Pursuit Test, the "reserved" dimension of V15, the "happy-go-lucky" dimension of V19, the "tough-minded" dimension of V22 and the "forthright" dimension of V25.

Factor 2 is clearly an "anxiety" factor. Trait and state anxiety load highest and are almost factorially "pure." These are the two highest loadings of the entire factor analysis. In addition, the loadings are the only positive loadings for V12 and V13. Each one also loads negatively between .2 and .3 on the third factor, but not at all on any other factor. The next two variables to load, in hierarchical order, are the "affected by feelings" dimension of V17 and the "tense" dimension of V30. Both dimensions were factorially "pure." The first four loadings provide powerful support to this as an "anxiety" factor. Other variables with appreciable loadings which support this as an "anxiety" factor are the "apprehensive" dimension of V26 and the "undisciplined self-conflict" dimension of V29. These last variables do not load as cleanly on the anxiety factor but still provide support for it.

There were nine other variables which loaded between .2 and .34 on the "anxiety" factor. It is unusual to have so many variables load on a factor that is as well-defined as this factor. In this case, most of the loadings of these "other" variables are negative loadings on measures that require performance under the pressure of a time limit. This would suggest that poor performance on timed tests goes along with high anxiety. Such a notion is supportive to the factor as an "anxiety" factor.

In the third factor, there is not a factorially "pure" measure with a high loading. However, the indications are strong that this is a factor that can be named "ability to work under stress." The three highest loadings are almost factorially "pure" in that the only positive loadings are on this factor. All three of the measures (V2-V4) are from the Press Test which measures the ability to work under stress. The same three measures had very small negative loadings on the "anxiety" factor, which detracts only slightly from the measures as independent of other factors.

The only factorially "pure" measure (with a loading of only .35) is the "self-sufficient" dimension of V28. Since the "self-sufficient" person goes "his own way, making decisions and taking action on his own... discounting public opinion (Manual for the 16PF, 1972, p. 20)," it could be said that this fits the character of the "ability to work under stress."

Other variables that load on this factor which support it as the "ability to work under stress" factor are the Pursuit Test, the Perceptual Speed Test and the Language portion of the Thurstone Test. All three of these also load on the "analytic" factor, but it could be argued that the time pressure present during each test imposes another demand, i.e., the need to be able to perform under stressful conditions. It is unfortunate that both the Pursuit and the Perceptual Speed tests break into so many other factors besides "ability to work under stress" and "analytic." Caution must be exercised in analyzing their contributions differentially across the various factors.

Factor 4 may be named the "conscientious, controlled" factor. The V28 "group-dependent" dimension loading was as high as the V29 "controlled" dimension loading but it was not a clean loading. "Group-dependent" loaded on two other factors in addition to Factor 4. The factor suggests a hard-working, responsible nature for a person who is in control of their own behavior and emotions. At the same time, it suggests the quality of being obsessed with correctness, sometimes to the point of being obstinate. This obsession with correctness is characteristic of the "humble" dimension of V18 (Manual for the 16PF, 1972, p. 18), which also loads highly, but not cleanly on Factor 4.

The negative loading for Closure Flexibility supports the "group dependent" dimension of this factor. Low Closure Flexibility scores suggest field-dependent behavior. Other variables which load between .2 and .36 were Two-Dimensional Perception, the "relaxed" dimension of V30, the GEFT, the Pursuit Test, and the "outgoing" dimension of V15.

A possible name for the fifth factor is the "trusting, outgoing" factor. The Manual for the 16PF (1972, p. 20) describes a person with the "trusting" dimension as "free of jealous tendencies, adaptable, cheerful, uncompetitive, concerned about other people, a good team worker." The "outgoing" dimension (p. 17) describes a person as "good-natured, easy-going... ready to cooperate, attentive to people, soft-hearted, kindly, adaptable... He is generous in personal relations." These two dimensions of personality appear to be compatible in this factor. Other measures which loaded on the "trusting, outgoing" factor were of considerably less magnitude than the two most important ones. These included: "venturesomeness," Perceptual Speed, "low intelligence," "group-dependency," Two-Dimensional Perception, and "humbleness."

There were no variables which cleanly loaded on only Factor 6, therefore, the name for the factor will simply remain Factor 6. The highest loading on Factor 6 was .68 which is lower than the highest loading for any other factor. The variable with that loading was the "happy-go-lucky" dimension of V19. The dimensions of "tender-minded" and "venturesome," from V22 and V21 respectively, had the next highest loadings. Of these three, the "venturesome" dimension loaded most cleanly, even though it did load on one other factor ("trusting, outgoing," .46).

Recall that "tender-mindedness" is marked by dependency and sensitivity; "happy-go-luckiness" is marked by a carefree but impulsive spirit; and, "venturesomeness" complements "happy-go-luckiness" with its uninhibited, spontaneous, and almost reckless character. Other variables which load on Factor 6 are Perceptual Speed, the "self-assured" dimension of V26, the Pursuit Test and the Two-Dimensional Perception Test.

Factor 7 is neater than Factor 6 and can be called the "imaginative, experimenting" factor. Both of these dimensions were factorially "pure" on this factor. In addition, in both cases, the other dimension for the variable did not load on any factor at all. The description for "imaginative" given in the Manual for the 16PF (p. 20) characterizes someone who is "unconventional, self-motivated, imaginatively creative... [with] inner-directed interests... his individuality tends to cause him to be rejected in group activities." The "experimenting" person is described as "free-thinking... more inclined to experiment in life generally, and more tolerant of inconvenience and change (p. 21)." These two descriptions appear to complement one another.

The "assertive" dimension of V18 also loaded cleanly but not as highly on the "imaginative, experimenting" factor. The other dimension of V18 loaded on three other factors. Therefore, while the variable is not so independent, the "assertive" dimension of the variable is reasonably independent. The self-assured independent-mindedness and the aggressive competitiveness that go with "assertiveness" (Manual for the 16PF, 1972, p. 18) also seem to fit the character of the factor. Small loadings for seven other variables are also part of the factor and help to alternately complement or confuse the issue, depending on the variable. The others are: "happy-go-lucky," Pursuit Test, "suspicious," "astute," "apprehensive", "group-dependent," and Perceptual Speed.

After the completion of the factor analyses, two sets of variables were entered into a canonical correlation analysis. The first set of variables included the same twenty-nine variables that went into the factor analyses. The second set of variables represented the dependent variables for CHAPARRAL but did not include all measures provided by the Army. There was little variance within each written test and there was not a measure for a final written test that was based on a larger set of items. Consequently, a written composite measure was constructed by summing the scores of the four existing written test measures. The variable name for computer input was WCOMPC and stands for "written composite CHAPARRAL." The canonical correlation summaries will reference this variable name.

Two other dependent variables were part of the set: the end of course proficiency test for CHAPARRAL (WC5) and the overall rating made by the drill instructor (ZR6). Only one measure for each of these kinds of measures was utilized because of the lack of variance within and between other measures of the same category.

There were no significant canonical correlations between pairs of canonical variates. However, as with the REDEYE canonical analysis, it was suspected that general ability could be operating as a confounding variable to mask the effects of other variables thought to be crucial to performance. A summary table of this canonical correlation analysis is presented in Table 36 and includes the same categories of information as in Table 24: (a) the magnitudes of the eigenvalues, (b) the canonical correlations, (c) Wilk's lambda, (d) the chi-square values, (e) the degrees of freedom, (f) the probabilities for significance, and (g) two matrices of standardized canonical variate coefficients, one for each of the two sets of variables entered into the analysis.

A second canonical analysis which took into consideration the masking effects of general ability was then performed. The seven variables of the first set with canonical variate coefficients of .30 or greater were entered into the second analysis. Likewise were all three of the variables of the second set. A significant canonical correlation of .685 for the first pair of canonical variates was observed ($\underline{p}$. $\leq$ .003). Like in the REDEYE analysis, this confirmed that general ability had been a confounding variable in the first analysis. The results of the second canonical correlation analysis are displayed in Table 37, which shows the same categories of information as were shown in Table 36.

The results of the analysis can be interpreted as follows: About 47% of the variance (listed as the eigenvalue for the first canonical correlation) is shared by the pair of canonical variates listed as having a significant canonical correlation. Recall that each canonical variate is composed of varying degrees of the original variables of the set. The size of the coefficients for each variable that make up each canonical variate indicate the relative contributions of the original variables to the composition of the variate.

In this analysis, the most important component variable to the variate for the first variable set was the GEFT (V10), followed in order by the language portion of the Thurstone Test of Mental Alertness (V7), 16PF-FQ3: Undisciplined self-conflict/controlled (V29), 16PF-FQ4: Relaxed/Tense (V30), State Anxiety (V12), Closure Speed (V6), and finally Trait Anxiety (V13). For the second variable set, the most important component variable to the variate for the set was the Written Composite score (WCOMPC) followed in order by the overall rating scale by the drill instructor (ZR6) and the End of Course Proficiency Test (WC5).

TABLE 36

SUMMARY OF CANONICAL CORRELATION ANALYSIS OF CHAPARRAL DATA BEFORE CONSIDERING THE MASKING EFFECTS OF GENERAL ABILITY ($\underline{N}$=67)

- - - - - - - - - - - - - - - C A N O N I C A L   C O R R E L A T I O N - - - - - - - - - -

NUMBER	EIGENVALUE	CANONICAL CORRELATION	WILK'S LAMBDA	CHI-SQUARE	D.F.	SIGNIFICANCE
1	0.64697	0.80434	0.14317	96.21498	87	0.234
2	0.37532	0.61264	0.40554	44.67540	56	0.862
3	0.35080	0.59228	0.64920	21.38460	27	0.768

NO CANONICAL CORRELATION FOUND AT THE 0.050 LEVEL OF SIGNIFICANCE.
THE FIRST (NON SIGNIFICANT) CANONICAL CORRELATION IS PRINTED BELOW.

COEFFICIENTS FOR CANONICAL VARIABLES OF THE FIRST SET

	CANVAR 1
V2	-0.09098
V3	-0.17394
V4	0.09310
V5	0.10459
V6	0.34226
V7	-0.45037
V8	0.00456
V10	-0.56837
V11	0.17111
V12	0.34472
V13	-0.30226
V14	-0.10346
V15	0.23841
V16	0.18669
V17	-0.25010
V18	0.20804
V19	-0.04857
V20	0.21525
V21	0.15655
V22	-0.11404
V23	-0.04605
V24	0.17577
V25	0.28215
V26	0.17266
V27	-0.11376
V28	0.04715
V29	-0.48776
V30	-0.38085
V40	-0.01614

COEFFICIENTS FOR CANONICAL VARIABLES OF THE SECOND SET

	CANVAR 1
WCOMPC	-0.49606
WC5	-0.31795
ZI6	-0.49159

TABLE 37

SUMMARY OF CANONICAL CORRELATION ANALYSIS OF CHAPARRAL DATA AFTER CONSIDERING THE MASKING EFFECTS OF GENERAL ABILITY (N=67)

---------------- CANONICAL CORRELATION ----------

NUMBER	EIGENVALUE	CANONICAL CORRELATION	WILK S LAMBDA	CHI-SQUARE	D.F.	SIGNIFICANCE
1	0.46898	0.68482	0.48996	43.16245	21	0.003
2	0.05384	0.23203	0.92269	4.86817	12	0.962
3	0.02481	0.15751	0.97519	1.51991	5	0.911

COEFFICIENTS FOR CANONICAL VARIABLES OF THE FIRST SET

	CANVAR 1
V6	0.21426
V7	-0.47736
V10	-0.55266
V12	0.33600
V13	0.05816
V29	-0.45489
V30	-0.42191

COEFFICIENTS FOR CANONICAL VARIABLES OF THE SECOND SET

	CANVAR 1
WCOMPC	-0.61045
WC5	-0.30252
ZR6	-0.38042

Results. The results of the CHAPARRAL analyses are:

1. The aptitude profile combinations identified in the REDEYE sample were not completely generalizable to the CHAPARRAL sample. Only Profile 3 was generalizable.

2. As with the REDEYE sample, the intellectual ability that emerges as a factor is more specialized than general. In the CHAPARRAL sample, the specialized intellectual ability is analytic ability.

3. Based on the results of the factor analysis, the underlying factors that characterize men who complete CHAPARRAL AIT Training are, in order of importance: "analytic", "anxiety", "ability to work under stress", "conscientious, controlled", "trusting, outgoing", an unnamed factor, and "imaginative, experimenting." Together, the first four factors explain 44.8% of the total variance while all seven explain 60.6% of the variance.

4. General ability is the most powerful predictor of CHAPARRAL performance, so much so that it confounds the effects of other crucial factors in performance.

5. Analytic ability is the most important factor in surviving CHAPARRAL AIT Training. Once the effects of general ability are taken into account, analytic ability is still most important in predicting CHAPARRAL performance (as measured by the canonical variate for CHAPARRAL performance measures).

6. The "ability to work under stress" factor is one of the three most important factors to characterize those who survive CHAPARRAL Training, yet it does not predict CHAPARRAL performance at all.

7. Stated in factor terms, the descriptive components which predict CHAPARRAL performance, in order of importance are: "analytic," "anxiety," and "conscientious, controlled." Elements of no other identified factors were predictive of CHAPARRAL performance. (Appendix E)

VULCAN

Analysis. The cases that were analyzed for this report included only those for whom there was a rating by a drill instructor, all test battery independent measures, and all written and proficiency measures provided by the Army. The rationale explicated for CHAPARRAL on the rating scales applies to VULCAN also. The final number of cases analyzed was 61. All of the cautions expressed already about small sample sizes for both REDEYE and CHAPARRAL apply to the VULCAN analysis too. Yet the fact that there are three similar analyses on different samples (even though they are small samples) does provide an opportunity for increased generalizability--if any promising results are suggested.

All aptitude tests were scored for all soldiers and standardized ratings (adjusted for the different raters) were compiled. Performance and written tests were scored by Army personnel and the scores were forwarded to the investigators. Descriptions of all dependent measures for VULCAN were given earlier in this chapter. A summary of the means, standard deviations, and number of cases on which each measure was based is presented in Table 38.

Factor analyses were conducted following the same pattern identified already for REDEYE and CHAPARRAL. The factor analyses were intended to investigate the underlying structure of the aptitude variables in the VULCAN sample. The correlation matrix upon which the factor analyses were based is shown in Appendix D.

The number of factors to be extracted in the first factor analysis was unrestricted and yielded ten factors with an eigenvalue greater than one. A summary of the eigenvalues, percent of variance explained, and the cumulative percent of variance for both significant and nonsignificant factors is presented in Table 39. The factor matrix before rotation by the varimax method, the rotated matrix, and the transformation matrix for the ten factors are all shown on Table 40. The number of factors was then restricted, partially because of the results of a scree analysis and partially because of the results of other analyses of similar data for REDEYE and CHAPARRAL.

Individual factor analyses were performed which restricted the number of factors to four, five, seven, and eight. Simple structure analyses revealed that the seven factor solution was probably the most meaningful. Considering that the other analyses (for REDEYE and CHAPARRAL) both resulted in seven factor solutions, a seven factor solution for VULCAN was desired. Fortunately, it was also an appropriate solution which met the criteria for simple structure. Table 41 shows the matrices for the solution restricted to seven factors. The same criteria for interpretation of factor loadings was used for VULCAN as was used for REDEYE and for CHAPARRAL and will not be repeated here.

Table 42 shows the loadings for each factor in order of magnitude starting with the highest loading. This is presented as such in order to make interpretation easier. Based on the loadings and on principles of logic, a description and discussion of each factor is documented. Tentative names for the first five are also presented.

TABLE 38

SUMMARY OF MEANS AND STANDARD DEVIATIONS FOR
VULCAN INDEPENDENT AND DEPENDENT VARIABLES

VARIABLES..	LABELS..	MEAN	STANDARD DEV	CASES
V2	WORD	62.8197	16.7506	61
V3	COLOR	65.0984	14.5461	61
V4	*INTC	53.9836	13.4616	61
V5	CLFLEX	32.9508	21.9889	61
V6	CLSPD	9.4918	4.9619	61
V7	LTH	18.4590	10.1547	61
V8	QTH	15.1148	6.8193	61
V10	GEFT	5.3607	4.6763	61
V11	PURSUIT	15.9672	6.7453	61
V12	STATE	42.9016	9.4087	61
V13	TRAIT	43.1147	8.5714	61
V14	2DIM	11.1639	6.7260	61
V15	FA	6.8033	2.4551	61
V16	FB	3.5574	1.2977	61
V17	FC	6.6721	2.3785	61
V18	FE	5.9016	2.0953	61
V19	FF	6.7213	2.2740	61
V20	FG	8.0820	2.1079	61
V21	FH	6.4590	2.3063	61
V22	FI	4.7869	1.8629	61
V23	FL	6.3934	2.1313	61
V24	FM	5.2459	1.9206	61
V25	FN	5.1803	2.0208	61
V26	FO	6.2131	2.0826	61
V27	Q1	6.5738	2.1327	61
V28	Q2	5.0984	2.2709	61
V29	Q3	7.0164	1.9958	61
V30	Q4	4.9836	2.0453	61
V40	GZPS	33.1475	10.0727	61
*V1		29.5574	5.3899	61
*V2		31.6393	5.0101	61
*V3		17.6393	1.8351	61
*V4		25.8033	2.9201	61
*V5		21.1639	3.6110	61
*V6	FINAL WT	85.9016	8.0098	61
PVC	PROFCOMP	7.6721	1.3382	61

TABLE 39

SUMMARY STATISTICS FOR ALL FACTORS IN UNROTATED FACTOR ANALYSIS OF 61 VULCAN CASES

VARIABLE	VALUE USED IN DIAGONAL	FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
V2	1.00000	1	5.57544	15.5	15.5
V3	1.00000	2	3.75401	10.4	25.9
V4	1.00000	3	3.01464	8.4	34.3
V5	1.00000	4	2.07051	5.8	40.0
V6	1.00000	5	1.97277	5.5	45.5
V7	1.00000	6	1.74155	4.8	50.4
V8	1.00000	7	1.62320	4.5	54.9
V10	1.00000	8	1.53643	4.3	59.1
V11	1.00000	9	1.35102	3.8	62.9
V12	1.00000	10	1.25593	3.5	66.4
V13	1.00000	11	1.21868	3.4	69.8
V14	1.00000	12	1.08644	3.0	72.8
V15	1.00000	13	0.97124	2.7	75.5
V16	1.00000	14	0.91008	2.5	78.0
V17	1.00000	15	0.82583	2.3	80.3
V18	1.00000	16	0.73802	2.1	82.3
V19	1.00000	17	0.67346	1.9	84.2
V20	1.00000	18	0.64724	1.8	86.0
V21	1.00000	19	0.59393	1.6	87.7
V22	1.00000	20	0.54380	1.5	89.2
V23	1.00000	21	0.50524	1.4	90.6
V24	1.00000	22	0.41874	1.2	91.7
V25	1.00000	23	0.40532	1.1	92.9
V26	1.00000	24	0.39148	1.1	94.0
V27	1.00000	25	0.36884	1.0	95.0
V28	1.00000	26	0.28925	0.8	95.8
V29	1.00000	27	0.26816	0.7	96.5
V30	1.00000	28	0.24132	0.7	97.2
V40	1.00000	29	0.22978	0.6	97.8
WV1	1.00000	30	0.19581	0.5	98.4
WV2	1.00000	31	0.16031	0.4	98.8
WV3	1.00000	32	0.12683	0.4	99.2
WV4	1.00000	33	0.10347	0.3	99.5
WV5	1.00000	34	0.09175	0.3	99.7
WV6	1.00000	35	0.05497	0.2	99.9
PVC	1.00000	36	0.04458	0.1	100.0

TABLE 40

FACTOR MATRICES (UNRESTRICTED) FOR VULCAN DATA (N=61)

FACTOR MATRIX USING PRINCIPAL FACTOR, NO ITERATIONS

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10	COMMUNALITY
V2	0.65160	0.02990	0.47711	-0.26594	-0.01326	0.00613	-0.17736	0.01013	0.06452	-0.15831	0.78494
V3	0.70689	-0.01744	0.49296	-0.24348	0.03859	-0.10419	-0.15962	-0.01259	-0.07280	-0.09251	0.85411
V4	0.69029	0.02058	0.48194	-0.16764	0.04109	0.03421	0.03558	-0.04819	-0.05882	-0.01092	0.74731
V5	0.43618	0.02336	-0.45871	-0.12023	0.48253	0.06822	0.04734	0.03538	0.09676	-0.05349	0.66892
V6	0.65959	-0.05039	-0.06003	0.29320	0.10251	-0.04047	0.05310	-0.21817	0.08312	-0.25164	0.66510
V7	0.64419	-0.08728	-0.18023	0.18014	-0.43626	0.02819	0.25179	0.13181	0.09034	0.06070	0.77126
V8	0.71926	0.05592	-0.29216	0.19579	-0.24227	0.19288	0.17638	-0.08986	0.05822	0.23018	0.83559
V10	0.47989	-0.08325	-0.34584	0.10336	0.58363	-0.12993	0.20893	0.12565	-0.09816	-0.02502	0.79472
V11	0.44621	0.16976	-0.12373	-0.32139	0.25989	-0.10909	0.48881	-0.21011	0.00697	0.15708	0.73376
V12	-0.27566	0.56036	0.21462	-0.06738	0.08296	0.19331	0.23063	0.13139	0.46837	-0.04076	0.77632
V13	-0.22112	0.74871	0.17107	-0.09164	0.15234	-0.01817	0.16056	0.12237	0.33850	-0.01131	0.82613
V14	0.35229	-0.08620	-0.35874	-0.05138	0.29761	0.31105	-0.10479	0.37059	0.04411	0.25975	0.66592
V15	-0.20407	-0.34173	0.42610	0.18491	0.17503	-0.08776	0.44669	0.24501	-0.09148	0.15198	0.70354
V16	0.54292	0.03236	-0.11740	0.30086	-0.23069	-0.07747	-0.03075	0.45411	0.00151	0.01357	0.67332
V17	0.08546	-0.59310	-0.19768	-0.29211	-0.22197	0.21249	-0.04014	0.15945	0.20282	0.05618	0.64943
V18	-0.01472	0.26108	0.18157	0.38366	0.26389	0.35494	-0.38563	0.16409	-0.12548	0.17995	0.66793
V19	0.09356	-0.25089	0.39667	0.52773	0.18710	-0.34010	0.06575	-0.04578	0.18003	0.23011	0.75374
V20	0.45163	-0.23837	0.18588	-0.16124	-0.13286	-0.22314	-0.35287	0.17667	0.25667	0.27206	0.68441
V21	-0.09397	-0.36882	0.28033	0.45465	-0.03416	0.18999	0.24152	-0.20063	0.17507	-0.00938	0.59673
V22	-0.01232	0.19030	0.37248	-0.34477	0.21856	0.58875	0.14349	0.02224	-0.01490	0.23367	0.76428
V23	0.31672	0.42731	0.10427	0.12099	-0.23292	0.00901	0.10168	0.21495	-0.35451	0.22603	0.59605
V24	0.01068	-0.06591	0.14624	-0.18567	-0.23298	0.04179	0.30996	0.54140	-0.21998	-0.52162	0.82601
V25	0.01857	0.27216	-0.15655	-0.17907	-0.40168	-0.18184	0.39157	-0.14596	0.18826	0.11349	0.53435
V26	0.05150	0.73024	0.06601	0.14406	-0.25741	-0.18299	-0.08537	0.02318	-0.05337	0.28409	0.75214
V27	0.14919	-0.18740	0.12636	0.34877	-0.19619	0.67974	0.12985	-0.17806	0.01402	-0.15295	0.76782
V28	0.22763	0.47436	-0.25256	0.08847	-0.16081	0.16011	-0.30459	-0.09266	0.29742	-0.24946	0.65211
V29	-0.07110	-0.51332	0.11550	-0.12433	0.02699	-0.07945	-0.03652	0.14068	0.54609	0.03439	0.62491
V30	0.11657	0.36508	0.04869	0.40615	0.26524	-0.18621	0.00653	0.17821	0.14529	-0.35749	0.59283
V40	0.75818	0.08181	0.13798	-0.08633	0.06005	-0.01229	-0.04189	-0.29989	-0.06194	-0.10083	0.71747

VARIMAX ROTATED FACTOR MATRIX

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10
V2	0.80454	-0.00541	0.09715	0.04758	-0.07863	-0.08371	-0.01914	0.05655	-0.01241	-0.09415
V3	0.90853	0.04017	0.08952	-0.07320	0.00983	0.02602	-0.08603	0.04662	0.00887	-0.05717
V4	0.82826	0.09691	0.13934	0.01716	0.07978	0.10768	0.08283	-0.01740	-0.07875	-0.02924
V5	0.08767	0.77388	0.05665	-0.00697	-0.08237	-0.21768	-0.04996	0.00789	0.02877	0.03213
V6	0.41690	0.35165	0.21017	-0.14080	0.03489	-0.11492	0.32347	-0.07010	0.41400	0.09088
V7	0.21647	0.12050	0.74092	-0.15198	-0.00643	-0.05391	0.21595	-0.28222	0.05904	-0.07133
V8	0.22407	0.31563	0.80161	-0.12519	0.14330	-0.18389	0.29471	-0.21101	-0.06875	0.20467
V10	0.09912	0.83024	0.10459	-0.12402	0.05868	0.13647	-0.06496	0.03815	0.20360	-0.00808
V11	0.29640	0.55259	0.00970	0.12811	0.16466	0.08423	-0.05466	-0.50200	-0.15400	0.10542
V12	-0.09830	-0.08513	-0.07476	0.86160	-0.00014	-0.04535	0.05495	-0.03841	-0.05450	-0.04402
V13	-0.05006	-0.03238	-0.04852	0.85424	0.20150	-0.08561	-0.17544	-0.05141	0.04179	0.00735
V14	-0.02231	0.56255	0.35219	-0.03567	-0.14495	-0.09941	-0.07090	0.32273	-0.28861	0.01652
V15	-0.05759	-0.04409	-0.04167	0.04565	-0.07084	0.80876	0.09986	0.03723	-0.02417	-0.15292
V16	0.16697	0.11938	0.73489	-0.03185	-0.00048	-0.03316	-0.04373	0.12280	0.22921	-0.13386
V17	-0.03512	0.02722	0.19405	-0.31497	-0.60631	-0.06592	0.06611	-0.07780	-0.32706	-0.13885
V18	-0.00166	-0.00254	0.06188	0.17483	0.26859	-0.01674	0.10953	0.71587	-0.05413	0.16359
V19	0.14553	-0.07276	0.11973	0.00062	-0.10270	0.60826	0.08429	0.13107	0.39759	0.18666
V20	0.67028	-0.08785	0.37058	-0.13360	-0.38038	0.01946	-0.31641	0.09463	-0.04058	0.21107
V21	-0.05400	-0.15718	-0.00067	-0.02869	-0.18245	0.38406	0.58987	0.02311	0.14020	0.13926
V22	0.23267	0.07384	-0.18143	0.39757	0.08034	0.09318	0.14653	0.16118	-0.65791	-0.03346
V23	0.17984	-0.05343	0.43576	0.08063	0.57620	0.04473	-0.09706	0.02720	-0.11709	-0.08112
V24	0.07341	-0.08472	0.10071	0.02973	-0.01001	0.10643	-0.00136	-0.06788	0.02209	-0.88650
V25	-0.08483	-0.11149	0.20838	0.20444	0.11155	-0.10082	-0.05094	-0.63068	-0.07106	0.03855
V26	0.02346	-0.25529	0.29950	0.36713	0.88838	-0.15403	-0.26951	-0.03673	0.05270	0.23534
V27	0.05694	-0.07469	0.14470	-0.05892	-0.00715	-0.05611	0.83059	0.14374	-0.12831	-0.06615
V28	0.06854	0.01218	0.19182	0.26855	0.06659	-0.88483	0.09104	0.05694	0.21434	0.08824
V29	0.02506	-0.06002	0.02588	0.03338	-0.75889	0.19588	-0.02807	-0.01794	0.01666	0.05682
V30	0.04641	0.17617	0.05325	0.35937	0.16800	-0.02087	0.02317	0.21089	0.88550	-0.10598
V40	0.71479	0.25792	0.10553	-0.12659	0.15519	-0.17775	0.13458	-0.12625	0.08466	0.12332

TRANSFORMATION MATRIX

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10
FACTOR 1	0.71499	0.41663	0.49718	-0.16254	0.06321	-0.13475	0.08897	-0.06771	0.07893	0.04869
FACTOR 2	0.02007	-0.02221	0.04075	0.65266	0.62795	-0.16488	-0.19201	-0.02333	0.05753	0.05727
FACTOR 3	0.59047	-0.49426	-0.20245	0.27291	0.02443	0.48651	0.11198	0.19685	-0.03641	-0.04070
FACTOR 4	-0.27667	-0.06493	0.12793	-0.03919	0.23688	0.23786	0.43863	0.34710	0.57119	0.24155
FACTOR 5	0.04737	0.70094	-0.49530	0.17820	-0.02556	0.24805	-0.10019	0.36738	0.08895	0.15488
FACTOR 6	-0.05936	0.08762	0.07561	0.14566	-0.01723	-0.25465	0.66016	0.34626	-0.57487	-0.12487
FACTOR 7	-0.14599	0.27244	0.07618	0.24481	0.14571	0.49818	0.30655	-0.61152	-0.07344	-0.26667
FACTOR 8	-0.14383	0.07538	0.4761[illegible]	0.20512	-0.19526	0.21412	-0.37697	0.40145	-0.05731	-0.57268
FACTOR 9	-0.00590	-0.00994	0.15747	0.56768	-0.69985	-0.14304	0.08992	-0.14141	0.18779	0.24133
FACTOR 10	-0.12407	-0.00349	0.33045	0.00083	0.04927	0.33844	-0.24543	0.02804	-0.52968	0.64042

TABLE 41

FACTOR MATRICES (RESTRICTED TO SEVEN FACTORS) FOR VULCAN DATA (N=61)

FACTOR MATRIX USING PRINCIPAL FACTOR, NO ITERATIONS

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	COMMUNALITY
V2	0.85168	0.02990	0.47711	-0.26594	-0.01326	0.00613	-0.17736	0.75561
V3	0.70608	-0.01744	0.49296	-0.24348	0.03859	-0.10419	-0.15962	0.84009
V4	0.69029	0.02058	0.48194	-0.16764	0.04109	0.03421	0.03558	0.74141
V5	0.43618	0.02334	-0.45871	-0.12023	0.46253	0.06822	0.04734	0.65535
V6	0.65959	-0.05039	-0.06003	0.29320	0.10251	-0.34047	0.05310	0.54213
V7	0.64419	-0.08728	-0.18023	0.18016	-0.43626	0.02819	0.25179	0.74204
V8	0.71926	0.03592	-0.29214	0.19579	-0.24227	0.19288	0.17638	0.77114
V10	0.47989	-0.38325	-0.34584	0.10336	0.58363	-0.12493	0.20893	0.76668
V11	0.44621	0.16976	-0.12373	-0.32139	0.25989	-0.10909	0.48881	0.66489
V12	-0.27566	0.56036	0.21462	-0.06738	0.08296	0.19331	0.23063	0.53833
V13	-0.22112	0.74871	0.17107	-0.09164	0.15234	-0.01817	0.16056	0.69644
V14	0.35229	-0.08620	-0.35874	-0.05138	0.29761	0.31105	-0.10479	0.45917
V15	-0.20607	-0.34173	0.42610	0.18491	0.17503	-0.08776	0.44669	0.61204
V16	0.54292	0.03236	-0.11740	0.30086	-0.23069	-0.07767	-0.03075	0.46028
V17	0.08546	-0.59310	-0.19768	-0.29211	-0.22197	0.21299	-0.04014	0.57972
V18	-0.01472	0.26108	0.18157	0.38366	0.26389	0.35494	-0.38563	0.54267
V19	0.09356	-0.25089	0.39667	0.52773	0.18710	-0.34010	0.06575	0.66254
V20	0.45163	-0.23637	0.16588	-0.16124	-0.13286	-0.22314	-0.35287	0.51330
V21	-0.09307	-0.36882	0.28033	0.45465	-0.03416	0.18999	0.24152	0.52574
V22	-0.01232	0.19030	0.37248	-0.34477	0.21856	0.58675	0.14349	0.70896
V23	0.11672	0.42731	0.10427	0.12999	-0.23292	0.00901	0.10168	0.37368
V24	0.01068	-0.06591	0.14624	-0.18567	-0.23298	0.04179	0.30996	0.21242
V25	0.31857	0.27216	-0.15655	-0.17907	-0.40168	-0.16184	0.39157	0.47186
V26	0.05153	0.73026	0.06601	0.14406	-0.25741	-0.18299	-0.08537	0.66865
V27	0.14919	-0.18780	0.12636	0.34677	-0.19619	0.67574	0.12985	0.71253
V28	0.22763	0.47636	-0.25256	0.08867	-0.16081	0.16011	-0.30459	0.49271
V29	-0.07113	-0.51332	0.11550	-0.12433	0.02699	-0.07945	-0.03652	0.30573
V30	0.11657	0.36508	0.04869	0.40615	0.26524	-0.16621	0.00653	0.41222
V40	0.75818	0.08181	0.13798	-0.08633	0.06005	-0.01229	-0.04189	0.61353

VARIMAX ROTATED FACTOR MATRIX

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7
V2	0.85514	-0.00027	0.10088	0.01717	-0.04674	-0.00493	0.10794
V3	0.90816	-0.00635	0.09387	0.07539	0.02595	0.00530	0.01026
V4	0.80020	0.05624	0.18885	0.12080	0.11645	0.06413	0.17320
V5	0.05460	-0.05564	0.09280	0.76699	-0.21485	-0.07545	-0.00226
V6	0.31904	0.03910	0.50624	0.36658	0.12372	-0.12355	-0.13258
V7	0.20211	-0.09105	0.77585	0.09266	-0.01815	0.27765	-0.07041
V8	0.18224	0.00098	0.78563	0.28920	-0.15233	0.10661	0.05003
V10	0.07737	0.00494	0.14180	0.83460	0.12616	-0.07098	-0.15825
V11	0.24410	0.16409	0.04302	0.59882	-0.00509	0.45719	0.09432
V12	-0.12016	0.54861	-0.21782	-0.09385	-0.02484	0.10516	0.39330
V13	-0.05155	0.73556	-0.28590	-0.01801	-0.12488	0.11337	0.20537
V14	0.03497	-0.20458	0.18020	0.50102	-0.23782	-0.22579	0.15829
V15	-0.03581	-0.05896	-0.15364	-0.04196	0.74571	0.12342	0.10299
V16	0.21839	0.05957	0.59417	0.07854	-0.04147	-0.03595	-0.21635
V17	0.00842	-0.72573	0.10465	-0.01145	-0.11111	0.14204	0.09669
V18	0.02155	0.28114	0.04055	-0.05248	-0.01776	-0.67713	0.22393
V19	0.16704	0.08714	0.08274	-0.03248	-0.68254	-0.23602	-0.31236
V20	[illegible]	-0.26926	0.09244	-0.07079	-0.09502	-0.05929	-0.27391
V21	-0.13019	-0.14727	0.22441	-0.16598	-0.60080	-0.14018	0.16903
V22	0.21076	0.09594	-0.23067	0.04293	-0.02221	-0.00415	0.77448
V23	0.20845	0.42019	0.34717	-0.07276	-0.10372	0.11718	0.05251
V24	0.06784	-0.36550	0.04451	-0.12642	0.10401	0.37962	0.17501
V25	-0.10250	0.21172	0.16789	-0.08458	-0.15613	0.59414	-0.03776
V26	0.06735	0.69657	0.14565	-0.24032	-0.27964	0.04858	-0.13701
V27	-0.06825	-0.17162	0.52020	-0.14037	0.19804	-0.21660	0.84951
V28	0.02323	0.30018	0.30060	-0.00677	-0.52245	-0.19670	0.00235
V29	0.07991	-0.46251	-0.16439	-0.05411	0.22150	0.01956	-0.07761
V30	0.00792	[illegible]	0.09941	0.17859	0.14970	-0.24739	-0.16252
V40	[illegible]	0.06351	0.32280	0.29238	-0.07996	0.00412	0.00752

TRANSFORMATION MATRIX

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7
FACTOR 1	0.88627	-0.02007	0.58397	0.41873	-0.09504	0.02304	-0.05206
FACTOR 2	0.00038	0.90149	-0.01793	-0.01389	-0.41408	0.03852	0.11770
FACTOR 3	0.54073	0.19282	-0.24568	-0.46273	0.51436	-0.07459	0.26313
FACTOR 4	-0.32147	0.27645	0.53244	-0.09424	0.47272	-0.50711	-0.21727
FACTOR 5	0.02794	0.11949	-0.48431	0.72254	0.24215	-0.40402	0.08028
FACTOR 6	-0.14269	-0.17451	0.23451	-0.01309	-0.16512	-0.28913	0.88496
FACTOR 7	-0.23575	0.16903	0.15890	0.28147	0.49555	0.69868	0.27017

TABLE 42

RANK ORDER OF FACTOR LOADINGS FOR VULCAN DATA OF TABLE 41.

FACTOR 1

V3	Color[a]	.91
V2	Word[a]	.86
V4	Wintc[a]	.80
V40	Perceptual Speed	.64
V20	Expedient/ Conscientious	.58
V6	Clspd	.32

(Five other variables loaded between .2 and .3)

FACTOR 2

V13	Trait Anxiety	.74
V17	Affected by Feelings/ Emotionally Stable	-.73
V26	Self assured/ Apprehensive	.70
V12	State Anxiety	.55
V30	Relaxed/Tense	.51
V29	Undisciplined Self conflict/ Controlled	-.46
V23	Trusting/ Suspicious	.42
V28	Group Dependent/ Self sufficient	.30

(Four other variables loaded between .2 and .3)

FACTOR 3

V8	QIH[b]	.79
V7	LIH[b]	.78
V16	Less Intell/ More Intell	.59
V27	Conservative/ Experimenting	.52
V6	Clspd	.51
V23	Trusting/ Suspicious	.35
V40	Perceptual Speed	.32
V28	Group Dependent/ Self sufficient	.30

(Four other variables loaded between .2 and .3)

FACTOR 4

V10	Gft	.83
V5	Clfix	.77
V11	Pursuit	.60
V14	2 Dim	.50
V6	Clspd	.37

(Three other variables loaded between .2 and .3)

FACTOR 5

V15	Reserved/ Outgoing	.75
V19	Sober/Happy go lucky	.68
V21	Shy/Venturesome	.60
V28	Group Dependent/ Self-sufficient	-.52

(Five other variables loaded between .2 and .3)

FACTOR 6

V18	Humble/ Assertive	-.68
V25	Forthright/ Astute	.60
V11	Pursuit	.46
V24	Practical/ Imaginative	.38

(Six other variables loaded between .2 and .3)

FACTOR 7

V22	Tough-minded/ Tender-minded	.77
V27	Conservative/ Experimenting	.55
V12	State Anxiety	.39
V19	Sober/Happy-go-lucky	-.31

(Four other variables loaded between .2 and .3)

[a] V2 V4 are three separate measures from the same test, all of which purport to measure the ability to work under stress.

[b] LIH and QIH are both measures of intelligence--for language and quantitative aspects respectively.

In the VULCAN sample, the first factor is the now familiar "ability to work under stress" factor. All three measures from the Press Test, which measures the ability to work under stress, load cleanly and very highly on this factor. The next highest loading (.64) is for Perceptual Speed, but it also loads on both the "general ability" factor (Factor 3) and the "spatial-analytic" factor (Factor 4). It makes sense that Perceptual Speed might load on all three of these factors. However, it is especially interesting that the highest weight for Perceptual Speed is clearly on the "ability to work under stress" factor and not on the other two. In order to score high on this test, the person must perform under the pressure of a short time limit. In a very short period of time, he must correctly do many problems requiring a meticulous attention to detail. Being able to do this apparently is more related to the ability to work under stress than it is to anything else. Also loading cleanly on the factor is the "conscientious" dimension of V20 (FG). The "conscientious" dimension is described as "persevering, rule-bound, [and] responsible," (Manual for the 16PF, p. 19). This is complementary to the notion of being able to work under stress.

Other variables with low or moderate loadings on the "ability to work under stress" factor are: Closure Speed, the language portion of the Thurstone Test, the Pursuit Test, "the more intelligent" dimension of FB from the 16PF, the "tender-minded" dimension of FI, and the "suspicious" dimension of FL also from the 16PF. The first three of the measures with moderate loadings require performance under stressful and/or time-pressured conditions.

Factor 2 can be called the "anxiety" factor since the first five measures which load on it are all clearly related to anxiety. Clean loading variables are: the "affected by feelings" dimension of FC, the "apprehensive" dimension of FO, and the "tense" dimension of Q4 (all from the 16PF). Also loading high on this factor are trait and state anxiety, although not as cleanly as the others already named. Other measures with appreciable loadings are the "undisciplined self-conflict" dimension of FQ3, the "suspicious" dimension of FL, and the "self-sufficient" dimension of FQ2, all from the 16PF. Additional measures with loadings of between .2 and .3 on the "anxiety" factor are: Two-Dimensional Perception (negatively), the "assertive" dimension of FE, the "expedient" dimension of FG, and the "astute" dimension of FN, also from the 16PF.

Factor 3 is best called a "general ability" factor, although it is not a completely clean factor. A particularly noteworthy feature of the factor is the absence of almost all spatial and analytic measures. The three highest loadings on this factor are those designed as formal measures of general ability; namely, the language and quantitative measures from the Thurstone Test of Mental Alertness, and FB (less intelligent/more intelligent) from the 16PF. The language Thurstone and FB have some relationship to the "ability to work under stress", factor while the quantitative Thurstone has some relationship to the "spatial-analytic" factor (Factor 4). Quantitative tests are by nature more analytic than general so the relationship with the "spatial-analytic" factor is not surprising. The time pressure and alternating question types of the Thurstone Test should be enough to warrant a relationship to the "ability to work under stress" factor for both subtests. It is not clear why the relationship was suggested for only the language subtest. It is also unclear why FB also loaded on the "stress" factor. There was no time limit or other pressure inherent in the testing situation for the 16PF to suggest any kind of stress.

A rather large number of other measures also loaded on this factor, many of which suggest inconsistent relationships with other factors in the solution. Variables which make sense in this as a "general ability" factor are: "experimenting," high Closure Speed, "suspicious," high Perceptual Speed, "self-sufficient," low trait and state anxiety, and "tough-minded." According to the Manual for the 16PF, the "experimenting" person is "interested in intellectual matters" (p. 21), the "suspicious" person is "interested in internal, mental life [and is] deliberate in his actions" (p. 20), the "self-sufficient" person is "accustomed to... making decisions and taking action on his own" (p. 22), and the "tough-minded" person is "practical, realistic...and independent" (p. 20). All of these are somewhat consistent with high general ability.

The fourth factor could be called the "spatial-analytic" factor and is a rather clean and neat factor. The GEFT is the highest loading measure and is factorially "pure." The Closure Flexibility measure is almost factorially "pure" in that the only positive loading for it is on this factor. There is a small negative loading for it on Factor 5, but zero or near zero loadings on every other factor. Both the GEFT and the Closure Flexibility Tests clearly tap analytic ability. The Two-Dimensional Perception Test which is the most spatially oriented of all of the measures in the test battery, has its only positive loading on this factor. Both the Two-Dimensional Perception Test and the Pursuit Test load highly on this factor and at the zero or near zero level on the general ability factor. Other measures which tap spatial or analytic skills which load at some level on this factor are Closure Speed, quantitative Thurstone, and Perceptual Speed. The last measure with an appreciable loading on this factor is the "self-assured" dimension of FO from the 16PF. It is noteworthy that this is the only personality factor which loads appreciably on this factor. All other factors in the solution had more than one personality factor associated with them.

Factor 5 might be called the "outgoing, happy-go-lucky" factor. The two highest loadings, for "outgoing" and "happy-go-lucky" are factorially "pure." The next highest loading is almost factorially "pure" and is for the "venturesome" dimension of FH. The "group-dependent" dimension of FQ2 also has a high loading and is an almost factorially "pure" dimension. Five other variables have loadings of between .2 and .3 on this factor. They are: Closure Flexibility and Two-dimensional Perception (negatively), the "self-assured" dimension of FO, the "experimenting" dimension of FQ1, and the "controlled" dimension of FQ3. This factor is remarkably like the fourth factor from the REDEYE sample with some exceptions. The exceptions are primarily on measures that had comparatively low loadings and which were present in the REDEYE solution but not in the VULCAN solution. The reader is referred to the discussion of the similar factor in the REDEYE chapter since the discussion here would be repetitive.

There is no loading with .7 or higher on Factor 6 and the pattern of meaning for those variables that do load on this factor is ambiguous. Consequently, the factor will be called simply Factor 6. The "humble" dimension, which has the highest loading and which is factorially "pure" describes a person who "tends to give way to others" (Manual for the 16PF, 1972, p. 18). The variable with the next highest loading on this factor is the "astute" dimension which loads on only one other factor (the "anxiety" factor, .21). The "astute" dimension describes a person who is "experienced, worldly, shrewd..., hardheaded and analytical" (astute, p. 21). The practical/imaginative variable loading is .38 and is factorially "pure." Included in the description of the imaginative dimension (p. 20) is "oblivious to particular people." It is assumed that this factorially "pure" variable suggests that in coping with this situation there are constraints set as to whom one behaves in a humble manner.

The other variables with appreciable loadings on Factor 6 are: the Pursuit Test and the Language Thurstone (positively), the Two-dimensional Perception Test (negatively), and the personality dimensions of "sober," "conservative," "group dependent," and "relaxed." In summary, Factor 6 is not easily interpreted.

The seventh factor will be called Factor 7 as there are no variables which load cleanly on it. This factor also is made up of primarily personality characteristics. The highest loading was for "tender-minded" which also loaded on the "ability to work under stress" factor. As has been stated earlier, "tender-mindedness" is marked by dependency and sensitivity. The other personality measures which load on the factor are: the "experimenting" dimension of FQ1, high state and trait anxiety, the "sober" dimension of FF and the "assertive" and "expedient" dimensions of FE and FG respectively. The only measure which loads on Factor 7 which is not a traditional personality measure is the "less intelligent" dimension of FB. Like Factor 6, Factor 7 is not particularly easy to interpret.

Canonical correlation analyses were performed for the VULCAN data in the same way that similar analyses were performed for REDEYE and CHAPARRAL. The same set of variables went into the first set for canonical correlation analysis as went into the first set of variables for CHAPARRAL. Three measures were entered with the second set: WV6 (Final Written Vulcan Test), PVC (Proficiency composite score--VULCAN), and ZR6 (the overall rating score already explained elsewhere).

No significant canonical correlations were observed as a result of the first analysis. The summary of the canonical correlation analysis just described can be found in Table 43 and includes all of the information already outlined under similar discussions earlier in this report. In order to investigate the masking effects of general ability, the second canonical analysis was performed. Only the eight variables from the first set with coefficients of $\pm$ .30 or greater on the first variate in the first analysis were submitted to the second analysis. Similarly, only the two variables from the second set which met this criteria were entered into the second analysis. There was a significant canonical correlation of .629 between the first pair of canonical variates ($p \leq .011$). Almost 40% of the variance was shared by the pair of canonical variates. The results of the second canonical correlation analysis are listed in Table 44.

For the VULCAN analysis, the component variable with the greatest weight to the variate from the first variable set was V13 (Trait Anxiety). In order of importance, the other variables that contributed to the variate were: V30 (16PF-FQ4: Relaxed/Tense), V21 (16PF-FH: Shy/Venturesome), V26 (16PF-FO: Self-Assured/Apprehensive), V12 (State Anxiety), V15 (16PF-FA: Reserved/Outgoing), V10 (GEFT), and finally V4 (Color Naming with Distraction from the Press Test). For the variate from the second variable set, PVC (the Proficiency Composite score) contributed most, followed by WV6 (the Final Written VULCAN Test).

Results. The results of the VULCAN analyses are:

1. The aptitude profile combinations identified in the REDEYE sample were not completely generalizable to the VULCAN sample. Only Profiles 2 and 3 were generalizable.

TABLE 43

SUMMARY OF CANONICAL CORRELATION ANALYSIS OF VULCAN DATA
BEFORE CONSIDERING THE MASKING EFFECTS OF GENERAL ABILITY ($\underline{N}=61$)

- - - - - - - - - - - - - - - CANONICAL CORRELATION - - - - - - - - - -

NUMBER	EIGENVALUE	CANONICAL CORRELATION	WILK'S LAMBDA	CHI-SQUARE	D.F.	SIGNIFICANCE
1	0.69953	0.83638	0.08102	109.31891	87	0.053
2	0.53825	0.73365	0.26964	57.01468	56	0.437
3	0.41606	0.64503	0.58394	23.40094	27	0.663

NO CANONICAL CORRELATION FOUND AT THE 0.050 LEVEL OF SIGNIFICANCE.
THE FIRST (NON SIGNIFICANT) CANONICAL CORRELATION IS PRINTED BELOW.

COEFFICIENTS FOR CANONICAL VARIABLES OF THE FIRST SET

	CANVAR 1
V2	-0.23842
V3	0.19195
V4	0.33303
V5	-0.21538
V6	[illegible]
V7	-0.03034
V8	-0.06384
V10	0.35328
V11	-0.07024
V12	0.41441
V13	-0.52700
V14	-0.12355
V15	-0.41925
V16	0.27252
V17	0.26924
V18	-0.08368
V19	-0.03098
V20	-0.19057
V21	-0.38629
V22	-0.09612
V23	0.00148
V24	0.24224
V25	0.23133
V26	-0.37938
V27	-0.02493
V28	-0.08048
V29	-0.12721
V30	0.40618
V40	-0.18488

COEFFICIENTS FOR CANONICAL VARIABLES OF THE SECOND SET

	CANVAR 1
MVG	0.47025
PVC	0.65697
ZHG	0.12101

TABLE 44

SUMMARY OF CANONICAL CORRELATION ANALYSIS OF VULCAN DATA
AFTER CONSIDERING THE MASKING EFFECTS OF GENERAL ABILITY ($\underline{N}$=61)

- - - - - - - - - - - - - - - - C A N O N I C A L   C O R R E L A T I O N - - - - - - - - - -

NUMBER	EIGENVALUE	CANONICAL CORRELATION	WILK S LAMBDA	CHI-SQUARE	D.F.	SIGNIFICANCE
1	0.39576	0.62910	0.55965	31.63441	16	0.011
2	0.07379	0.27165	0.92621	4.17791	7	0.759

COEFFICIENTS FOR CANONICAL VARIABLES OF THE FIRST SET

	CANVAR 1
V4	0.15392
V10	0.05416
V12	0.40717
V13	-0.66149
V15	-0.36227
V21	-0.52745
V26	-0.50935
V30	0.56557

COEFFICIENTS FOR CANONICAL VARIABLES OF THE SECOND SET

	CANVAR 1
PV6	0.49992
PVC	0.70058

2. Intellectual ability, in this sample splits into two distinct factors, a "general ability" factor and a specialized "spatial-analytic" factor, both of which explain less variance than some factors more closely related to personality.

3. Based on the factor analysis, the "ability to work under stress" factor appears to be the most important factor in surviving VULCAN training, but based on the canonical correlation analysis, it is not as predictive of performance as is the "anxiety" factor or the "outgoing, happy-go-lucky" factor.

4. The underlying factors that characterize men who complete VULCAN Training are, in order of importance: "ability to work under stress," "anxiety," "general ability," "spatial-analytic ability," "outgoing, happy-go-lucky," and two unnamed factors. The first four factors explain 40% of the total variance while all seven explain 54.9%.

5. General ability is crucial to successful VULCAN performance but masks the effects of other crucial factors.

6. Once the masking effects of general ability are taken into consideration, the components predictive of VULCAN performance, in order of importance, are: "anxiety," "outgoing, happy-go-lucky," "ability to work under stress," and "spatial-analytic" ability. Elements of no other identified factors contributed to the prediction of VULCAN performance. (Appendix E)

7. The effects of personality factors contribute far more to the prediction of VULCAN task performance than they do to the underlying structure of abilities of the men who complete VULCAN training.

CHAPTER V

DISCUSSION AND RECOMMENDATIONS

Discussion

It is instructive to compare the results of the factor analyses for REDEYE, CHAPARRAL, and VULCAN. Each was presented and discussed separately earlier in this report. Table 45 shows the information of Tables 23, 35, and 42 all on the same table so as to facilitate comparisons between the seven factors in each sample. The same information is condensed on Table 46.

In the factor analyses summarized in Tables 45 and 46, the groups described can be thought of as having all been successful in completing the specific training. Three characteristics were identified which strongly influence the successful learning of a complex psychomotor task. They are Analytic/Spatial, Ability to Work Under Stress and Anxiety. Although analytic qualities are very often measured along with general ability, the spatial and nonverbal analytic components were stronger predictors of whether a trainee would complete training. They survived as independent factors even after adjusting for the strong effects of general ability. Stress and anxiety measures had been considered one characteristic in the previous contract studies (Hebein, 1978; Sullivan et al., 1978), however, they now appear to be clearly different in their effects on learning.

Although these three factors were the most important factors for all three systems, (REDEYE, CHAPARRAL, and VULCAN) their relative position changed as shown in Table 46. The most drastic change occurred with analytic/spatial which contributed to about twenty percent of the variance in REDEYE and CHAPARRAL and less than six percent in VULCAN.

To the instructional developer, techniques are available to treat the anxiety and analytic characteristics but there is very little research to indicate methods for exploiting the ability to work under stress or compensating for the lack of it. The stress factor never appeared later than third but is first in the VULCAN case. It seems that there is something different about the VULCAN task or the learning environment which makes the ability to work under stress more important than are intellectual abilities.

After these common factors, different sets of personality variables cluster into what would appear to be task related or learning environment related factors. The most frequent variables were "Sober/Happy-go-lucky",

TABLE 45

RANK ORDER OF FACTOR LOADINGS FOR REDEYE, CHAPARRAL AND VULCAN DATA (TAKEN FROM TABLES 23, 35, and 42)

SAMPLE	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7
REDEYE	V10 Geft .87 V5 Clflx .82 V14 2dim .67 V7 LTH .61 V6 Clspd .59 V8 QIH .57 V16 Less Intell/ More Intell .57 V15 Reserved/ Outgoing -.51 V11 Pursuit .42 V25 Forthright/ Astute -.41 V23 Trusting/ Suspicious .30 (Two other variables loaded between .2 and .3)	V3 Color .93 V2 Word .87 V4 Wintc .83 V11 Pursuit .69 V8 QIH .55 V7 LTH .50 V6 Clspd .37 (Four other variables loaded between .2 and .3)	V30 Relaxed/Tense .79 V26 Self-assured/ Apprehensive .75 V13 Trait Anxiety .67 V17 Affected by Feelings/ Emotionally Stable -.59 V16 Less Intell/ More Intell -.41 V12 State Anxiety .40 V21 Shy/Venturesome -.33 (Four other variables loaded between .2 and .3)	V19 Sober/Happy-go-lucky .71 V21 Shy/Venturesome .67 V15 Reserved/ Outgoing .64 V25 Forthright/ Astute -.48 V28 Group Dependent/ Self-sufficient -.42 V13 Trait Anxiety -.35 (Four other variables loaded between .2 and .3)	V23 Trusting/ Suspicious .76 V18 Humble/Assertive .66 V16 Less Intell/ More Intell .39 V24 Practical/ Imaginative -.36 V8 QIH[b] .34 V25 Forthright/ Astute .33 V12 State Anxiety -.32 (Two other variables loaded between .2 and .3)	V22 Tough-minded Tender-minded .70 V29 Undisciplined Self conflict/ Controlled .57 V12 State Anxiety -.56 V20 Expedient/ Conscientious .41 V25 Forthright/ Astute -.30 (Two other variables loaded between .2 and .3)	V27 Conservative/ Experimenting .66 V28 Group Dependent/ Self-sufficient .63 V20 Expedient/ Conscientious -.54 V24 Practical/ Imaginative .51 (Three other variables loaded between .2 and .3)
CHAPARRAL	V8 QIH .80 V10 Geft .75 V7 LTH .70 V16 FB(Low Intell/ High) .62 V6 Clspd .56 V5 Clflx .54 V40 Perceptual speed .44 V14 2 Dim .40 V11 Pursuit .31 V15 Reserved/ Outgoing -.30 (Three other variables loaded between .2 and .3)	V13 Trait Anxiety .83 V12 State Anxiety .80 V17 Affected by Feelings/ Emotionally Stable -.78 V30 Relaxed/Tense .62 V26 Self assured/ Apprehensive .50 V29 Undisciplined Self conflict/ Controlled -.38 V25 Forthright/ Astute .34 (Eight other variables loaded between .2 and .3)	V3 Color .81 V4 Wintc .77 V2 Word .73 V11 Pursuit .50 V18 Humble/ Assertive -.50 V40 Perceptual Speed .50 V28 Group Dependent/ Self-sufficient .35 V26 Self assured/ Apprehensive -.32 V7 LTH .31 V22 Tough minded/ Tender minded .31 (Four other variables loaded between .2 and .3)	V20 Expedient/ Conscientious .76 V28 Group Dependent/ Self-sufficient -.53 V29 Undisciplined Self conflict/ Controlled .51 V5 Clflx -.46 V18 Humble/ Assertive -.45 V14 2 Dim .36 V30 Relaxed/Tense .32 (Three other variables loaded between .2 and .3)	V15 Reserved/ Outgoing .71 V23 Trusting/ Suspicious -.71 V21 Shy/Venturesome .46 V40 Perceptual Speed .39 V16 Low Intell/ High Intell -.31 V28 Group Dependent/ Self-sufficient -.31 (Two other variables loaded between .2 and .3)	V19 Sober/Happy-go-lucky .60 V22 Tough minded/ Tender/minded .54 V21 Shy/Venturesome .53 V40 Perceptual Speed -.37 V26 Self Assured/ Apprehensive -.30 (Two other variables loaded between .2 and .3)	V24 Practical/ Imaginative .73 V27 Conservative/ Experimenting .62 V18 Humble/ Assertive .42 (Seven other variables loaded between .2 and .3)
VULCAN	V3 Color .91 V2 Word .86 V4 Wintc .80 V40 Perceptual Speed .64 V20 Expedient/ Conscientious .58 V6 Clspd .32 (Five other variables loaded between .2 and .3)	V13 Trait Anxiety .74 V17 Affected by Feelings/ Emotionally Stable -.73 V26 Self-assured/ Apprehensive .70 V12 State Anxiety .55 V30 Relaxed/Tense .51 V29 Undisciplined Self-conflict/ Controlled -.46 V23 Trusting/ Suspicious .42 V28 Group Dependent/ Self sufficient .30 (Four other variables loaded between .2 and .3)	V8 QIH .79 V7 LTH .78 V16 Less Intell/ More Intell .59 V27 Conservative/ Experimenting .52 V6 Clspd .51 V23 Trusting/ Suspicious .35 V40 Perceptual Speed .32 V28 Group Dependent/ Self-sufficient .30 (Four other variables loaded between .2 and .3)	V10 Geft .83 V5 Clflx .77 V11 Pursuit .60 V14 2 Dim .50 V6 Clspd .37 (Three other variables loaded between .2 and .3)	V15 Reserved/ Outgoing .75 V19 Sober/Happy-go-lucky .68 V21 Shy/Venturesome .60 V28 Group Dependent/ Self-sufficient -.52 (Five other variables loaded between .2 and .3)	V18 Humble/ Assertive -.68 V25 Forthright/ Astute .60 V11 Pursuit .46 V24 Practical/ Imaginative .38 (Six other variables loaded between .2 and .3)	V22 Tough-minded/ Tender-minded .77 V27 Conservative/ Experimenting .55 V12 State Anxiety .39 V19 Sober/Happy-go-lucky -.31 (Four other variables loaded between .2 and .3)

TABLE 46

SUMMARY OF SEPARATE FACTOR ANALYSES USING SUGGESTED FACTOR NAMES
(CONDENSED FROM DATA OF TABLE 45)

SAMPLE	FACTORS 1	2	3	4	5	6	7
REDEYE ($\underline{N}$=61)	Spatial-Analytic (22.8)	Ability to Work Under Stress (11.8)	Anxiety (8.2)	Happy-go-lucky, Venturesome, Outgoing (7.2)	Assertive-ness (6.5)	Tender-minded, Conscien-tious (5.8)	Factor 7 (4.7)
CHAPARRAL ($\underline{N}$=67)	Analytic (18.7)	Anxiety (11.5)	Ability to Work Under Stress (8.4)	Conscientious, Controlled (6.3)	Trusting, Outgoing (5.7)	Factor 6 (5.2)	Imaginative, Experiment-ing (5.0)
VULCAN ($\underline{N}$=61)	Ability to Work Under Stress (15.5)	Anxiety (10.4)	General Ability (8.4)	Spatial-Analytic (5.8)	Outgoing, Happy-go lucky (5.5)	Factor 6 (4.8)	Factor 7 (4.5)

<u>Note</u>. For all samples, the number in parentheses for each factor represents the percent of variance accounted for by the factor. Also, because of their small sample sizes, statements about the meaning and importance of the various factors should be viewed with caution. Comparisons of factors between samples can be made, but are speculative. The existence of the factors suggested for each sample should be confirmed with larger sample sizes.

"Shy/Venturesome", and "Reserved/Outgoing." The lefthand descriptors tend to indicate individuals who would profit more from group training while the righthand desciptors would probably be more suited to self study. These factors have been the subject of little direct research so that no substantive conclusions can made as to prescibing specific treatments. REDEYE factor four is clearly the same as VULCAN factor five and while this lends some evidence that the analysis method is reliable, it offers little insight into how one applies such a factor to the training task.

Table 47 displays the descriptive components stated in factor terms which predict task performance and retention. Here it is notable that the REDEYE task has more descriptors than do the other two tasks. This is most probably explained by the fact that the REDEYE population had been REDEYE gunners for a considerable time, while the others were just completing training. Normal attrition in this MOS may have caused the characteristics to converge on this profile.

The REDEYE and CHAPARRAL profiles change very little from the factor analysis to the canonical analysis. No factor changes more than one column although many of the CHAPARRAL factors disappear. VULCAN factors change in order of importance from the factors representative of soldiers in VULCAN training to components predicting successful VULCAN training performance. It would appear that the factors which predict successful completion of VULCAN training are different from those predicting high or low VULCAN training performance. It should be noted here that the VULCAN dependent measures were the least objective of all the outcome measures and that anxiety becomes the first factor when predicting VULCAN performance.

The behavior of the "ability to work under stress" is always an important factor in predicting the completion of training. When looking at the performance measures it becomes less important as the size of the team grows. Components of the "ability to work under stress" factor are most important in REDEYE, the one man task, but drop to third in VULCAN, a four man task. They drop out altogether in CHAPARRAL, the five man task. It would appear that the effects of stress can be distributed within a population.

This phenomenon indicates that the Stress factor must always be considered when designing training regardless of the team size. It may or may not be a serious factor when the trainee goes into the field.

One could speculate that the personality factors would be more important in training than in performance because of the possible influence they might have in the interpersonal relationship between the trainee and the instructor to

TABLE 47

SUMMARY OF SEPARATE CANONICAL CORRELATION ANALYSES SHOWING RANK ORDER OF DESCRIPTIVE COMPONENTS STATED IN FACTOR TERMS (INTERPRETED FROM TABLES 25, 37, AND 44)

SAMPLE	ORDER OF CONTRIBUTING FACTORS TO PERFORMANCE				
	First	Second	Third	Fourth	Fifth
REDEYE (N=61)	Ability to Work Under Stress	Spatial-Analytic	Happy-go-lucky, Venturesome, Outgoing	Anxiety	Tender-minded/ Conscientious
CHAPARRAL (N=67)	Analytic	Anxiety	Conscientious/ Controlled	--	--
VULCAN N=61)	Anxiety	Outgoing, Happy-go-lucky	Ability to Work Under Stress	Spatial-Analytic	--

Note. The factor names listed are taken from Table 47. *If one or more variables important to a* factor survived into the second canonical correlation analysis, then the factor with which the variable(s) is associated appears on this table. (See Appendix E) increase the individuals share of the training time. This does not seem to be the case, as "sober/happy-go-lucky" components improved the contribution to prediction in the canonical analysis with both REDEYE and VULCAN while "conscientious/controlled" moved up to third with CHAPARRAL. It should not surprise anyone responsible for training that the characteristics required to learn a task are not necessarily the same as those characteristics required to do the task.

Recommendations

The "ability to work under stress" should be more closely investigated to develop operational parameters and instuctional strategies to optimize the factor in the development of training materials. Some investigation into the question of how much stress should be incorporated into the training in relation to the amount of stress in the task would be of immediate use. Stress, in the medical sense, is being studied intensely at present to determine its effects on productivity. An educational definition may be timely.

The instruments used in this study seem to be valid measures of the ability to work under stress. The factors remained relatively pure through several levels of analysis.

There may be strategies to teach people to work under stress better than they would normally. This would be useful as beginning instruction for a task identified as being stressful.

Although the term "specialized general ability" would seem to be paradoxical, the intellectual measures which traditionally load on general ability seem to be leaning toward the spatial imagery skills and are only useable after a certain threshold of general ability is attained. Some investigation to clarify this relationship may prove productive.

No firm conclusions can be drawn about the efficiency of the strategies used in the REDEYE study until the methodology can be refined to include better controls, larger N, and clearer measures of performance.

However, there was reason to believe as a result of the study that some strategies designed for some groups were in fact effective. For example, in more instances than not, Strategy 3 was more effective for Profile 3 than were other strategies. This was especially true for Film 12 Retention. Those who received Strategy 3 who had Profile 3 contributed enough to make Profile 3 people outperform all other profiles on Film 12 Retention. This was the only instance when Profile 3 outperformed every other profile group. In all other cases, Profile 3 scored lower than every other profile group. While there was no significant interaction observed, such an occurrence arouses speculation that some kind of interaction effect was present.

Consequently, it seems reasonable to conclude that poor performance by certain profile groups could be mediated by particular strategies, as appeared to be the case with Profile 3 on Film Retention for those who received Strategy 3 (just mentioned). This conclusion cannot be stated more firmly because there were not enough people with Profile 2 who received Strategy 2 or enough people with Profile 1 who received Strategy 1 to be able to generalize across all profiles. It was unfortunate that this complex aptitude x treatment interaction methodology did not receive an adequate test in the present study. It remains a promising approach for the improvement of military training--if appropriate controls can be maintained.

Personality variables such as Sober/Happy-go-lucky, Shy/Venturesome and Reserved/Outgoing do contribute significantly to the prediction of learning and performing certain cognitive/psychomotor tasks. They have not been investigated in depth and as a result do not have corresponding instructional uses. Studies using only these variables might allow some theory to develop.

There are still some reasonably clean factors which present the researcher with the dilemma of trying to guess what they are. Continuing research to clarify these contributing characteristics should be encouraged.

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APPENDIX A

DETAILED DESCRIPTIONS (in outline form) OF THE FOUR INSTRUCTIONAL STRATEGIES USED IN THE REDEYE STUDY

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DETAILED DESCRIPTIONS (in outline form) OF THE FOUR INSTRUCTIONAL STRATEGIES USED IN THE REDEYE STUDY

STRATEGY 1: DETAILED

I. GROUP VS. INDIVIDUAL INSTRUCTION

Was primarily individual in that all information was presented via the self-paced packet. The only group requirement was to get the packet and receive general instructions on what they could or could not do before testing. Men could work in groups, with a buddy, or alone. That was their decision to make.

A. Print, in the form of a self-paced packet (with some photos and diagrams).

B. Dummy model of weapon made available for those who wanted to practice firing sequence (outside simulator).

C. Pictures of aircraft posted on walls or model airplanes hanging from ceiling. These were not in the MTS itself but were in adjoining or nearby rooms and/or hallways

D. The simulator itself for practice for those who requested it.

III. SEQUENCE

A. Of Presentation Modes:

1. Print (definitely).

2. Visuals within the print materials.

3/4/5/6. Maybe Simulator.
3/4/5/6. Maybe a Model.
3/4/5/6. Maybe only Mental Imagery.
3/4/5/6. Maybe Visuals other than those embedded within the print materials.

B. Of events during training period:

1. Men were gathered into the MTS in their group, where they met for approximately 3 minutes to find out what they were supposed to do.

2. Men were dismissed to go through their self-paced training.

3. Men "did their own thing" without supervision.

4. Men returned at appointed time or sooner.

5. Men were dismissed for lunch as training was over.

IV. PACING -- Individual

V. MOTIVATION (Including Social Atmosphere)

Intrinsic motivation. No one was supervising to make sure they did what was suggested; it was strictly up to them to motivate themselves. Any interactions they had with others were as a result of their own efforts.

VI. STRUCTURE

A. Of the materials themselves:

Print packet was highly structured and step by step, although it was somewhat verbally loaded in parts.

B. Of the training situation:

There was virtually no structure other than a definite starting and ending point. There was nothing done to insure that all of the content of the packet was "covered."

VII. PRACTICE

A. Mental (as in observing others) and/or actual practice in the simulator was <u>optional</u>. It was <u>not</u> required and was experienced <u>only</u> at the discretion of each individual.

B. Practice with the dummy model <u>outside</u> the simulator was also done only at the discretion of each individual.

C. Mental practice outside the simulator was also a possibility, although not required.

VIII. FEEDBACK

A. No extrinsic feedback was provided as part of the training.

B. Individuals provided their own feedback, if any was to be received.

STRATEGY 2: DETAILED

I. GROUP VS. INDIVIDUAL INSTRUCTION -- Group

II. PRESENTATION MODES

A. Diagrams
B. Visuals (still)
C. Simulator
D. Videotape (motion visual)
E. Discussion
F. Demonstration

III. SEQUENCE

A. Of Presentation Modes:

1. Videotape
2. Visual/Diagrams
3. Diagrams
4. Discussion
5. Visual
6. Visual/Print
7. Discussion
8. Visual
9. Print
10. Discussion
11. Simulator
12. Demonstration in simulator
13. Visual
14. Discussion during visual
15. Simulator

B. Of events during training period:

1. Nineteen minute videotape: "Introduction to Redeye."

2. Slide set on general use of weapon, emphasizing maximum and minimum angles for firing (script read live by instructor).

3. Quiz #1 on angles.

4. Supportive feedback discussion on quiz.

5. Slide set on nomenclature of weapon, repeated twice (script read live by instructor).

6. Quiz #2 on nomenclature.

7. Supportive feedback as in #4 above.

8. Slide set on firing sequence (script read live by instructor).

9. Quiz #3.

10. Supportive feedback as in #4 and #7.

11. Ten to fifteen minute break.

12. Moved to simulator: "hands on" experience. Two passes each on slower aircraft. They were told not to be concerned about getting the correct firing sequence.

13. Demonstration by instructor in simulator.

14. Back to classroom: Slide set on range estimation, identification of aircraft and range ring coverage. Give and take discussion and reasoning on each example working backwards and forwards from certain reference points, while slide set was going.

15. Actual practice (not testing): They were told to be concerned with both sequence and with getting hits this time.

    3 passes each on slow aircraft (Film 5)
    3 passes each on fast aircraft (Film 9)

IV. PACING -- Group

V. MOTIVATION (Including Social Atmosphere)

Provided by instructor in a supportive fashion. There were periodic quizzes after each small chunk of information that were constructed for success and were therefore externally motivating. The peer group modeled the supportive manner of the instructor providing a friendly and non-threatening, yet mild competition.

VI. STRUCTURE

A. Of Materials:

1. Started with mostly simple information and progressed to more complex.

2. Used as few words as possible keeping information only to minimum essentials.

B. Of the Training Situation:

1. Demands made on tests and during practice started very low and continued to increase; as training continued, more was expected.

2. Entire training period proceeded in small steps and in step by step process with each activity being rather short in and of itself.

VII. PRACTICE

Distributed actual practice in the simulator with more at the end of training than earlier in training.

VIII. FEEDBACK

It was immediate, corrective, supportive and continual in both written and practice.

STRATEGY 3: DETAILED

I. GROUP VS. INDIVIDUAL INSTRUCTION -- Group

II. PRESENTATION MODES

A. Videotape (motion visual)

B. Simulator

III. SEQUENCE

A. Of Presentation Modes:

1. Videotape

2. Simulator

B. Of events during training period:

1. Short clip (about 3 minutes) from same videotape shown in Treatment #2. (Only the part on the firing sequence was shown.)

2. Instructor demonstration on activation procedure (once with empty weapon).

3. Instructor gave rules of engagement once orally.

4. Soldiers practiced on Film 5 in the simulator.

5. Soldiers practiced on Film 9 in the simulator.

6. Men were dismissed for lunch at the end of training.

IV. PACING -- Group

V. MOTIVATION (Including Social Atmosphere)

Extrinsic and provided in part by the competitive atmosphere of the peer group that was allowed to emerge. The desire for approval was intended to motivate and approval was <u>not</u> easy to get for those in this strategy.

VI. STRUCTURE

A. Of the Materials:

The only thing other than practice and verbal instructions was the short 3-minute videotape segment and it gave a step by step sequence, which is of course highly structured.

B. Of the training situation:

1. The bare minimum of instruction was presented -- virtually all verbally by the instructor. His remarks were always made at a simple level and any content was presented in small steps. Therefore, the direct instruction was structured.

2. The practice proceeded from easier targets to harder targets which is also a structured approach.

3. HOWEVER, since practice was the main method of instruction and since they got so much of it compared to other groups, it might be stated that there was less structure in the training situation (for the most part) than for the other groups. This was because even though the men had to be present together during all practice, there was a loose and unstructured atmosphere to the situation. Such a situation was able to develop because of the lack of formal instruction.

4. The men learned things more experientially than conceptually, in contrast to the other groups. In this sense there was less structure than in other groups--a more inductive approach.

VII. PRACTICE

A. It was the main method of instruction, therefore, it was, in a sense, massed practice.

B. Since only 2 people could physically practice at a time it was necessarily somewhat distributed for each person.

C. The total atmosphere of the practice, if you consider both mental and physical practice, was definitely massed rather than distributed.

VIII. FEEDBACK

A. Immediate through practice.

B. Provided primarily when something wrong was done.

C. Was minimal in terms of corrective information.

D. Given by both instructor and peers in a negative way.

STRATEGY 4: DETAILED

I. GROUP VS. INDIVIDUAL INSTRUCTION -- Group

II. PRESENTATION MODES

A. Visuals (still)

B. Lecture

C. Diagrams

D. Simulator

E. Discussion

F. Videotape (motion visual)

G. Print

III. SEQUENCE

A. Of Presentation Modes:

1. Videotape

2. Visual/diagrams with lecture

3. Discussion (during visuals)

4. Visual/diagrams with lecture

5. Print

6. Visual

7. Print

8. Simulator

B. Of events during Training:

1. Videotape (same as in Treatment #2).

2. Part I of slide set on techniques of fire with lecture live from instructor to accompany slides.

3. Discussion in question and answer format while slide set was going (for material of Part I.).

4. Break.

5. Part II of slide set on techniques of fire with lecture live from instructor to accompany slides.

6. Written quiz on techniques of fire.

7. Self evaluation.

8. Break.

9. Techniques of fire test (written) with some items requiring judging something from a visual on a slide.

10. Practice on film 9 in simulator; 2 passes per person only.

11. Dismissal for lunch at the end of training.

IV. PACING -- Group

V. MOTIVATION (Including Social Atmosphere)

A. Extrinsic motivation in that a criterion was set up at the beginning of instruction of 90%. The soldiers were told they must meet it.

B. Although it did not happen with the particular military instructor that participated in this study, usually the regular army training is based on negative incentives motivation (e.g., "If you don't do well, I'm going to put you or detail for 8 hours").

VI. STRUCTURE

A. Of the Materials:

1. The script was not as structured as the one in Treatment #2, primarily because the same information was repeated in more than one place with intervening information on other material in between.

2. Also, some of the sequential information was embedded within some of the other information. There were not clear separations in the presentation from one topic to another.

3. However, there was a structure that was repeated several times in the repetition sequence so that within smaller segments there was more structure.

4. There were a lot of words for each slide -- fewer words may have provided more structure.

B. Of the Training Situation:

It was structured in that it went right along from one activity to another and clear expectations were set.

VII. PRACTICE

Very limited actual practice at the end of training.

VIII. FEEDBACK

Immediate on both tests and practice, but given with a more neutral attitude than in either Group 2 or 3.

APPENDIX B

EXCEPTIONS TO STANDARD EXPERIMENTAL PROCEDURES DURING REDEYE STUDY

APPENDIX B

EXCEPTIONS TO STANDARD EXPERIMENTAL PROCEDURES DURING REDEYE STUDY

This appendix describes the exceptions to the standard field procedures that occurred at each fort. In addition, any information about the overall experimental conditions at each fort that might provide insights to later interpretation of the findings are documented.

At Fort Carson, training was conducted on the first day and aptitude testing on the second day as planned. For performance testing on the first day, the print of Film 10 that was available was very old and was not in good working order. There was no other print of Film 10 available and no other film has the same target representation as does Film 10. There was no other choice but to use the bad print of the film. If any other film were used instead, it would invalidate the performance testing because the men, across all forts would then not be tested at the same skill level.

During testing, 12 of the 20 targets on Film 10 appeared in a normal enough manner that they could be engaged by the gunners just as would any target on a film in good working order. The other 8 targets appeared with erratic motion that sometimes defied the capabilities of any aircraft. For example, some high performance jets moved across the sky, took a dive into the ground and continued to fly on the ground before abruptly changing direction to bounce back and forth between sky and ground. Since gunners are not trained to engage targets like that, having to engage such a target would be an unfair test of a gunner. There was no way to predict which targets would behave erratically. Consequently, as soon as it became clear that a gunner was faced with such a target, he was told to disregard it and was given another target instead. While this provided a small amount of extra practice for some gunners, every gunner seemed to have an equal chance to be faced with an erratic target. In other words, it appeared to randomize itself out. Other than the problem with Film 10, everything at Fort Carson proceeded according to plan.

Such was not the case at Fort Bragg, however. Upon arrival at Fort Bragg the day before training was to begin, it was brought to the attention of the investigator and assistants that the soldiers who had been tasked for two days of training would not be released for that duty. Instead, the division commander had called a surprise inspection that would prevent them from participating in the study. On-site coordination involving the R&D coordinator, members of the XVIII Corps ADA element, and Division personnel was effective in making some changes. A commitment that the soldiers would appear at 12:30 p.m. on the first day instead of at 7:30 a.m. as originally planned was obtained. In addition, assurances were given that the troopers would be authorized to participate on the second day as well.

These conditions required that the field procedures at Fort Bragg be altered. Instead of having training on the first day, the aptitude testing was done during the afternoon after the men arrived. They did not arrive until almost 45 minutes after the appointed time. After the men arrived, the aptitude testing was conducted without complication other than the fact that it was out of sequence from the experimental plan.

The next day the men arrived for training by 7:30 a.m. Some informed the experimenters that they had to be dismissed by approximately 2:30 p.m. because it was payday and they had "payday activities" scheduled. They volunteered to work through lunch so they could be dismissed early. Other troopers informed the Major that their commanding officer had indicated that they must return to their unit by 1:00 p.m. for another special inspection. Again, on-site coordination by the Major resulted in assurances that all the men would be present for the duration of the training and testing that day. He convinced the commanding officer that the men should be dismissed from the inspection so that they could complete the training. However, it was decided to work through the lunch hour because the indications were that some of the men still might be pulled out for inspection.

Fort Bragg was the only fort where the possibility of losing subjects during training or before training ended was a constant condition. It was a condition that was known to both the soldiers and the experimenters. This meant that the entire conduct of the study at Fort Bragg was done in a different time frame and order than at the other sites. However, if such arrangements had not been made, it is doubtful if the study could have been conducted there at all. The research team was fortunate to have the major as an assistant because he was able to rectify many situations that would have otherwise been beyond control at Fort Bragg or at the other installations.

There were additional complications at Fort Bragg. The tracking head trainers were not working properly during training or performance testing. It was learned that most of the THTs needed new seekers and therefore were not picking up the IR heat source very well. Some men had to be sent back to their units to get other THTs so that there would be working equipment for the performance testing. For the first part of the testing period, one of the working THTs started to malfunction intermittently. This made it difficult to know whether the gunner was making errors or whether there was really a malfunction in the trainer. It was at that point that use of that trainer was discontinued and someone was sent to locate a different trainer. For about one hour of the performance testing, there was only one working THT, which slowed the progress of the testing coniderably.

By the time a new trainer was brought in, it was almost 2:00 p.m. and the men were anxious to leave for the day, having already worked through lunch. With only about a half hour left to complete all testing, three troopers were called for the third time to report to the inspection after all. In all the other instances, when their commanding officer had recalled them, the Major had been able to talk the officer out of it. In this instance, the Major had stepped out for a few minutes to take care of other business, so the officer had to be obeyed. As a result, those troopers had to be dropped from the study.

All in all, the complications at Fort Bragg, as numerous as they were, did cast a shadow on the fidelity of the procedures there. The whole tone of the base was quite different from that of any other fort represented in the study.

At Fort Riley, the most serious complications concerned the actual population as well as the conditions surrounding efforts to put them through the training. Of the 18 soldiers who appeared in the first group at Ft. Riley, only 16 received security clearance to enter the MTS. The other two had been court-martialed and could not be given clearance. Of the 23 soldiers in the second group, the security clearance for 5 of them was "unknown." This was totally unexpected because confidential clearance is a prerequisite to being in the 16P MOS. Confidential clearance is also required to enter any MTS. As a result, complete data for both independent and dependent measures could be collected on only the 16 soldiers from the first group who had clearance.

For the second group at Fort Riley, independent measures were collected on all 23 soldiers, without entering the MTS, while clearances were being checked. The next day, the issue of security clearances for the five soldiers was still unresolved. In addition, the primary piece of MTS equipment needed for training had been removed from the premises for repair. Consequently, no training was conducted and no performance data could be collected for the second group at that time. Approximately 30 days later, 14 of the 23 soldiers from that group were trained and tested for the first time. (This should have been when retention data was collected on them.) Only one of the five with questionable security clearance status had been able to get clearance. The other five who did not appear for training were either on leave or were being held by their commanding officers for other duty.

With regard to the actual training, for the first group it was conducted on the first day and the aptitude testing on the morning of the second day. Other than the fact that training started late on the first day because of the clearance problems, everything went smoothly and according to plan. However, when the operator of the MTS took the special film projector away at the end of the first day to be repaired, there was some concern on the part of the investigators. There had been no reason to suspect that something had broken, because the films for the first group all ran quite normally. Nevertheless, assurances were made that the projector would be back in time to train the second group two days later.

The second group came on the afternoon of the second day at Fort Riley for aptitude testing. They were not present with the first group at the same time at all during training or testing even though both groups did receive aptitude testing on the same day. This second group at Fort Riley was the only group of soldiers at any fort to come to the experiment directly from having been out on maneuvers in the field. They were tired and irty and had already had a full day's work before they reached the classroom. Once the testing began, they seemed more fresh and relaxed, probably because it was a change of pace for them. All procedures for aptitude testing went smoothly and according to plan other than the fact that the testing took place in an afternoon instead of a morning.

On the next day, the men arrived at the MTS along with the experimenters, only to find it locked with a note from the operator that the projector would not be fixed for "a while." Since clearance still had to be secured for some men, as outlined earlier, a small wait seemed reasonable. Unfortunately, nothing worked to secure the clearances or to repair the projector and the men had to be dismissed and told to return about 30 days later for the training. This group is the only group who had such a long time lag between their aptitude testing and their training/performance testing. These circumstances were far beyond the control of the research team.

When the research team returned a month later to train the second group, only 14 of the 23 appeared. The training began over an hour late because of a malfunctioning videotape player and another piece of missing equipment. Once everything was there and in working order, the training progressed smoothly. The films worked well as did the THTs except for an occasional malfunction of the batteries for the BCUs. Such malfunctions were mild compared to what happened at Fort Bragg, so it was not considered serious.

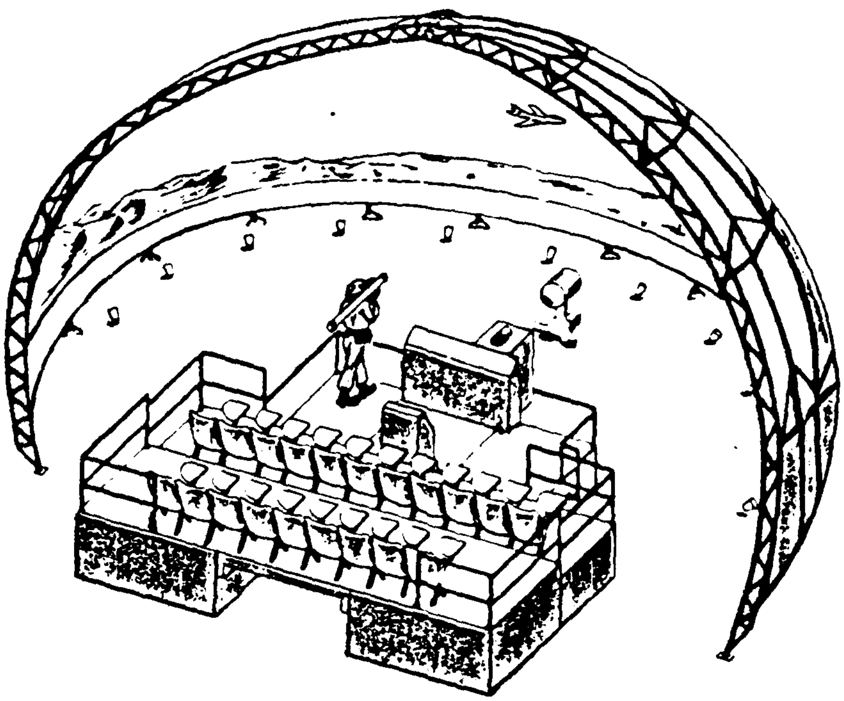
In between the two trips to Fort Riley, the group at Fort Hood was trained and tested. This was the first fort at which there were not all REDEYE films to be used in the MTS. The next generation up from REDEYE is the STINGER Missile System. It is similar to the REDEYE but has a greater range and capability. Eventually, all REDEYE films will be replaced by STINGER films. STINGER films have some targets that would be out of range for the Redeye. For one of the practice films, there was a STINGER film in use at Fort Hood. Also, Film 10 at Fort Hood was a STINGER film. It was the judgement of all of the experimenters that the STINGER Film 10 was not significantly different from the REDEYE Film 10. However, there was also agreement that the launch boundary and IR lights on the MTS console were inaccurate. As a result, independent judgements by one experimenter were made with regard to launch boundary for every launch.

In addition, all experimenters agreed that the IR spot, superimposed on the film, appeared to be slightly off the mark. This resulted in some errors that were not the gunners' faults. There were some complaints from the gunners that the THTs were not picking up IR properly. From the collective observation of all who were doing the scoring, it was determined that most of the time, the mistakes that concerned acquisition of IR tone were the fault of the gunners and not of the equipment. One of the THTs did have a poorly functioning battery pack. If the battery clearly malfunctioned, the gunner was given another target to engage.

In terms of sequence of activities, at Fort Hood, the training was done on the first day and the aptitude testing on the second day according to the original experimental plan.

APPENDIX C

MOVING TARGET SIMULATOR (MTS) AND SCORING PROCEDURES DURING REDEYE STUDY



Moving Target Simulator (MTS)
(from FM 44-23-1, p. 7-4, Department of the Army, October 1977)

Point Values Used in Scoring Film 10 & Film 12 for Refresher REDEYE training:

For each try:

A. If the gunner did not activate the weapon at all, did not put in the BCU, did not take the cover off, did not acquire the target at all, or did not continue to keep the target acquired through the sequence: 0 pts.

B. If he acquired the target only: 1 pt.

C. If he did B above and also uncaged: 2 pts.

D. If B and C above and also superelevated: 3 pts.

E. If B, C and D above and got a hit, but it was either out of launch boundary or he violated 65° angle rule: 4 pts.

F. If B, C and D above and got a clean hit: 5 pts.

(Note: Condition D above is not possible to get without also getting condition E or F as well. It was believed that the additional weighting that results for any kind of hit was appropriate.

A try consists of the time from trigger pull to trigger pull or the time that a single target remains in view (whichever comes first).

It does not count as a try if the gunner does not pull the trigger UNLESS he had no other trigger pull during the time that the target was in view.

There was only one possible instance when a gunner could get a perfect score without pulling the trigger; that was for a target that never came within range. If he correctly did NOT fire in that instance, he earned 5 points for that try.

APPENDIX D

CORRELATION MATRICES UPON WHICH FACTOR ANALYSES AND CANONICAL CORRELATION ANALYSES WERE BASED

APPENDIX D

CORRELATION MATRICES UPON WHICH FACTOR ANALYSES AND CANONICAL CORRELATION ANALYSES WERE BASED

In this appendix, two correlation matrices for each sample are presented--one for the factor analyses and another which included both independent and dependent variables. In addition, summaries of the variable names and labels are repeated (taken from Chapters III and IV) so that the reader does not have to refer back to the body of the report to make interpretations.

SUMMARY OF INDEPENDENT AND DEPENDENT VARIABLES COLLECTED FROM REDEYE GUNNERS AT TIME OF REFRESHER TRAINING

Variable Name	Variable Label	Extended Label
V1	Age	
V2	Word	From the Press Test
V3	Color	From the Press Test
V4	Wintc	From the Press Test (Color naming with distraction)
	(Note:	V2-V4 purport to measure the ability to work under stress.)
V5	Clflex	Closure Flexibility
V6	Clspd	Closure Speed
V7	LTH	Language Thurstone
V8	QTH	Quantitative Thurstone
V9	TTH	Total Thurstone
V10	GEFT	Group Embedded Figures Test
V11	Pursuit	From MacQuarrie Test
V12	State	State Anxiety
V13	Trait	Trait Anxiety
V14	2dim	Two Dimensional Spatial Relations
V15	FA	Reserved/Outgoing
V16	FB	Less Intell/More Intell
V17	FC	Affected by feelings/Emotionally Stable
V18	FE	Humble/Assertive
V19	FF	Sober/Happy-go-lucky
V20	FG	Expedient/Conscientious
V21	FH	Shy/Venturesome
V22	FI	Tough-minded/Tender-minded
V23	FL	Trusting/Suspicious
V24	FM	Practical/Imaginative
V25	FN	Forthright/Astute
V26	FO	Self-Assured/Apprehensive
V27	Q1	Conservative/Experimenting
V28	Q2	Group-dependent/Self-sufficient
V29	Q3	Undisciplined Self-conflict/Controlled
V30	Q4	Relaxed/Tense
V33	Film 10	Film 10 (Fast, Constant Speed Targets)
V34	Film 12	Film 12 (Variable Speed, Mixed Target-Types)
V35	MTS ANX	State Anxiety for MTS Performance
V36	RRP	Range Ring Profile Written Test
V37	Film 10R	Film 10 Retention
V38	Film 12R	Film 12 Retention
V39	RRPR	Range Ring Profile Retention

CORRELATION MATRIX FOR FACTOR
ANALYSES IN REDEYE STUDY (N=61)

CORRELATION COEFFICIENTS..

	V2	V3	V4	V5	V6	V7	V8	V10	V11	V12
V2	1.00000	0.85276	0.72281	0.33561	0.42087	0.48514	0.49644	0.36141	0.59947	0.10631
V3	0.85276	1.00000	0.80470	0.31901	0.30298	0.54103	0.56404	0.33284	0.60049	0.06095
V4	0.72281	0.80470	1.00000	0.35238	0.38882	0.50136	0.52656	0.37259	0.50293	0.01398
V5	0.33561	0.31901	0.35238	1.00000	0.51268	0.60837	0.60297	0.77147	0.51778	0.14011
V6	0.42087	0.30298	0.38882	0.51268	1.00000	0.44652	0.38479	0.52655	0.46151	0.28755
V7	0.48514	0.54103	0.50136	0.60837	0.44652	1.00000	0.89103	0.65875	0.48547	-0.14079
V8	0.49644	0.56404	0.52656	0.60297	0.38479	0.89103	1.00000	0.65236	0.58942	-0.05015
V10	0.36141	0.33284	0.37259	0.77147	0.52655	0.65875	0.65236	1.00000	0.51102	0.08629
V11	0.59947	0.60049	0.50293	0.51778	0.46151	0.48547	0.58942	0.51102	1.00000	0.10108
V12	0.10631	0.06095	0.01398	0.14011	0.28755	-0.14079	-0.05015	0.08629	0.10108	1.00000
V13	-0.25460	-0.18802	-0.33656	-0.13314	-0.05532	-0.32702	-0.27982	-0.19737	-0.08685	0.42283
V14	0.15533	0.12726	0.17368	0.60149	0.35049	0.31261	0.26338	0.52693	0.31082	0.26363
V15	-0.21268	-0.13758	-0.14529	-0.30709	-0.25674	-0.31093	-0.26706	-0.44436	-0.16954	-0.06785
V16	0.30335	0.30566	0.29797	0.45143	0.18123	0.57956	0.55399	0.54877	0.20463	-0.14601
V17	0.26457	0.10221	0.17495	-0.03996	0.05012	0.11602	-0.01270	-0.01590	-0.04019	-0.07755
V18	-0.03505	0.13079	0.01755	-0.19836	-0.20270	-0.00958	0.04446	-0.06639	-0.03708	-0.14539
V19	-0.08915	-0.10519	0.04131	0.04502	0.09299	0.01718	0.02176	0.02615	0.00337	-0.04948
V20	0.07089	0.07010	0.02080	0.06936	0.05635	0.06036	0.03395	0.19064	0.19108	-0.12716
V21	0.01465	0.05060	0.21722	0.10053	-0.05354	0.18611	0.14483	0.00575	-0.00167	-0.13221
V22	0.06060	0.00924	0.00634	-0.14372	-0.10565	0.08292	0.00235	-0.19989	0.02383	-0.26460
V23	0.07671	0.12617	0.10328	0.24951	0.11988	0.21290	0.28491	0.41229	0.22839	-0.07629
V24	0.29671	0.22522	0.15282	0.00429	0.12532	0.07662	-0.03312	-0.04720	0.08512	0.02978
V25	0.03900	0.13824	-0.04183	-0.18699	-0.33037	-0.23955	-0.13213	-0.25311	-0.15318	0.03940
V26	-0.12398	-0.15284	-0.25787	0.01547	0.17289	-0.16926	-0.12501	-0.02215	0.12668	0.26367
V27	0.10943	-0.00052	0.00703	0.08853	0.13861	0.25355	0.24577	0.26282	-0.10729	0.07786
V28	0.15288	0.09018	0.14006	0.07196	0.34662	0.20114	0.10289	0.12826	0.09300	0.01537
V29	-0.07947	-0.16954	-0.05700	-0.03069	0.00805	0.03106	-0.05405	0.06336	-0.09423	-0.24350
V30	-0.21095	-0.18830	-0.15301	-0.18127	0.10184	-0.21064	-0.12070	-0.17335	-0.01293	0.28451

	V13	V14	V15	V16	V17	V18	V19	V20	V21	V22
V2	-0.25460	0.15533	-0.21268	0.30335	0.26457	-0.03605	-0.08915	0.07089	0.01465	0.06060
V3	-0.18802	0.12726	-0.13758	0.30566	0.10221	0.13079	-0.10519	0.07010	0.05060	0.00924
V4	-0.33656	0.17368	-0.14529	0.29797	0.17495	0.01755	0.04131	0.02080	0.21722	0.00634
V5	-0.13314	0.60149	-0.30709	0.45143	-0.03996	-0.19836	0.04502	0.06936	0.10053	-0.14372
V6	-0.05532	0.35049	-0.25674	0.18123	0.05012	-0.20270	0.09299	0.05635	-0.05354	-0.10565
V7	-0.32702	0.31261	-0.31093	0.57956	0.11602	-0.00958	0.01718	0.06036	0.18611	0.08292
V8	-0.27982	0.26338	-0.26706	0.55399	-0.01270	0.04446	0.02176	0.03395	0.14483	0.00235
V10	-0.19737	0.52693	-0.44438	0.54877	-0.01590	-0.06639	0.02615	0.19064	0.00575	-0.19989
V11	-0.08685	0.31082	-0.16954	0.20463	-0.04019	-0.03708	0.00337	0.19108	-0.00167	0.02383
V12	0.42283	0.26363	-0.06785	-0.14601	-0.07755	-0.14539	-0.04948	-0.12716	-0.13221	-0.26460
V13	1.00000	0.05487	-0.10484	-0.32520	-0.45477	0.13337	-0.22800	-0.07086	-0.38877	-0.08817
V14	0.05487	1.00000	-0.37519	0.27588	-0.00421	-0.00842	0.02338	0.02213	-0.00640	-0.05494
V15	-0.10484	-0.37519	1.00000	-0.36226	0.09908	-0.16717	0.29902	-0.14486	0.27768	0.06959
V16	-0.32520	0.27588	-0.36226	1.00000	0.20755	0.11425	-0.16227	0.05192	0.11303	-0.07378
V17	-0.45477	-0.00421	0.09908	0.20755	1.00000	-0.07280	0.11513	0.00930	0.32590	0.04434
V18	0.13337	-0.00842	-0.16717	0.11425	-0.07280	1.00000	-0.16245	-0.07543	-0.07966	-0.10770
V19	-0.22800	0.02338	0.29902	-0.16227	0.11513	-0.16245	1.00000	-0.02800	0.30011	0.03069
V20	-0.07086	0.02213	-0.14486	0.05192	0.00930	-0.07543	-0.02800	1.00000	-0.09262	0.21605
V21	-0.38877	-0.00640	0.27768	0.11303	0.32590	-0.07966	0.30011	-0.09262	1.00000	-0.02109
V22	-0.08817	-0.05494	0.06959	-0.07378	0.04434	-0.10770	0.03069	0.21605	-0.02109	1.00000
V23	0.06418	0.15119	-0.09721	0.36012	-0.03715	0.36728	0.00748	-0.02095	0.02182	-0.14990
V24	-0.06609	0.24521	-0.01919	-0.07417	0.20976	0.11002	-0.06712	-0.22537	0.00751	0.13860
V25	0.27956	-0.15262	-0.08463	-0.16688	-0.21834	0.35912	-0.23890	-0.08718	-0.31836	-0.13263
V26	0.44593	-0.05204	0.05956	-0.25122	-0.39241	0.02982	0.04223	0.03174	-0.21896	-0.08264
V27	-0.28535	0.08724	-0.05133	0.26280	0.21553	-0.06940	0.24140	-0.22612	0.05998	0.05996
V28	0.02130	0.06415	-0.43197	0.06950	0.03130	0.00680	-0.22663	-0.10755	-0.25330	0.04312
V29	-0.25157	0.05102	0.16944	0.00572	0.19941	-0.08075	0.07027	0.11289	0.32723	0.38436
V30	0.40776	-0.07107	0.10811	-0.30325	-0.34548	0.00527	0.09610	0.02167	-0.07538	-0.00083

	V23	V24	V25	V26	V27	V28	V29	V30
V2	0.07671	0.29671	0.03900	-0.12398	0.10943	0.15288	-0.07947	-0.21095
V3	0.12617	0.22522	0.13824	-0.15284	-0.00052	0.09018	-0.16954	-0.18830
V4	0.10328	0.15282	-0.04183	-0.25787	0.00703	0.14006	-0.05700	-0.15301
V5	0.24951	0.00429	-0.18699	0.01547	0.08853	0.07196	-0.03069	-0.18127
V6	0.11988	0.12532	-0.33037	0.17289	0.13861	0.34662	0.00805	0.10184
V7	0.21290	0.07662	-0.23955	-0.16926	0.25355	0.20114	0.03106	-0.21064
V8	0.28491	-0.03312	-0.13213	-0.12501	0.24577	0.10289	-0.05405	-0.12070
V10	0.41229	-0.04720	-0.25311	-0.02215	0.26282	0.12826	0.06336	-0.17335
V11	0.22839	0.08512	-0.15318	0.12668	-0.10729	0.09300	-0.09423	-0.01243
V12	-0.07629	0.02978	0.03940	0.26367	0.07786	0.01537	-0.24350	0.28451
V13	0.06418	-0.06609	0.27956	0.44593	-0.28535	0.02130	-0.25157	0.40776
V14	0.15119	0.24521	-0.15262	-0.05204	0.08724	0.06415	0.05102	-0.07107
V15	-0.09721	-0.01919	-0.08463	0.05956	-0.05133	-0.43197	0.16944	0.10811
V16	0.36012	-0.07417	-0.16688	-0.25122	0.26280	0.06950	0.00572	-0.30325
V17	-0.03715	0.20976	-0.21834	-0.39241	0.21553	0.03130	0.19941	-0.34548
V18	0.36728	0.11002	0.35912	0.02982	-0.06940	0.00680	-0.08075	0.00527
V19	0.00748	-0.06712	-0.23890	0.04223	0.24140	-0.22663	0.07027	0.09610
V20	-0.02095	-0.22537	-0.08718	0.03174	-0.22612	-0.10755	0.11289	0.02167
V21	0.02182	0.00751	-0.31836	-0.21896	0.05998	-0.25330	0.32723	-0.07538
V22	-0.14990	0.13860	-0.13263	-0.08264	0.05996	0.04312	0.38436	-0.00083
V23	1.00000	-0.27763	0.11665	0.12273	0.17273	0.10690	0.05724	0.00633
V24	-0.27763	1.00000	0.01945	-0.28264	0.12129	0.18553	0.05492	-0.07596
V25	0.11665	0.01945	1.00000	0.03391	-0.13131	0.06281	-0.22001	-0.09435
V26	0.12273	-0.28264	0.03391	1.00000	-0.21927	-0.14597	-0.28055	0.41377
V27	0.17273	0.12129	-0.13131	-0.21927	1.00000	0.21153	0.18697	-0.12358
V28	0.10690	0.18553	0.06281	-0.14597	0.21153	1.00000	-0.08893	0.16412
V29	0.05724	0.05492	-0.22001	-0.28055	0.18697	-0.08893	1.00000	-0.16389
V30	0.00633	-0.07596	-0.09435	0.41377	-0.12358	0.16412	-0.16389	1.00000

DETERMINANT OF CORRELATION MATRIX = 0.0000000(0.1228341?D-07)

CORRELATION MATRIX FOR INDEPENDENT AND DEPENDENT VARIABLES IN REDEYE STUDY (N=61)

CORRELATION COEFFICIENTS...

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12
V1	1.00000	0.09713	0.14948	0.12281	0.02260	-0.02510	0.27396	0.17949	0.23854	-0.00903	0.05060	-0.32928
V2	0.09713	1.00000	0.85276	0.72281	0.33561	0.42087	0.49514	0.45644	0.50390	0.37140	0.59947	0.10631
V3	0.14948	0.85276	1.00000	0.80470	0.31901	0.30298	0.54103	0.56404	0.56669	0.31284	0.60049	0.06055
V4	0.12281	0.72281	0.80470	1.00000	0.35238	0.38882	0.50136	0.52655	0.52691	0.37259	0.50293	0.01397
V5	0.02260	0.33561	0.31901	0.35238	1.00000	0.51268	0.60938	0.60297	0.62296	0.77148	0.51778	0.14011
V6	-0.02510	0.42087	0.30298	0.38882	0.51268	1.00000	0.44652	0.38479	0.43087	0.52655	0.46151	0.20755
V7	0.27396	0.49514	0.54103	0.50136	0.60938	0.44652	1.00000	0.89104	0.97832	0.65875	0.48547	-0.14079
V8	0.17949	0.45644	0.56404	0.52655	0.60297	0.38479	0.89104	1.00000	0.96572	0.65235	0.58942	-0.05015
V9	0.23854	0.50390	0.56669	0.52691	0.62296	0.43087	0.97832	0.96572	1.00000	0.67430	0.54650	-0.10339
V10	-0.00903	0.37140	0.31284	0.37259	0.77148	0.52655	0.65875	0.65235	0.67430	1.00000	0.51102	0.08629
V11	0.05060	0.59947	0.60049	0.50293	0.51778	0.46151	0.48547	0.58942	0.54650	0.51102	1.00000	0.10108
V12	-0.32928	0.10631	0.06055	0.01397	0.14011	0.20755	-0.14079	-0.05015	-0.10339	0.08629	0.10108	1.00000
V13	-0.31364	-0.25460	-0.18802	-0.33656	-0.13314	-0.05532	-0.22702	-0.27982	-0.31466	-0.15737	-0.09895	0.42283
V14	0.03707	0.15533	0.12726	0.17368	0.60149	0.35049	0.31261	0.26338	0.29891	0.52693	0.31863	0.26363
V15	-0.00533	-0.21268	-0.13758	-0.14529	-0.30708	-0.25674	-0.31093	-0.26707	-0.29964	-0.44438	-0.16954	-0.06765
V16	0.12365	0.30335	0.30566	0.29797	0.45143	0.18123	0.57956	0.55399	0.58414	0.54877	0.20463	-0.14601
V17	0.11237	0.26458	0.10221	0.17495	-0.03996	0.05012	0.11602	-0.01270	0.06055	-0.01590	-0.04019	-0.07755
V18	0.02617	-0.03505	0.13079	0.01755	-0.19836	-0.20270	-0.00958	0.04446	0.01480	-0.06639	-0.03708	-0.14539
V19	-0.08653	-0.08915	-0.10519	0.04131	0.04502	0.09299	0.01718	0.02176	0.01975	0.02616	0.00337	-0.04948
V20	0.18777	0.07089	0.07010	0.02080	0.06936	0.05635	0.06036	0.03395	0.05000	0.19064	0.19108	-0.12716
V21	0.18029	0.01465	0.05060	0.21722	0.10053	-0.05354	0.18611	0.14483	0.17249	0.00575	-0.00167	-0.13221
V22	0.20095	0.00060	0.00924	0.00634	-0.14372	-0.10565	0.08292	0.00235	0.04849	-0.19985	0.02383	-0.26460
V23	0.08767	0.07671	0.12617	0.10328	0.24951	0.11988	0.21290	0.28491	0.25172	0.41229	0.22839	-0.02629
V24	0.01713	0.29671	0.22522	0.15282	0.00429	0.12532	0.07662	-0.03312	0.02870	-0.04720	0.08512	0.02578
V25	0.11023	0.03950	0.13824	-0.04183	-0.18659	-0.33017	-0.23955	-0.13213	-0.19726	-0.25311	-0.15318	0.03540
V26	-0.31565	-0.12398	-0.13204	-0.25787	0.01547	0.17289	-0.16926	-0.12501	-0.15382	-0.02215	0.12658	0.26367
V27	-0.03277	0.10943	-0.00052	0.00703	0.08853	0.13861	0.25355	0.24577	0.25710	0.20282	-0.10725	0.07766
V28	0.08542	0.15788	0.09014	0.14006	0.07196	0.34662	0.20114	0.10289	0.16196	0.12826	0.09300	0.01537
V29	0.25325	-0.07647	-0.16954	-0.05700	-0.03069	0.00805	0.03106	-0.05405	-0.00689	0.06336	-0.09423	-0.29350
V30	-0.13214	-0.21095	-0.18830	-0.15201	-0.18127	0.10184	-0.21064	-0.12070	-0.17552	-0.17335	-0.01243	0.28451
V33	-0.25946	0.21296	0.19417	0.20150	0.24020	0.03925	0.02162	0.10907	0.06212	0.18278	0.20501	0.12767
V34	0.08458	0.12295	0.21582	0.29704	0.17545	0.14645	0.20377	0.16767	0.19644	0.25421	0.07645	0.00855
V35	-0.20488	0.07725	-0.00146	-0.06596	0.04816	0.17209	-0.19304	-0.14005	-0.17428	-0.04563	-0.07940	0.65735
V36	0.13070	0.32907	0.35664	0.35159	0.51433	0.39850	0.49188	0.45562	0.48913	0.53428	0.43352	-0.02810
V37	0.18657	0.07688	0.06615	0.04707	0.04944	0.04004	0.27141	0.23550	0.26263	0.22747	0.18599	-0.22576
V38	-0.06703	-0.02091	0.07935	0.06014	0.01599	-0.07491	-0.12026	-0.11314	-0.12038	-0.08088	0.10659	-0.00073
V39	0.12916	0.34434	0.33121	0.43514	0.51033	0.29708	0.50588	0.56125	0.54532	0.52186	0.45588	0.03428

	V13	V14	V15	V16	V17	V18	V19	V20	V21	V22	V23	V24
V1	-0.31364	0.03707	-0.00533	0.12365	0.11237	0.02617	-0.08653	0.18777	0.18029	0.20095	0.08767	0.01713
V2	-0.25460	0.15533	-0.21268	0.30335	0.26458	-0.03505	-0.08915	0.07089	0.01465	0.00060	0.07671	0.29671
V3	-0.18802	0.12726	-0.13758	0.30566	0.10221	0.13079	-0.10519	0.07010	0.05060	0.00924	0.12617	0.22522
V4	-0.33656	0.17368	-0.14529	0.29797	0.17495	0.01755	0.04131	0.02080	0.21722	0.00634	0.10328	0.15282
V5	-0.13314	0.60149	-0.30708	0.45143	-0.03996	-0.19836	0.04502	0.06936	0.10053	-0.14372	0.24951	0.00429
V6	-0.05532	0.35049	-0.25674	0.18123	0.05012	-0.20270	0.09299	0.05635	-0.05354	-0.10565	0.11988	0.12532
V7	-0.22702	0.31261	-0.31093	0.57956	0.11602	-0.00958	0.01718	0.06036	0.18611	0.08292	0.21290	0.07662
V8	-0.27982	0.26338	-0.26707	0.55399	-0.01270	0.04446	0.02176	0.03395	0.14483	0.00235	0.28491	-0.03312
V9	-0.31466	0.29891	-0.29964	0.58414	0.06055	0.01480	0.01975	0.05000	0.17249	0.04849	0.25172	0.02870
V10	-0.15737	0.52693	-0.44438	0.54877	-0.01590	-0.06639	0.02616	0.19064	0.00575	-0.19985	0.41229	-0.04720
V11	-0.09895	0.31863	-0.16954	0.20463	-0.04019	-0.03708	0.00337	0.19108	-0.00167	0.02383	0.22839	0.08512
V12	0.42283	0.26363	-0.06765	-0.14601	-0.07755	-0.14539	-0.04948	-0.12716	-0.13221	-0.26460	-0.02629	0.02978
V13	1.00000	0.05487	-0.10494	-0.33520	-0.45477	0.11137	-0.22800	-0.07086	-0.30877	-0.08817	0.04418	-0.06699
V14	0.05487	1.00000	-0.37519	0.27588	-0.00421	-0.00842	0.02338	0.02213	-0.00640	-0.05494	0.15119	0.24521
V15	-0.10494	-0.37519	1.00000	-0.36225	0.09908	-0.16717	0.29002	-0.14486	0.27748	0.06959	-0.09721	-0.01919
V16	-0.33520	0.27588	-0.36225	1.00000	0.20755	0.11425	-0.16227	0.05192	0.11303	-0.07378	0.36012	-0.07417
V17	-0.45477	-0.00421	0.09908	0.20755	1.00000	-0.07280	0.11513	0.00930	0.32590	0.04434	-0.03715	0.20976
V18	0.11137	-0.00842	-0.16717	0.11425	-0.07280	1.00000	-0.16245	-0.07543	-0.07566	-0.10770	0.38728	0.11002
V19	-0.22800	0.02338	0.29002	-0.16227	0.11513	-0.16245	1.00000	-0.02800	0.30011	0.03069	0.00748	-0.06712
V20	-0.07086	0.02213	-0.14486	0.05192	0.00930	-0.07543	-0.02800	1.00000	-0.09262	0.21605	-0.02095	-0.22537
V21	-0.30877	-0.00640	0.27748	0.11303	0.32590	-0.07566	0.30011	-0.09262	1.00000	-0.02109	0.02182	0.00751
V22	-0.08817	-0.05494	0.06959	-0.07378	0.04434	-0.10770	0.03069	0.21605	-0.02109	1.00000	-0.14950	0.13860
V23	0.04418	0.15119	-0.09721	0.36012	-0.03715	0.38728	0.00748	-0.02095	0.02182	-0.14950	1.00000	-0.27763
V24	-0.06699	0.24521	-0.01919	-0.07417	0.20976	0.11002	-0.06712	-0.22537	0.00751	0.13860	-0.27763	1.00000
V25	0.37956	-0.15262	-0.08453	-0.16688	-0.21834	0.35512	-0.23990	-0.08718	-0.31836	-0.13263	0.11655	0.01945
V26	0.44503	-0.05264	0.05956	-0.25122	-0.39241	0.02902	0.04223	0.03174	-0.21096	-0.08264	0.12273	-0.28264
V27	-0.25515	0.08724	-0.05113	0.26281	0.21553	-0.08940	0.24140	-0.22612	0.05958	0.05995	0.17273	0.12129
V28	0.02130	0.08415	-0.43157	0.06951	0.03130	0.00880	-0.22663	-0.10755	-0.25330	0.04312	0.10690	0.18553
V29	-0.25157	0.05102	0.16544	0.00572	0.19941	-0.08075	0.07027	0.11289	0.32723	0.38436	0.05724	0.05492
V30	0.49776	-0.07107	0.10811	-0.20366	-0.34548	0.00527	0.09610	0.02147	-0.07538	-0.00083	0.00633	-0.07597
V33	-0.09602	0.08973	-0.00874	0.19331	0.11316	-0.01009	-0.16473	0.12644	-0.00522	-0.30117	0.09170	-0.04068
V34	-0.13081	0.24133	0.04614	0.14944	0.14358	0.10751	-0.06208	0.04108	0.20429	-0.17947	0.07206	0.22620
V35	0.41346	0.19949	-0.10560	-0.14883	-0.07620	-0.19875	0.03359	-0.14382	-0.13147	-0.05846	-0.02228	0.12653
V36	-0.20600	0.42824	-0.37528	0.35519	0.11278	0.12304	0.02971	0.10466	0.01185	-0.09397	0.20058	0.11101
V37	-0.17504	0.12531	-0.15007	0.08262	0.15242	0.02769	-0.13141	0.12514	-0.10037	0.11975	0.11346	0.07247
V38	0.07963	0.18235	-0.05672	0.07515	-0.06146	0.26239	-0.17476	-0.01685	-0.20375	-0.25951	0.12466	0.02717
V39	-0.31653	0.34112	-0.35480	0.54111	0.11027	0.02298	-0.11207	0.03770	0.08127	-0.10126	0.18758	0.05487

CORRELATION MATRIX FOR INDEPENDENT AND DEPENDENT VARIABLES IN REDEYE STUDY ($\underline{N}$=61) (cont)

CORRELATION COEFFICIENTS...

	V25	V26	V27	V28	V29	V30	V33	V34	V35	V36	V37	V38	V39
V1	0.11023	-0.31565	-0.00277	0.06542	0.25325	-0.13214	-0.25946	0.09458	-0.20488	0.13030	0.18657	-0.06703	0.12916
V2	0.03960	-0.12398	0.10543	0.15208	-0.07967	-0.21095	0.21256	0.12295	0.07725	0.32907	0.07688	-0.02091	0.34434
V3	0.13824	-0.15284	-0.00052	0.05018	-0.16954	-0.18830	0.13417	0.21982	-0.00146	0.35664	0.06635	0.07935	0.33121
V4	-0.04183	-0.25787	0.00703	0.14006	-0.05700	-0.15301	0.20150	0.29704	-0.06596	0.35159	0.04707	0.00014	0.43514
V5	-0.18649	0.01547	0.08851	0.07196	-0.03069	-0.18127	0.24020	0.17545	0.04816	0.51433	0.04944	0.01599	0.51033
V6	-0.33037	0.17289	0.13861	0.34662	0.00805	0.10184	0.03725	0.14645	0.17209	0.39850	0.04004	-0.07491	0.29708
V7	-0.23955	-0.16926	0.25355	0.20114	0.03106	-0.21064	0.02162	0.20977	-0.19304	0.49188	0.27141	-0.12026	0.50588
V8	-0.11213	-0.12501	0.24577	0.10289	-0.05405	-0.12070	0.10967	0.16717	-0.14005	0.45562	0.23550	-0.11314	0.56125
V9	-0.12726	-0.15382	0.29710	0.16156	-0.00609	-0.17552	0.06212	0.19644	-0.17428	0.48913	0.26273	-0.12038	0.54532
V10	-0.25311	-0.02215	0.20282	0.12826	0.00336	-0.17335	0.19278	0.25421	-0.04561	0.53428	0.22747	-0.00088	0.52186
V11	-0.15318	0.13658	-0.10729	0.09300	-0.05423	-0.01243	0.20501	0.07645	-0.07940	0.43352	0.18559	0.10659	0.45588
V12	0.03560	0.26367	-0.07786	0.01537	-0.29310	0.29451	0.12767	0.00855	0.65735	-0.02810	-0.22576	-0.00073	0.03428
V13	0.27656	0.44561	-0.25535	0.02130	-0.25157	0.49776	-0.09602	-0.13081	0.41346	-0.20600	-0.17504	0.07963	-0.32653
V14	-0.21222	-0.02204	0.00724	0.07415	0.05102	-0.07107	0.00873	0.24133	0.19943	0.42824	0.12531	0.18235	0.34112
V15	-0.04453	0.05956	-0.05133	-0.43157	0.16544	0.10811	-0.00874	0.04614	-0.10560	-0.37528	-0.15007	-0.05672	-0.25480
V16	-0.10188	-0.25122	0.21281	0.07551	0.00572	-0.30326	0.19331	0.14944	-0.14883	0.35519	0.08262	0.07515	0.53113
V17	-0.21814	-0.39241	0.21553	0.03130	0.15941	-0.34548	0.11316	0.14358	-0.07620	0.11278	0.15242	-0.06146	0.11027
V18	0.35512	0.02982	-0.00940	0.00380	-0.00075	0.00527	-0.01309	0.10751	-0.15875	0.12304	0.02769	0.26239	0.02298
V19	-0.21860	0.04223	0.24140	-0.22163	0.07027	0.09610	-0.16473	-0.06904	0.02359	0.02571	-0.13141	-0.17476	-0.11207
V20	-0.08718	0.03174	-0.22612	-0.10755	0.11309	0.02147	0.12644	0.04108	-0.14302	0.10466	0.12514	-0.01685	0.03770
V21	-0.31836	-0.21896	0.05558	-0.25330	0.32723	-0.07538	-0.00522	0.20429	-0.13147	0.01385	-0.10037	-0.20375	0.08127
V22	-0.13623	-0.08214	0.05995	0.04312	0.38436	-0.00083	-0.30327	-0.17947	-0.05866	-0.09357	0.11575	-0.25551	-0.10126
V23	0.11655	0.12273	0.17273	0.10690	0.05724	0.00633	0.39170	0.07206	-0.02228	0.20058	0.11346	0.12466	0.18798
V24	0.01545	-0.28264	0.12129	0.10551	0.05492	-0.07597	-0.04618	0.22620	0.12651	0.11101	0.07347	0.02717	0.05487
V25	1.00000	0.03391	-0.13131	0.07281	-0.22001	-0.09435	0.11239	-0.03244	0.07578	-0.07415	-0.12101	0.13122	-0.05574
V26	0.03391	1.00000	-0.21927	-0.14597	-0.28055	0.41376	-0.01737	-0.32478	0.29630	0.00087	-0.12488	0.00013	-0.13729
V27	-0.13131	-0.21927	1.00000	0.21153	0.18697	-0.12358	-0.04460	0.06748	0.02185	0.05592	0.15901	-0.14892	0.28313
V28	0.07281	-0.14597	0.21153	1.00000	-0.08893	0.16412	-0.02125	0.03481	0.11174	0.07518	0.14658	0.00970	0.10188
V29	-0.22001	-0.28055	0.18697	-0.08893	1.00000	-0.16389	-0.12711	0.17554	-0.25686	0.13015	0.25174	-0.22858	0.08638
V30	-0.09435	0.41376	-0.12358	0.16412	-0.16389	1.00000	-0.13625	-0.00691	0.29795	-0.21415	0.08401	-0.02214	-0.19126
V33	0.11239	-0.03737	-0.04460	-0.02125	-0.12711	-0.13625	1.00000	0.34310	-0.01126	0.22215	0.13833	0.30560	0.30442
V34	-0.03244	-0.32478	0.06748	0.03481	0.17554	-0.00691	0.34310	1.00000	-0.13952	0.28631	0.23422	0.09255	0.28718
V35	0.07578	0.29630	0.02185	0.11174	-0.25686	0.29795	-0.01126	-0.13952	1.00000	-0.17969	-0.33266	-0.05176	-0.23760
V36	-0.07415	0.00087	0.05592	0.07518	0.13015	-0.21415	0.22215	0.28631	-0.17969	1.00000	0.47255	0.13283	0.64975
V37	-0.12101	-0.12488	0.15901	0.14658	0.25174	0.08401	0.13833	0.23422	-0.33266	0.47255	1.00000	0.17006	0.37545
V38	0.13122	0.00013	-0.14892	0.00970	-0.22858	-0.02214	0.30560	0.09255	-0.05176	0.13283	0.17006	1.00000	0.25833
V39	-0.05574	-0.13729	0.28313	0.10188	0.08638	-0.19126	0.30442	0.28718	-0.23760	0.64975	0.37545	0.25833	1.00000

SUMMARY OF INDEPENDENT AND DEPENDENT VARIABLES IN CHAPARRAL/VULCAN ANALYSES

Variable Name	Variable Label	Extended Label
V1	Age	
V2	Word	From the Press Test
V3	Color	From the Press Test
V4	Wintc	From the Press Test (Color naming with distraction)
V5	Clflex	Closure Flexibility
V6	Clspd	Closure Speed
V7	LTH	Language Thurstone
V8	QTH	Quantitative Thurstone
V10	GEFT	Group Embedded Figures Test
V11	Pursuit	From MacQuarrie Test
V12	State	State Anxiety
V13	Trait	Trait Anxiety
V14	2dim	Two Dimensional Spatial Relations
V15	FA	Reserved/Outgoing
V16	FB	Less Intell/More Intell
V17	FC	Affected by feelings/Emotionally Stable
V18	FE	Humble/Assertive
V19	FF	Sober/Happy-go-lucky
V20	FG	Expedient/Conscientious
V21	FH	Shy/Venturesome
V22	FI	Tough-minded/Tender-minded
V23	FL	Trusting/Suspicious
V24	FM	Practical/Imaginative
V25	FN	Forthright/Astute
V26	FO	Self-Assured/Apprehensive
V27	Q1	Conservative/Experimenting
V28	Q2	Group-dependent/Self-sufficient
V29	Q3	Undisciplined Self-conflict/ Controlled
V30	Q4	Relaxed/Tense
V40	GZPS	Guilford Zimmerman Perceptual Speed
ZR6	ZOVERALL	Standardized Overall Performance Rating (Appendix F)
WC5	EOC CHAP	End of Course Final Proficiency Test (CHAPARRAL)
WCOMPC		Summed Composite of 4 CHAPARRAL Written Tests (WC1-WC4) (See Table 28, p. 83 for information about WC1-WC4)
WV6		Final Written VULCAN Test
PVC	PROFCOMP	Proficiency VULCAN Composite (See Table 29)

CORRELATION MATRIX FOR FACTOR ANALYSES OF CHAPARRAL DATA (N=67)

CORRELATION COEFFICIENTS..

	V2	V3	V4	V5	V6	V7	V8	V10	V11	V12
V2	1.00000	0.01671	0.57765	0.17426	0.26743	0.23301	0.23208	0.05743	0.21264	-0.32003
V3	0.01671	1.00000	0.78294	0.16218	0.37671	0.26818	0.26685	0.23868	0.39059	-0.30954
V4	0.57765	0.78294	1.00000	0.25021	0.36636	0.19314	0.18938	0.22546	0.33010	-0.31852
V5	0.17426	0.16218	0.25021	1.00000	0.29427	0.15641	0.23508	0.54319	0.08883	0.02114
V6	0.26743	0.37671	0.36636	0.29427	1.00000	0.44202	0.33340	0.51915	0.28017	-0.21853
V7	0.23301	0.26818	0.19314	0.15641	0.44202	1.00000	0.74367	0.34427	0.30903	-0.03223
V8	0.23208	0.26685	0.18938	0.23508	0.33340	0.74367	1.00000	0.46045	0.32655	-0.09522
V10	0.05743	0.23868	0.22546	0.54319	0.51915	0.34427	0.46045	1.00000	0.31046	-0.25573
V11	0.21264	0.39059	0.33010	0.08883	0.28017	0.30903	0.32655	0.31046	1.00000	-0.17720
V12	-0.32003	-0.30954	-0.31852	0.02114	-0.21853	-0.03223	-0.09522	-0.25573	-0.17720	1.00000
V13	-0.30930	-0.37597	-0.25492	-0.04317	-0.35228	-0.10431	-0.11306	-0.28269	-0.16933	0.00560
V14	-0.01647	0.14565	0.04670	0.04225	0.15190	0.15790	0.41479	0.25945	0.17544	-0.37717
V15	0.03400	-0.15582	-0.00029	-0.13144	-0.22850	-0.25837	-0.22154	-0.22263	-0.00924	-0.09038
V16	0.02832	0.15991	0.02483	0.22328	0.21907	0.41884	0.52230	0.34654	0.14659	-0.03146
V17	0.16080	0.28109	0.19439	-0.04498	0.15542	-0.22948	-0.06127	0.13277	0.08878	-0.02416
V18	-0.28505	-0.30620	-0.20156	0.05241	-0.12469	-0.14156	-0.03992	0.08203	-0.30281	0.05019
V19	0.02655	0.02369	0.11164	0.20056	0.16296	0.10521	0.10132	0.14133	-0.03134	-0.06306
V20	-0.08015	0.03773	-0.01554	-0.23289	-0.07087	0.01741	0.04712	-0.14518	0.06714	-0.04211
V21	0.36984	0.04409	0.09443	0.01496	0.10659	0.03757	-0.07533	-0.07676	-0.08549	-0.27198
V22	0.01054	0.17515	0.15643	0.02175	-0.05508	0.08828	-0.10091	-0.22472	0.04177	0.12594
V23	-0.17591	-0.01015	-0.04443	-0.10366	0.03117	0.14828	0.11540	0.09028	0.05350	0.16886
V24	0.18320	0.12435	0.18068	0.09287	0.01947	-0.19066	-0.00085	0.11975	0.19025	-0.04320
V25	0.04076	0.10571	0.05862	-0.13011	-0.15679	0.02576	-0.10430	-0.17447	0.12530	0.09439
V26	-0.36001	-0.25440	-0.24001	-0.00048	-0.23156	-0.07796	-0.04630	-0.06575	-0.06983	0.30714
V27	0.06829	0.02354	-0.01230	-0.01098	0.10049	0.12376	0.04726	0.01974	0.12386	-0.00355
V28	0.22602	0.16242	0.15251	0.15509	0.04244	0.16589	0.03873	0.02344	0.02651	0.12651
V29	0.22165	0.17280	0.20870	0.02985	0.13623	0.08179	0.14093	0.08155	0.10882	-0.20857
V30	-0.12749	-0.09198	-0.03727	0.10627	-0.20713	0.01546	-0.14246	-0.12061	-0.13084	0.37606
V40	0.40485	0.37205	0.41061	0.36924	0.35673	0.26131	0.31741	0.48394	0.41854	-0.14576

	V13	V14	V15	V16	V17	V18	V19	V20	V21	V22
V2	-0.30930	-0.01647	0.03400	0.02832	0.16080	-0.28505	0.02655	-0.08015	0.36984	0.01054
V3	-0.37597	0.14565	-0.15582	0.15991	0.28109	-0.30620	0.02369	0.03773	0.04409	0.17515
V4	-0.25492	0.04670	-0.00029	0.02483	0.19439	-0.20156	0.11164	-0.01554	0.09443	0.15643
V5	-0.04317	0.04225	-0.13144	0.22328	-0.04498	0.05241	0.20056	-0.23289	0.01496	0.02175
V6	-0.35228	0.15190	-0.22850	0.21907	0.15542	-0.12469	0.16296	-0.07087	0.10659	-0.05508
V7	-0.10431	0.15790	-0.25837	0.41884	-0.22948	-0.14156	0.10521	0.01741	0.03757	0.08828
V8	-0.11306	0.41479	-0.22154	0.52230	-0.06127	-0.03992	0.10132	0.04712	-0.07533	-0.10091
V10	-0.28269	0.25945	-0.22263	0.34654	0.13277	0.08203	0.14133	-0.14518	-0.07676	-0.22472
V11	-0.16933	0.17544	-0.00924	0.14659	0.08878	-0.30281	-0.03134	0.06714	-0.08549	0.04177
V12	0.00560	-0.37717	-0.09038	-0.03146	-0.02416	0.05019	-0.06306	-0.04211	-0.27198	0.12594
V13	1.00000	-0.27705	-0.00172	-0.13004	-0.50942	0.18892	-0.19777	-0.14087	-0.30734	0.04729
V14	-0.27705	1.00000	0.04532	0.23317	0.19288	-0.02174	0.10684	0.22944	-0.02000	-0.07491
V15	-0.00172	0.04532	1.00000	-0.34322	0.14169	-0.24719	-0.03801	-0.01434	0.30831	0.11560
V16	-0.13004	0.23317	-0.34322	1.00000	0.07976	-0.10630	0.09771	0.12409	0.05868	-0.10888
V17	-0.50942	0.19288	0.14169	0.07976	1.00000	-0.23606	-0.03979	0.14593	0.24639	-0.07660
V18	0.18892	-0.02174	-0.24719	-0.10630	-0.23606	1.00000	0.06364	-0.32568	-0.23418	-0.19866
V19	-0.19777	0.10684	-0.03801	0.09771	-0.03979	0.06364	1.00000	0.07236	0.21465	0.13364
V20	-0.14087	0.22944	-0.01434	0.12409	0.14593	-0.32568	0.07236	1.00000	-0.09425	-0.03820
V21	-0.30734	-0.02000	0.30831	0.05868	0.24639	-0.23418	0.21465	-0.09425	1.00000	0.11506
V22	0.04729	-0.07491	0.11560	-0.10888	-0.07660	-0.19866	0.13364	-0.03820	0.11506	1.00000
V23	0.03011	-0.15673	-0.27500	0.19035	-0.20596	0.18281	-0.09298	-0.07959	-0.31475	0.03594
V24	-0.05807	-0.02500	-0.03345	-0.03029	0.07200	0.15292	0.10050	0.05532	0.06397	0.07888
V25	0.12882	0.15883	0.11895	-0.19443	-0.19347	0.03814	-0.06697	-0.06392	0.01418	0.13069
V26	0.55439	-0.06610	-0.04157	0.02565	-0.30922	0.36279	-0.16956	-0.04107	-0.30096	0.02812
V27	-0.08658	0.09607	0.13266	0.08876	-0.11947	0.13880	-0.02027	0.14581	0.11082	-0.03266
V28	0.09204	-0.17155	-0.25061	0.06238	-0.02729	0.08183	-0.16304	-0.29283	-0.03886	0.16448
V29	-0.37972	0.13618	0.14119	0.11741	0.21342	-0.30238	0.12098	0.41077	0.06087	-0.00808
V30	0.44816	-0.21385	-0.04405	-0.14355	-0.37642	0.18319	-0.18254	-0.17183	-0.19390	0.16409
V40	-0.07344	0.17985	0.09979	0.04529	0.08773	-0.19733	-0.13299	-0.15564	0.05089	-0.25122

	V23	V24	V25	V26	V27	V28	V29	V30	V40
V2	-0.17591	0.18320	0.04076	-0.36001	0.06829	0.22602	0.22165	-0.12749	0.40485
V3	-0.01015	0.12435	0.10571	-0.25440	0.02354	0.16242	0.17280	-0.09198	0.37205
V4	-0.04443	0.18068	0.05862	-0.24001	-0.01230	0.15251	0.20870	-0.03727	0.41061
V5	-0.10366	0.09287	-0.13011	-0.00048	-0.01098	0.15509	0.02985	0.10627	0.36924
V6	0.03117	0.01947	-0.15679	-0.23156	0.10049	0.04244	0.13623	-0.20713	0.35673
V7	0.14828	-0.19066	0.02576	-0.07796	0.12376	0.16589	0.08179	0.01546	0.26131
V8	0.11540	-0.00085	-0.10430	-0.04630	0.04726	0.03873	0.14093	-0.14246	0.31741
V10	0.09028	0.11975	-0.17447	-0.06575	0.01974	0.02344	0.08155	-0.12061	0.48394
V11	0.05350	0.19025	0.12530	-0.06983	0.12386	0.02651	0.10882	-0.13084	0.41854
V12	0.16886	-0.04320	0.09439	0.30714	-0.00355	0.12651	-0.20857	0.37606	-0.14576
V13	0.03011	-0.05807	0.12882	0.55439	-0.08658	0.09204	-0.37972	0.44816	-0.07344
V14	-0.15673	-0.02500	0.15883	-0.06610	0.09607	-0.17155	0.13618	-0.21385	0.17985
V15	-0.27500	-0.03345	0.11895	-0.04157	0.13266	-0.25061	0.14119	-0.04405	0.09979
V16	0.19035	-0.03029	-0.19443	0.02565	0.08876	0.06238	0.11741	-0.14355	0.04529
V17	-0.20596	0.07200	-0.19347	-0.30922	-0.11947	-0.02729	0.21342	-0.37642	0.08773
V18	0.18281	0.15292	0.03814	0.36279	0.13880	0.08183	-0.30238	0.18319	-0.19733
V19	-0.09298	0.10050	-0.06697	-0.16956	-0.02027	-0.16304	0.12098	-0.18254	-0.13299
V20	-0.07959	0.05532	-0.06392	-0.04107	0.14581	-0.29283	0.41077	-0.17183	-0.15564
V21	-0.31475	0.06397	0.01418	-0.30096	0.11082	-0.03886	0.06087	-0.19390	0.05089
V22	0.03594	0.07888	0.13069	0.02812	-0.03266	0.16448	-0.00808	0.16409	-0.25122
V23	1.00000	0.05341	-0.01862	0.12362	0.21965	0.10719	-0.06334	0.07071	-0.11659
V24	0.05341	1.00000	0.00834	0.04436	0.22123	-0.01862	0.08023	-0.09473	0.18121
V25	-0.01862	0.00834	1.00000	-0.01366	0.03441	0.04413	-0.15946	0.19106	0.09982
V26	0.12362	0.04436	-0.01366	1.00000	0.03494	-0.04238	-0.30167	0.37101	-0.08862
V27	0.21965	0.22123	0.03441	0.03494	1.00000	-0.02723	-0.08510	0.08516	0.18834
V28	0.10719	-0.01862	0.04413	-0.04238	-0.02723	1.00000	-0.37623	0.18670	0.13151
V29	-0.06334	0.08023	-0.15946	-0.30167	-0.08510	-0.37623	1.00000	-0.40822	0.12193
V30	0.07071	-0.09473	0.19106	0.37101	0.08516	0.18670	-0.40822	1.00000	0.06766
V40	-0.11659	0.18121	0.09982	-0.08862	0.18834	0.13151	0.12193	0.06766	1.00000

DETERMINANT OF CORRELATION MATRIX = 0.0000001 (0.14314504D-06)

CORRELATION MATRIX FOR INDEPENDENT AND DEPENDENT VARIABLES IN CHAPARRAL ANALYSIS (N=67)

CORRELATION COEFFICIENTS...

	V2	V3	V4	V5	V6	V7	V8	V10	V11	V12
V2	1.00000	0.61671	0.57765	0.17427	0.26743	0.23301	0.23208	0.05743	0.21264	-0.32003
V3	0.61671	1.00000	0.78294	0.16218	0.37671	0.26818	0.26685	0.23868	0.39059	-0.36954
V4	0.57765	0.78294	1.00000	0.25021	0.36636	0.19314	0.18938	0.22546	0.33010	-0.31852
V5	0.17427	0.16218	0.25021	1.00000	0.29427	0.15641	0.23508	0.54319	0.08883	0.02114
V6	0.26743	0.37671	0.36636	0.29427	1.00000	0.44201	0.33340	0.51915	0.28017	-0.21853
V7	0.23301	0.26818	0.19314	0.15641	0.44201	1.00000	0.74367	0.34427	0.30903	-0.03223
V8	0.23208	0.26685	0.18938	0.23508	0.33340	0.74367	1.00000	0.46045	0.32655	-0.09522
V10	0.05743	0.23868	0.22546	0.54319	0.51915	0.34427	0.46045	1.00000	0.31046	-0.25573
V11	0.21264	0.39059	0.33010	0.08883	0.28017	0.30903	0.32655	0.31046	1.00000	-0.17719
V12	-0.32003	-0.36954	-0.31852	0.02114	-0.21853	-0.03223	-0.09522	-0.25573	-0.17719	1.00000
V13	-0.30930	-0.37597	-0.25491	-0.04317	-0.35228	-0.10431	-0.11305	-0.28269	-0.16933	0.80560
V14	-0.01947	0.14585	0.04970	0.04225	0.15191	0.15790	0.41480	0.25945	0.17544	-0.37717
V15	0.03400	-0.15582	-0.00029	-0.13144	-0.22850	-0.25837	-0.22154	-0.22263	-0.00924	-0.09038
V16	0.02832	0.15991	0.02483	0.22328	0.21907	0.41864	0.52231	0.34654	0.14959	-0.03146
V17	0.16080	0.28109	0.19439	-0.04498	0.15542	-0.22948	-0.06127	0.13277	0.08878	-0.62416
V18	-0.28506	-0.30620	-0.26156	0.05241	-0.12469	-0.14156	-0.03992	0.08203	-0.30281	0.05019
V19	0.02655	0.02369	0.11164	0.20056	0.16296	0.10521	0.10132	0.19133	-0.03133	-0.06306
V20	-0.08915	0.03773	-0.01554	-0.23289	-0.07087	0.01741	0.04712	-0.14518	0.04714	-0.09211
V21	0.36594	0.04409	0.09443	0.01496	0.10659	0.03757	-0.07533	-0.07676	-0.08549	-0.27198
V22	0.01054	0.17515	0.15643	0.02175	-0.05508	0.08828	-0.10091	-0.22472	0.04177	0.12594
V23	-0.17591	-0.01015	-0.04443	-0.10366	0.03117	0.14628	0.11540	0.09028	0.05350	0.16866
V24	0.18320	0.12435	0.18068	0.09287	0.01947	-0.19064	-0.00085	0.11975	0.19025	-0.04321
V25	0.04076	0.10571	0.05962	-0.13011	-0.15679	0.02576	-0.10430	-0.17447	0.12530	0.09439
V26	-0.36000	-0.25440	-0.24001	-0.00048	-0.23156	-0.07796	-0.04638	-0.06575	-0.06583	0.30714
V27	0.06829	0.02354	-0.01230	-0.01098	0.10049	0.12376	0.04726	0.01974	0.12386	-0.00355
V28	0.22602	0.16242	0.15250	0.15510	0.04244	0.16589	0.03873	0.02344	0.02651	0.12651
V29	0.22165	0.17280	0.26870	0.02985	0.13623	0.08179	0.14093	0.08155	0.10882	-0.26857
V30	-0.12749	-0.09198	-0.03727	0.10627	-0.20713	0.01546	-0.14246	-0.12061	-0.13684	0.37806
V40	0.49486	0.37205	0.41061	0.36924	0.35673	0.26131	0.31741	0.48394	0.41854	-0.14676
WCOMPC	0.22525	0.32280	0.25451	0.21281	0.26314	0.35772	0.43276	0.46317	0.15670	-0.27552
WC5	0.04890	0.18782	0.16230	0.12840	0.12426	0.36819	0.25389	0.24457	0.04605	-0.20267
ZR6	0.19937	0.23490	0.22088	0.13902	0.11286	0.27366	0.21298	0.31221	0.06500	-0.21653

	V13	V14	V15	V16	V17	V18	V19	V20	V21	V22
V2	-0.30930	-0.01947	0.03400	0.02832	0.16080	-0.28506	0.02655	-0.08915	0.36594	0.01054
V3	-0.37597	0.14585	-0.15582	0.15991	0.28109	-0.30620	0.02369	0.03773	0.04409	0.17515
V4	-0.25491	0.04970	-0.00029	0.02483	0.19439	-0.26156	0.11164	-0.01554	0.09443	0.15643
V5	-0.04317	0.04225	-0.13144	0.22328	-0.04498	0.05241	0.20056	-0.23289	0.01496	0.02175
V6	-0.35228	0.15191	-0.22850	0.21907	0.15542	-0.12469	0.16296	-0.07087	0.10659	-0.05508
V7	-0.10431	0.15790	-0.25837	0.41864	-0.22948	-0.14156	0.10521	0.01741	0.03757	0.08828
V8	-0.11305	0.41480	-0.22154	0.52231	-0.06127	-0.03992	0.10132	0.04712	-0.07533	-0.10091
V10	-0.28269	0.25945	-0.22263	0.34654	0.13277	0.08203	0.19133	-0.14518	-0.07676	-0.22472
V11	-0.16933	0.17544	-0.00924	0.14959	0.08878	-0.30281	-0.03133	0.04714	-0.08549	0.04177
V12	0.80560	-0.37717	-0.09038	-0.03146	-0.62416	0.05019	-0.06306	-0.09211	-0.27198	0.12594
V13	1.00000	-0.27705	-0.00172	-0.13004	-0.59942	0.18892	-0.19777	-0.14687	-0.30734	0.04729
V14	-0.27705	1.00000	0.04532	0.23317	0.19288	-0.02174	0.10884	0.22944	-0.02000	-0.07991
V15	-0.00172	0.04532	1.00000	-0.34322	0.14169	-0.24719	-0.03801	-0.01434	0.30831	0.11560
V16	-0.13004	0.23317	-0.34322	1.00000	0.07976	-0.10630	0.09771	0.12409	0.05868	-0.10688
V17	-0.59942	0.19288	0.14169	0.07976	1.00000	-0.23606	-0.03979	0.14593	0.24639	-0.07661
V18	0.18892	-0.02174	-0.24719	-0.10630	-0.23606	1.00000	0.08364	-0.32568	-0.23418	-0.19866
V19	-0.19777	0.10884	-0.03801	0.09771	-0.03979	0.08364	1.00000	0.07236	0.21465	0.13385
V20	-0.14687	0.22944	-0.01434	0.12409	0.14593	-0.32568	0.07236	1.00000	-0.09425	-0.03820
V21	-0.30734	-0.02000	0.30831	0.05868	0.24639	-0.23418	0.21465	-0.09425	1.00000	0.11506
V22	0.04729	-0.07991	0.11560	-0.10688	-0.07661	-0.19866	0.13385	-0.03820	0.11506	1.00000
V23	0.03011	-0.15673	-0.27590	0.19635	-0.26596	0.18281	-0.09298	-0.07959	-0.31475	0.03594
V24	-0.05807	-0.02590	-0.03145	-0.03629	0.07200	0.15292	0.10050	0.05532	0.06397	0.07886
V25	0.12882	0.15683	0.11895	-0.19443	-0.19347	0.03814	-0.09897	-0.06392	0.01418	0.13069
V26	0.55439	-0.08610	-0.04157	0.02565	-0.30921	0.36279	-0.16956	-0.04107	-0.36096	0.07812
V27	-0.04658	0.09607	0.11266	0.06876	-0.11997	0.13880	-0.02027	0.14541	0.11082	-0.03266
V28	0.09209	-0.17155	-0.25064	0.05238	-0.02729	0.08183	-0.16304	-0.29283	-0.03846	0.10448
V29	-0.37972	0.13618	0.14119	0.11741	0.21342	-0.30238	0.12098	0.41077	0.06048	-0.06888
V30	0.44616	-0.21385	-0.04405	-0.14355	-0.37441	0.18319	-0.18254	-0.17183	-0.19390	0.16309
V40	-0.07144	0.17985	0.09979	0.04529	0.06773	-0.19734	-0.13299	-0.15564	0.05089	-0.25122
WCOMPC	-0.27358	0.21945	-0.23919	0.11292	0.12491	0.00165	0.08055	0.01354	-0.12481	-0.08650
WC5	-0.20150	0.10223	-0.11636	0.24794	0.09121	-0.25104	0.09569	0.03133	0.08328	0.00811
ZR6	-0.16707	0.06406	-0.02123	0.13102	0.14724	-0.15090	-0.05075	-0.03847	-0.08525	0.06481

CORRELATION MATRIX FOR INDEPENDENT AND DEPENDENT VARIABLES IN CHAPARRAL ANALYSIS (N=67) (cont)

CORRELATION COEFFICIENTS...

	V23	V24	V25	V26	V27	V28	V29	V30	V40	WCUMPC
V2	-0.17591	0.18120	0.04076	-0.36000	0.06829	0.22602	0.22165	-0.12749	0.49486	0.22525
V3	-0.01015	0.12435	0.10571	-0.25440	0.02354	0.16242	0.17280	-0.09198	0.37205	0.32280
V4	-0.04443	0.18068	0.05962	-0.24001	-0.01230	0.15250	0.26870	-0.03727	0.41061	0.25451
V5	-0.10366	0.09287	-0.13011	-0.00048	-0.01098	0.15510	0.02985	0.10627	0.36924	0.21281
V6	0.03117	0.01947	-0.15679	-0.23156	0.10049	0.04244	0.13623	-0.20713	0.35673	0.26314
V7	0.14628	-0.19064	0.02576	-0.07796	0.12376	0.16589	0.08179	0.01546	0.26131	0.35772
V8	0.11540	-0.00085	-0.10430	-0.04638	0.04726	0.03873	0.14093	-0.14246	0.31741	0.43276
V10	0.09028	0.11975	-0.17447	-0.06575	0.01974	0.02344	0.08155	-0.12061	0.48394	0.46317
V11	0.05150	0.19025	0.12530	-0.06583	0.12386	0.02631	0.10882	-0.13684	0.41854	0.15670
V12	0.16406	-0.04321	0.09439	0.30714	-0.00355	0.12651	-0.26857	0.37806	-0.14576	-0.27552
V13	0.03011	-0.05807	0.12882	0.55439	-0.08658	0.09209	-0.37972	0.44616	-0.07344	-0.29398
V14	-0.15673	-0.02590	0.15683	-0.08610	0.09607	-0.17155	0.13618	-0.21385	0.17985	0.21945
V15	-0.27590	-0.03145	0.11895	-0.04157	0.13266	-0.25064	0.14119	-0.04405	0.09979	-0.23919
V16	0.14635	-0.03629	-0.19443	0.02565	0.06876	0.05238	0.11741	-0.14355	0.04529	0.11292
V17	-0.26596	0.07200	-0.19347	-0.30921	-0.11997	-0.02729	0.21342	-0.37441	0.06773	0.12491
V18	0.18281	0.15292	0.03814	0.36279	0.13880	0.08183	-0.30238	0.18319	-0.19734	0.00165
V19	-0.09298	0.10050	-0.09897	-0.16956	-0.02027	-0.16304	0.12098	-0.18254	-0.13299	0.08055
V20	-0.07959	0.05532	-0.06392	-0.04107	0.14541	-0.29283	0.41077	-0.17183	-0.15564	0.01354
V21	-0.31475	0.06397	0.01418	-0.36096	0.11082	-0.03846	0.06048	-0.19390	0.05089	-0.12481
V22	0.03504	0.07886	0.13069	0.02812	-0.03266	0.10448	-0.06888	0.16309	-0.25122	-0.08650
V23	1.00000	0.05341	-0.01652	0.12362	0.21965	0.10719	-0.06334	0.07071	-0.11659	0.14330
V24	0.05341	1.00000	0.06834	0.04437	0.22123	-0.01652	0.08023	-0.09473	0.18121	-0.02767
V25	-0.01652	0.06834	1.00000	-0.01346	0.03441	0.04413	-0.15948	0.19166	0.09922	-0.14733
V26	0.12362	0.04437	-0.01346	1.00000	0.03494	-0.04238	-0.30167	0.37101	-0.08652	-0.09932
V27	0.21965	0.22123	0.03441	0.03494	1.00000	-0.02723	-0.06510	0.08516	0.18834	0.00797
V28	0.10719	-0.01652	0.04413	-0.04238	-0.02723	1.00000	-0.37623	0.16670	0.13151	-0.08337
V29	-0.06334	0.08023	-0.15948	-0.30167	-0.06510	-0.37623	1.00000	-0.46822	0.12153	0.19090
V30	0.07071	-0.09473	0.19166	0.37101	0.08516	0.16670	-0.46822	1.00000	0.06768	0.04671
V40	-0.11659	0.18121	0.09922	-0.08652	0.18834	0.13151	0.12153	0.06768	1.00000	0.27507
WCOMPC	0.14330	-0.02767	-0.14733	-0.09932	0.00797	-0.08337	0.19090	0.04671	0.27507	1.00000
WC5	-0.07038	-0.24005	-0.24491	-0.19004	-0.15687	-0.15436	0.23617	-0.00740	0.05931	0.37942
ZR6	0.00067	-0.18309	-0.21578	-0.17120	-0.00414	0.18160	0.27020	0.00483	0.28845	0.34513

	WC5	ZH6
V2	0.04890	0.19937
V3	0.18782	0.23490
V4	0.16230	0.22088
V5	0.12880	0.13902
V6	0.12426	0.11286
V7	0.16819	0.27366
V8	0.25389	0.21298
V10	0.24457	0.31221
V11	0.04605	0.00500
V12	-0.20267	-0.21653
V13	-0.20150	-0.16707
V14	0.10223	0.06406
V15	-0.11636	-0.02323
V16	0.24794	0.13102
V17	0.09121	0.14724
V18	-0.25104	-0.15090
V19	0.01569	-0.05075
V20	0.03133	-0.03847
V21	0.08328	-0.08525
V22	0.00811	0.06481
V23	-0.07038	0.00067
V24	-0.24005	-0.18309
V25	-0.24491	-0.21578
V26	-0.19004	-0.17120
V27	-0.15687	-0.00414
V28	-0.15436	0.18160
V29	0.23617	0.27020
V30	-0.00740	0.00483
V40	0.05931	0.28845
WCOMPC	0.37942	0.34513
WC5	1.00000	0.39395
ZH6	0.39395	1.00000

CORRELATION MATRIX FOR FACTOR ANALYSES OF VULCAN DATA (N=61)

CORRELATION COEFFICIENTS..

	V2	V3	V4	V5	V6	V7	V8	V10	V11	V12
V2	1.00000	0.75646	0.65389	0.16387	0.26758	0.23095	0.22663	0.10383	0.18846	-0.03882
V3	0.75646	1.00000	0.76774	0.15055	0.41173	0.22287	0.20016	0.13325	0.20948	-0.14144
V4	0.65389	0.76774	1.00000	0.15686	0.35843	0.28755	0.33063	0.20449	0.26430	-0.12344
V5	0.16387	0.15055	0.15686	1.00000	0.25319	0.04556	0.36160	0.59892	0.30754	-0.08236
V6	0.26758	0.41173	0.35843	0.25319	1.00000	0.35996	0.41451	0.36645	0.27686	-0.16460
V7	0.23095	0.22287	0.28755	0.04556	0.35996	1.00000	0.72247	0.24775	0.26885	-0.14221
V8	0.22663	0.20016	0.33063	0.36160	0.41451	0.72247	1.00000	0.29345	0.31748	-0.18166
V10	0.10383	0.13325	0.20449	0.59892	0.36645	0.24775	0.29345	1.00000	0.36919	-0.22571
V11	0.18846	0.20948	0.26430	0.30754	0.27686	0.26885	0.31748	0.36919	1.00000	0.05772
V12	-0.03882	-0.14144	-0.12344	-0.08236	-0.16460	-0.14221	-0.18166	-0.22571	0.05772	1.00000
V13	-0.02980	-0.12026	-0.01674	-0.05497	-0.20826	-0.27060	-0.16931	-0.13951	0.07876	0.67821
V14	0.04642	0.12334	0.06317	0.36889	0.18481	0.16579	0.26230	0.36530	0.12465	-0.11167
V15	-0.08396	-0.04845	0.04630	-0.20425	-0.14790	-0.04512	-0.18877	0.05855	-0.06380	-0.00590
V16	0.28225	0.24779	0.22950	0.16042	0.32425	0.50891	0.45782	0.20251	0.06114	-0.09917
V17	0.01146	-0.01110	-0.00277	0.12524	-0.00870	0.13261	0.13286	-0.05662	-0.08690	-0.20883
V18	0.02988	0.00798	0.00290	-0.00047	-0.02893	-0.14589	-0.02369	-0.01673	-0.14764	0.10687
V19	0.08267	0.11824	0.12453	-0.05028	0.16449	0.05616	0.02252	0.10051	-0.09188	-0.05194
V20	0.33887	0.46340	0.34013	0.00404	0.17455	0.29175	0.23587	0.04768	0.04942	-0.22481
V21	-0.09575	-0.05552	0.03836	-0.20856	0.11393	-0.06323	0.00931	-0.13305	-0.14258	-0.06240
V22	0.13441	0.12441	0.23512	-0.04379	-0.15255	-0.15685	-0.01247	-0.07712	0.17716	0.28880
V23	0.13180	0.22559	0.27092	-0.00563	0.14530	0.19712	0.24568	-0.00611	0.13655	0.02523
V24	0.13247	0.08801	0.05332	-0.08219	-0.08362	0.14538	-0.10272	-0.03973	-0.03925	0.04287
V25	-0.06500	0.00732	0.00746	0.02683	-0.02561	0.13154	0.14723	-0.14104	0.18752	0.08962
V26	0.08664	-0.00841	-0.00047	-0.09694	-0.06192	0.05756	0.16489	-0.09873	0.00169	0.26987
V27	0.10978	0.00675	0.10598	-0.00792	0.19653	0.26006	0.26355	-0.05117	-0.17129	-0.03877
V28	0.10256	0.00576	0.07311	0.16165	0.19828	0.20110	0.25971	-0.00163	-0.03025	0.15569
V29	0.10479	-0.02130	-0.05086	-0.01821	-0.04459	0.01689	-0.18383	-0.02306	-0.05939	-0.04252
V30	-0.02003	0.05384	0.03510	0.09189	0.24879	-0.00124	0.01089	0.20277	0.00238	0.13416
V40	0.60755	0.59696	0.48774	0.22232	0.49072	0.37377	0.49352	0.26210	0.43425	-0.18696

	V13	V14	V15	V16	V17	V18	V19	V20	V21	V22
V2	-0.02980	0.04642	-0.08396	0.28225	0.01146	0.02988	0.08267	0.33887	-0.09575	0.13441
V3	-0.12026	0.12334	-0.04845	0.24779	-0.01110	0.00798	0.11824	0.46340	-0.05552	0.12441
V4	-0.01674	0.06317	0.04630	0.22950	-0.00277	0.00290	0.12453	0.34013	0.03836	0.23512
V5	-0.05497	0.36889	-0.20425	0.16042	0.12524	-0.00047	-0.05028	0.00404	-0.20856	-0.04379
V6	-0.20826	0.18481	-0.14790	0.32425	-0.00870	-0.02893	0.16449	0.17455	0.11393	-0.15255
V7	-0.27060	0.16579	-0.04512	0.50891	0.13261	-0.14589	0.05616	0.29175	-0.06323	-0.15685
V8	-0.16931	0.26230	-0.18877	0.45782	0.13286	-0.02369	0.02252	0.23587	0.00931	-0.01247
V10	-0.13951	0.36530	0.05855	0.20251	-0.05662	-0.01673	0.10051	0.04768	-0.13305	-0.07712
V11	0.07876	0.12465	-0.06380	0.06114	-0.08690	-0.14764	-0.09188	0.04942	-0.14258	0.17716
V12	0.67821	-0.11167	-0.00590	-0.09917	-0.20883	0.10687	-0.05194	-0.22481	-0.06240	0.28880
V13	1.00000	-0.08364	-0.04247	-0.05979	-0.39952	0.10365	-0.12574	-0.19701	-0.14941	0.22283
V14	-0.08364	1.00000	-0.12923	0.26431	0.18156	0.16791	-0.13317	0.15421	0.00151	0.08397
V15	-0.04247	-0.12923	1.00000	-0.13241	0.03444	-0.01678	0.35722	-0.00971	0.28407	0.09636
V16	-0.05979	0.26431	-0.13241	1.00000	0.03319	0.05115	0.10999	0.21454	-0.03679	-0.23269
V17	-0.39952	0.18156	0.03444	0.03319	1.00000	-0.27412	-0.09729	0.27139	0.06739	0.02158
V18	0.10365	0.16791	-0.01678	0.05115	-0.27412	1.00000	0.09209	0.00940	0.07503	0.16106
V19	-0.12574	-0.13317	0.35722	0.10999	-0.09729	0.09209	1.00000	0.14045	0.34259	-0.12835
V20	-0.19701	0.15421	-0.00971	0.21454	0.27139	0.00940	0.14045	1.00000	-0.00958	-0.02519
V21	-0.14941	0.00151	0.28407	-0.03679	0.06739	0.07503	0.34259	-0.00958	1.00000	-0.05056
V22	0.22283	0.08397	0.09636	-0.23269	0.02158	0.16106	-0.12835	-0.02519	-0.05056	1.00000
V23	0.11061	0.11066	-0.10281	0.23875	-0.17797	0.08345	-0.02514	0.00383	-0.13568	0.08443
V24	-0.02604	-0.05807	0.16949	0.11795	0.09821	-0.09743	-0.15959	-0.00882	0.00796	0.03352
V25	0.22394	-0.06352	-0.12039	-0.02625	-0.01870	-0.18862	-0.14297	-0.01135	0.03201	-0.09145
V26	0.43276	-0.19648	-0.18399	0.15265	-0.37932	0.18058	0.00219	-0.05720	-0.27054	0.03768
V27	-0.20241	-0.04268	0.05693	0.08726	0.11984	0.13592	0.00259	-0.13669	0.28101	0.18650
V28	0.21262	0.08295	-0.39407	0.09420	-0.12970	0.13517	-0.20762	0.03311	-0.15197	-0.03436
V29	-0.19205	0.01097	0.12993	-0.01002	0.31012	-0.18693	0.19199	0.19380	0.14317	-0.04835
V30	0.32049	-0.05674	-0.02057	0.12281	-0.23752	0.17463	0.12084	0.00805	-0.01604	-0.05342
V40	-0.06004	0.15167	-0.21717	0.21673	-0.04456	-0.02062	0.07386	0.26238	-0.05103	0.02746

	V23	V24	V25	V26	V27	V28	V29	V30	V40
V2	0.13180	0.13247	-0.06500	0.08664	0.10978	0.10256	0.10479	-0.02003	0.60755
V3	0.22559	0.08801	0.00732	-0.00841	0.00675	0.00576	-0.02130	0.05384	0.59696
V4	0.27092	0.05332	0.00746	-0.00047	0.10598	0.07311	-0.05086	0.03510	0.48774
V5	-0.00563	-0.08219	0.02683	-0.09694	-0.00792	0.16165	-0.01821	0.09189	0.22232
V6	0.14530	-0.08362	-0.02561	-0.06192	0.19653	0.19828	-0.04459	0.24879	0.49072
V7	0.19712	0.14538	0.13154	0.05756	0.26006	0.20110	0.01689	-0.00124	0.37377
V8	0.24568	-0.10272	0.14723	0.16489	0.26355	0.25971	-0.18383	0.01089	0.49352
V10	-0.00611	-0.03973	-0.14104	-0.09873	-0.05117	-0.00163	-0.02306	0.20277	0.26210
V11	0.13655	-0.03925	0.18752	0.00169	-0.17129	-0.03025	-0.05939	0.00238	0.43425
V12	0.02523	0.04287	0.08962	0.26987	-0.03877	0.15569	-0.04252	0.13416	-0.18696
V13	0.11061	-0.02604	0.22394	0.43276	-0.20241	0.21262	-0.19205	0.32049	-0.06004
V14	0.11066	-0.05807	-0.06352	-0.19648	-0.04268	0.08295	0.01097	-0.05674	0.15167
V15	-0.10281	0.16949	-0.12039	-0.18399	0.05693	-0.39407	0.12993	-0.02057	-0.21717
V16	0.23875	0.11795	-0.02625	0.15265	0.08726	0.09420	-0.01002	0.12281	0.21673
V17	-0.17797	0.09821	-0.01870	-0.37932	0.11984	-0.12970	0.31012	-0.23752	-0.04456
V18	0.08345	-0.09743	-0.18862	0.18058	0.13592	0.13517	-0.18693	0.17463	-0.02062
V19	-0.02514	-0.15959	-0.14297	0.00219	0.00259	-0.20762	0.19199	0.12084	0.07386
V20	0.00383	-0.00882	-0.01135	-0.05720	-0.13669	0.03311	0.19380	0.00805	0.26238
V21	-0.13568	0.00796	0.03201	-0.27054	0.28101	-0.15197	0.14317	-0.01604	-0.05103
V22	0.08443	0.03352	-0.09145	0.03768	0.18650	-0.03436	-0.04835	-0.05342	0.02746
V23	1.00000	0.07369	0.14191	0.45766	0.05217	0.08829	-0.23063	0.18503	0.16106
V24	0.07369	1.00000	0.06139	-0.12583	-0.01468	-0.05914	-0.01411	0.00953	-0.02603
V25	0.14191	0.06139	1.00000	0.21645	-0.09015	0.10140	-0.12472	-0.03557	-0.07830
V26	0.45766	-0.12583	0.21645	1.00000	-0.15932	0.30914	-0.30561	0.14170	0.06680
V27	0.05217	-0.01468	-0.09015	-0.15932	1.00000	0.00536	0.04864	-0.01691	0.09807
V28	0.08829	-0.05914	0.10140	0.30914	0.00536	1.00000	-0.18791	0.20848	0.16913
V29	-0.23063	-0.01411	-0.12472	-0.30561	0.04864	-0.18791	1.00000	-0.15101	-0.13941
V30	0.18503	0.00953	-0.03557	0.14170	-0.01691	0.20848	-0.15101	1.00000	0.06080
V40	0.16106	-0.02603	-0.07830	0.06680	0.09807	0.16913	-0.13941	0.06080	1.00000

DETERMINANT OF CORRELATION MATRIX = 0.0000007(0.69917718D-06)

CORRELATION MATRIX FOR INDEPENDENT AND DEPENDENT VARIABLES IN VULCAN ANALYSIS (N=61)

CORRELATION COEFFICIENTS...

	V2	V3	V4	V5	V6	V7	V8	V10	V11	V12
V2	1.00000	0.75646	0.65389	0.16387	0.26758	0.23395	0.22663	0.10383	0.18846	-0.03882
V3	0.75646	1.00000	0.76774	0.15055	0.41173	0.22287	0.20016	0.13325	0.20948	-0.14144
V4	0.65389	0.76774	1.00000	0.15686	0.35843	0.28755	0.33063	0.20449	0.26430	-0.12344
V5	0.16387	0.15055	0.15686	1.00000	0.25319	0.04556	0.36160	0.59892	0.10754	-0.09236
V6	0.26758	0.41173	0.35843	0.25319	1.00000	0.35996	0.41451	0.36645	0.27686	-0.16460
V7	0.23395	0.22287	0.28755	0.04556	0.35996	1.00000	0.72247	0.24775	0.26885	-0.14221
V8	0.22663	0.20016	0.33063	0.36160	0.41451	0.72247	1.00000	0.29345	0.31743	-0.18166
V10	0.10383	0.13325	0.20449	0.59892	0.36645	0.24775	0.29345	1.00000	0.36919	-0.22571
V11	0.18846	0.20948	0.26430	0.10754	0.27686	0.26885	0.31743	0.36919	1.00000	0.05772
V12	-0.03882	-0.14144	-0.12344	-0.09236	-0.16460	-0.14221	-0.18166	-0.22571	0.05772	1.00000
V13	-0.02980	-0.12026	-0.01674	-0.05497	-0.20826	-0.27060	-0.16931	-0.13951	0.07876	0.67821
V14	0.04642	0.12334	0.06317	0.36889	0.18481	0.16579	0.26230	0.36530	0.12465	-0.11167
V15	-0.08396	-0.04845	0.04630	-0.20425	-0.14790	-0.04512	-0.18877	0.05855	-0.06380	-0.00590
V16	0.28225	0.24779	0.22950	0.16042	0.32425	0.50891	0.45782	0.20251	0.06114	-0.09917
V17	0.01146	-0.01110	-0.00277	0.12524	-0.03870	0.13261	0.13286	-0.05662	-0.08690	-0.26883
V18	0.02988	0.00799	0.00290	-0.00047	-0.02893	-0.14589	-0.02367	-0.01673	-0.14764	0.10687
V19	0.08267	0.11824	0.12453	-0.05028	0.16449	0.05616	0.02252	0.10051	-0.09188	-0.05194
V20	0.33887	0.46340	0.34013	0.00404	0.17455	0.29175	0.23587	0.04768	0.04942	-0.22481
V21	-0.09575	-0.05552	0.03836	-0.20856	0.11393	-0.06123	0.00931	-0.13305	-0.14258	-0.06240
V22	0.13441	0.12441	0.23512	-0.04379	-0.15255	-0.15685	-0.01247	-0.07712	0.17716	0.28880
V23	0.13180	0.27559	0.27092	-0.00563	0.14530	0.19712	0.24569	-0.00611	0.13055	0.02523
V24	0.13247	0.08801	0.05302	-0.08214	-0.06362	0.14533	-0.10272	-0.03973	-0.03925	0.04287
V25	-0.36500	0.00732	0.00746	0.02683	-0.02561	0.13154	0.14723	-0.14104	0.19752	0.08948
V26	0.08664	-0.00841	-0.00047	-0.09694	-0.06192	0.05756	0.16489	-0.09873	0.00169	0.26987
V27	0.10978	0.00675	0.10598	-0.00792	0.19653	0.26006	0.26155	-0.05117	-0.17129	-0.00877
V28	0.10256	0.00575	0.07311	0.16165	0.19828	0.20110	0.25971	-0.00183	-0.03025	0.15569
V29	0.10479	-0.02130	-0.05086	-0.01821	-0.04459	0.01689	-0.18383	-0.02386	-0.05739	-0.04252
V30	-0.02003	0.05384	0.01510	0.09189	0.24879	-0.00124	0.01087	0.23277	0.00238	0.13416
V40	0.60755	0.58695	0.48774	0.22232	0.49072	0.37377	0.49352	0.26210	0.43425	-0.18096
EV1	-0.10631	0.03266	-0.03226	-0.03998	0.11110	0.21389	0.06353	0.06529	-0.10126	-0.07844
EV2	0.26037	0.30237	0.29546	0.25142	0.39007	0.46161	0.36271	0.38623	0.31281	-0.15981
EV3	-0.03522	-0.00514	0.06182	0.26017	0.25225	0.29880	0.10164	0.20185	-0.03194	-0.21155
EV4	-0.09193	-0.19415	-0.16332	0.01542	-0.06338	0.19756	0.04300	0.09194	-0.06402	0.01142
EV5	0.08591	-0.04632	0.09400	0.04439	0.03914	0.17108	0.07571	0.21161	0.05018	-0.00933
EV6	0.30185	0.16416	0.04280	0.10567	0.18827	0.18663	0.03042	0.10419	-0.12438	-0.11933
PVC	-0.03614	0.03422	0.06724	0.11272	0.10250	0.11423	-0.04695	0.19499	0.15389	-0.00393
ZR6	-0.01050	0.20250	0.21720	0.21130	0.03090	0.11720	0.14190	0.22140	-0.12310	-0.00790

	V13	V14	V15	V16	V17	V18	V19	V20	V21	V22
V2	-0.02980	0.04642	-0.08396	0.28225	0.01146	0.02988	0.08267	0.33887	-0.09575	0.13441
V3	-0.12026	0.12334	-0.04845	0.24779	-0.01110	0.00799	0.11824	0.46340	-0.05552	0.12441
V4	-0.01674	0.06317	0.04630	0.22950	-0.00277	0.00290	0.12453	0.34013	0.03836	0.23512
V5	-0.05497	0.36889	-0.20425	0.16042	0.12524	-0.00047	-0.05028	0.00404	-0.20856	-0.04379
V6	-0.20826	0.18481	-0.14790	0.32425	-0.03870	-0.02893	0.16449	0.17455	0.11393	-0.15255
V7	-0.27060	0.16579	-0.04512	0.50891	0.13261	-0.14589	0.05616	0.29175	-0.06123	-0.15685
V8	-0.16931	0.26230	-0.18877	0.45782	0.13286	-0.02367	0.02252	0.23587	0.00931	-0.01247
V10	-0.13951	0.36530	0.05855	0.20251	-0.05662	-0.01673	0.10051	0.04768	-0.13305	-0.07712
V11	0.07876	0.12465	-0.06380	0.06114	-0.08690	-0.14764	-0.09188	0.04942	-0.14258	0.17716
V12	0.67821	-0.11167	-0.00590	-0.09917	-0.26883	0.10687	-0.05194	-0.22481	-0.06240	0.28880
V13	1.00000	-0.06364	-0.04247	-0.05979	-0.39952	0.10365	-0.12574	-0.19701	-0.14941	0.22283
V14	-0.06364	1.00000	-0.12923	0.26431	0.18156	0.16791	-0.13317	0.15421	0.00151	0.08397
V15	-0.04247	-0.12923	1.00000	-0.13241	0.03444	-0.01678	0.35722	-0.00971	0.28407	0.09636
V16	-0.05979	0.26431	-0.13241	1.00000	0.03319	0.05115	0.10999	0.21454	-0.03679	-0.23269
V17	-0.39952	0.18156	0.03444	0.03319	1.00000	-0.27412	-0.09729	0.27139	0.06739	0.02158
V18	0.10365	0.16791	-0.01678	0.05115	-0.27412	1.00000	0.09209	0.00940	0.07503	0.16106
V19	-0.12574	-0.13317	0.35722	0.10999	-0.09729	0.09209	1.00000	0.14045	0.34259	-0.12835
V20	-0.19701	0.15421	-0.00971	0.21454	0.27139	0.00940	0.14045	1.00000	-0.06958	-0.02519
V21	-0.14941	0.00151	0.28407	-0.03679	0.06739	0.07503	0.34259	-0.06958	1.00000	-0.05056
V22	0.22283	0.08397	0.09636	-0.23269	0.02158	0.16106	-0.12835	-0.02519	-0.05056	1.00000
V23	0.11061	0.11966	-0.10281	0.23875	-0.17797	0.08345	-0.02514	0.00383	-0.13568	0.08443
V24	-0.02604	-0.05607	0.16949	0.11795	0.09821	-0.09743	-0.15959	-0.06682	0.00796	0.03352
V25	0.22394	-0.06352	-0.12039	-0.02625	-0.01870	-0.18862	-0.16297	-0.01135	0.03201	-0.09145
V26	0.43276	-0.19648	-0.18394	0.15265	-0.37932	0.18058	0.00219	-0.05720	-0.27054	0.03768
V27	-0.20241	-0.04268	0.05693	0.08726	0.11984	0.13592	0.00259	-0.13669	0.28101	0.18650
V28	0.21262	0.08295	-0.39407	0.09420	-0.12970	0.13517	-0.20762	0.03311	-0.15197	-0.03436
V29	-0.19705	0.01097	0.12993	-0.01002	0.11012	-0.18693	0.19199	0.19380	0.14317	-0.04835
V30	0.32049	-0.05674	-0.02057	0.12281	-0.23752	0.17463	0.12084	0.00805	-0.01604	-0.05342
V40	-0.06104	0.15157	-0.21717	0.21673	-0.04456	-0.02062	0.07386	0.26234	-0.05103	0.02746
EV1	-0.25502	0.01721	-0.10619	0.00965	0.11330	0.00936	-0.15029	0.02378	-0.06183	-0.17554
EV2	-0.19035	0.05915	-0.16711	0.25701	0.10739	-0.06377	-0.00458	0.28692	-0.14987	-0.05659
EV3	-0.46151	0.09260	0.01358	0.16979	0.19010	-0.14804	-0.10436	-0.04824	-0.00355	-0.18861
EV4	-0.20750	-0.04330	-0.07980	0.21853	0.16573	-0.06042	-0.11632	-0.04317	-0.21076	-0.08749
EV5	-0.08731	0.15259	-0.33846	0.13666	0.02577	-0.06172	-0.16087	-0.17916	-0.15528	-0.17310
EV6	-0.28240	-0.06590	-0.14085	0.18815	0.36302	-0.16544	-0.11131	-0.17474	-0.12563	-0.15110
PVC	-0.10419	0.00377	-0.25332	0.13578	0.24319	-0.20785	-0.19484	0.06286	-0.29604	-0.12209
ZR6	-0.21910	0.26260	-0.05160	0.10030	0.20660	0.04180	-0.15090	0.23060	[illegible]	0.04820

CORRELATION MATRIX FOR INDEPENDENT AND DEPENDENT VARIABLES IN VULCAN ANALYSIS ($\underline{N}$=61) (cont)

CORRELATION COEFFICIENTS...

	V23	V24	V25	V26	V27	V28	V29	V30	V40	WV1
V2	0.11180	0.13247	-0.06500	0.00664	0.10978	0.10256	0.10479	-0.02003	0.60755	-0.10631
V3	0.22559	0.08301	0.00732	-0.00841	0.00675	0.00576	-0.02130	0.05384	0.58696	0.03266
V4	0.27392	0.05302	0.00746	-0.00047	0.10598	0.07311	-0.05086	0.03510	0.48774	-0.03226
V5	-0.00563	-0.08219	0.02683	-0.09694	-0.00792	0.16165	-0.01821	0.03189	0.22232	-0.03998
V6	0.14530	-0.06362	-0.02561	-0.06192	0.19653	0.19828	-0.04459	0.24879	0.49072	0.11110
V7	0.19712	0.14539	0.13154	0.05756	0.26006	0.20110	0.01689	-0.00124	0.37377	0.21389
V8	0.24568	-0.10272	0.13723	0.16483	0.26355	0.25971	-0.18343	0.31089	0.49352	0.06353
V10	-0.00611	-0.03973	-0.14104	-0.09873	-0.05117	-0.00181	-0.02386	0.20277	0.26210	0.06529
V11	0.13655	-0.03923	0.18752	0.00163	-0.17129	-0.03025	-0.05939	0.00238	0.43425	-0.10126
V12	0.02523	0.04287	0.08948	0.26987	-0.00877	0.15563	-0.04252	0.13416	-0.18696	-0.07844
V13	0.11061	-0.02604	0.22194	0.43276	-0.29241	0.21262	-0.19205	0.32049	-0.06004	-0.25502
V14	0.11866	-0.05607	-0.06352	-0.19648	-0.04268	0.08295	0.01097	-0.05674	0.15167	0.01721
V15	-0.10281	0.16949	-0.12033	-0.16399	0.95691	-0.39407	0.12993	-0.02057	-0.21717	-0.10619
V16	0.23875	0.11795	-0.02625	0.15265	0.08726	0.09423	-0.01002	0.12281	0.21673	0.00965
V17	-0.17797	0.09821	-0.01873	-0.37932	0.11984	-0.12970	0.31032	-0.23752	-0.04456	0.11330
V18	0.08345	-0.09743	-0.18862	0.18050	0.13592	0.13517	-0.18693	0.17463	-0.02062	0.00936
V19	-0.02514	-0.15959	-0.16297	0.00219	0.00259	-0.20762	0.19193	0.12084	0.07386	-0.15029
V20	0.00381	-0.06542	-0.01135	-0.05720	-0.13669	0.03311	0.19383	0.00805	0.26238	0.02378
V21	-0.13568	0.30795	0.03201	-0.27054	0.28131	-0.15197	0.14317	-0.01604	-0.05103	-0.05383
V22	0.08443	0.03352	-0.09145	0.03768	0.18650	-0.03436	-0.04835	-0.05342	0.02746	-0.17554
V23	1.00000	0.07369	0.14191	0.45766	0.05217	0.08829	-0.23663	0.18503	0.16106	0.11407
V24	0.07369	1.00000	0.06139	-0.12583	-0.01468	-0.05914	-0.01411	0.00953	-0.02603	0.18780
V25	0.14191	0.06139	1.00000	0.21645	-0.09015	0.10140	-0.12472	-0.03557	-0.07830	-0.14863
V26	0.45766	-0.12583	0.21645	1.00000	-0.15932	0.30914	-0.30561	0.14170	0.06680	-0.10133
V27	0.35217	-0.01468	-0.09015	-0.15932	1.00000	0.00536	0.04866	-0.01691	0.09607	0.23124
V28	0.08829	-0.05914	0.10140	0.30914	0.00536	1.00000	-0.18791	0.20848	0.16913	0.01042
V29	-0.23663	-0.01411	-0.12472	-0.13561	0.04866	-0.18791	1.00000	-0.15101	-0.13941	-0.06594
V30	0.18503	0.00953	-0.03557	0.14170	-0.01691	0.20848	-0.15101	1.00000	0.06080	0.14447
V40	0.16106	-0.02503	-0.07830	0.06680	0.09607	0.16913	-0.13941	0.06080	1.00000	-0.00983
WV1	0.11407	0.18710	-0.14863	-0.10133	0.23124	0.01042	-0.06594	0.14447	-0.00983	1.00000
WV2	0.14462	0.04921	0.07402	-0.02286	0.16787	-0.01880	0.14062	0.18646	0.34355	0.39208
WV3	0.08802	0.16745	-0.01812	-0.18888	0.34758	-0.21131	-0.02111	-0.07265	0.30743	0.38294
WV4	-0.04359	0.17519	-0.18312	-0.13276	0.15758	-0.14783	0.12925	0.02736	-0.18145	0.32794
WV5	0.13657	0.03735	-0.05437	-0.07343	0.10877	0.13011	0.06669	0.01617	0.11479	0.27696
WV6	0.05991	0.28004	0.07113	-0.19755	0.12922	0.01887	-0.04786	0.19320	-0.04237	0.32287
PVC	-0.01245	0.23941	0.09002	-0.21971	-0.13154	-0.04954	-0.07908	0.19287	-0.08167	0.15054
ZR6	0.01610	0.18640	-0.08340	-0.10600	0.04910	-0.01800	0.14700	0.01150	-0.07470	0.27580

	WV2	WV3	WV4	WV5	WV6	PVC	ZR6
V2	0.26037	-0.03522	-0.09103	0.08591	0.00185	-0.03614	-0.03050
V3	0.30237	-0.00616	-0.19415	-0.04632	0.16416	0.03422	0.20250
V4	0.29546	0.06182	-0.16332	0.09400	0.04280	0.06724	0.21720
V5	0.25142	0.26017	0.01542	0.04439	0.10567	0.11272	0.21130
V6	0.34007	0.25225	-0.06338	0.03914	0.18827	0.10253	0.03090
V7	0.46161	0.29880	0.19756	0.17108	0.18683	0.11429	0.19720
V8	0.36271	0.30168	0.04300	0.07571	0.03042	-0.04695	0.14190
V10	0.38623	0.20185	0.09194	0.21161	0.10419	0.19499	0.23140
V11	0.31291	-0.03194	-0.06802	0.05018	-0.12438	0.15383	-0.12310
V12	-0.15881	-0.21155	0.01142	-0.00933	-0.11933	-0.00393	-0.06790
V13	-0.19035	-0.46353	-0.20750	-0.08731	-0.28240	-0.10419	-0.21910
V14	0.05916	0.09264	-0.04330	0.15259	-0.06590	0.00977	0.26260
V15	-0.16711	0.01358	-0.07988	-0.33846	-0.14085	-0.25332	-0.05460
V16	0.25701	0.16979	0.31453	0.13666	0.18815	0.13578	0.10830
V17	0.10739	0.19010	0.16573	0.02577	0.06302	0.24319	0.28660
V18	-0.06377	-0.14808	-0.06042	-0.06172	-0.16544	-0.20785	-0.04940
V19	-0.00456	-0.10436	-0.11612	-0.16687	-0.11133	-0.19484	-0.15090
V20	0.28692	-0.04024	-0.04337	-0.17916	-0.17424	0.06286	0.23060
V21	-0.14987	-0.00355	-0.29076	-0.15528	-0.12563	-0.29604	-0.04680
V22	-0.35659	-0.18861	-0.08749	-0.17310	-0.15110	-0.12209	0.04820
V23	0.14462	0.08802	-0.04359	0.13657	0.05991	-0.01245	0.01610
V24	0.04921	0.16745	0.17519	0.03735	0.28004	0.23941	0.18640
V25	0.07402	-0.01812	-0.18312	-0.05437	0.07113	0.09002	-0.08340
V26	-0.02286	-0.18889	-0.13276	-0.07343	-0.19755	-0.21971	-0.30600
V27	0.16787	0.34758	0.15758	0.10877	0.12922	-0.13154	0.04910
V28	-0.01880	-0.21131	-0.14783	0.13011	0.01887	-0.04954	-0.01800
V29	0.14062	-0.02111	0.12925	0.06669	-0.04786	-0.07908	0.14700
V30	0.18646	-0.07265	0.02736	0.01617	0.19320	0.19287	0.01150
V40	0.34355	0.00743	-0.18145	0.11479	-0.04237	-0.08167	-0.07470
WV1	0.39208	0.38294	0.32794	0.27696	0.32287	0.15054	0.27580
WV2	1.00000	0.30466	0.30607	0.26035	0.28482	0.19337	0.12630
WV3	0.30466	1.00000	0.41884	0.25555	0.40120	0.17501	0.33750
WV4	0.30607	0.41884	1.00000	0.30658	0.51149	0.30310	0.32170
WV5	0.26035	0.25555	0.30658	1.00000	0.26448	0.29414	0.22910
WV6	0.28482	0.40120	0.51149	0.26448	1.00000	0.37013	0.39180
PVC	0.19337	0.17501	0.30310	0.29414	0.37013	1.00000	0.33980
ZR6	0.12630	0.33750	0.32170	0.22910	0.39180	0.33980	1.00000

APPENDIX E

DESCRIPTION OF THE PROCEDURES OF INTERPRETATION FOR CANONICAL ANALYSES

APPENDIX E

DESCRIPTION OF THE PROCEDURES OF INTERPRETATION FOR CANONICAL ANALYSES

The procedures for interpretation of the results of canonical correlation analyses for REDEYE, CHAPARRAL, and VULCAN data were essentially the same. In the effort to make the results of complicated statistical analyses less cumbersome and more understandable to the general public, the investigators reasoned that if interpretations of canonical correlation results could be explained in factor terms, it would be easier for readers to successfully synthesize the factor analytic and canonical results into a unified and meaningful representation.

This appendix describes the manner in which the two different sets of results were synthesized for interpretation. The results of each of the three independent factor analytic "studies" (REDEYE, CHAPARRAL, and VULCAN) are so integral to the respective canonical correlation results that the latter cannot be effectively interpreted without the former.

The seven independent factors that emerged for each of the three samples (REDEYE, CHAPARRAL, and VULCAN) are unique mathematical composites, each of which explains variance quite independently from the other factors in the same series of analyses. Such is the nature of carefully performed factor analyses. From this basis, and from the theoretical discussions that explain and/or define each factor (REDEYE, pages 57-65; CHAPARRAL, pages 98-101; VULCAN, pages 112-115), the most useful way to interpret the respective canonical correlation analyses (for the same three sets of data) seemed to be to integrate the interpretations with factor interpretations already presented.

The factor interpretations have been explained thoroughly and are quite solid, yet they do not relate specifically to performance on the job or even to performance in training. It is the canonical correlation analyses results that address the relation between variables that make up the "factors" (from the factor analyses) and ultimate performance. It is the relationships between these two sets of variables that are of most interest for the present study.

Let the reader know that even though all variables that made up specific factors (from the factor analyses) were <u>not</u> represented in each of the final canonical analyses, the relation of an entire factor (as represented by the components which <u>did</u> survive into each of the final canonical solutions) was suggested. Because of this, the variables which were part of each second iteration of canonical analylsis were interpreted, at the least, as a component of the appropriate "named factor." They were described either as a component of that factor or perhaps using the factor term itself.

For example, in the REDEYE analysis, the "ability to work under stress" was cited as the "factor" contributing most to REDEYE performance (Table 47). In actuality, only V3, V4 and V11, (from the factor analysis, Factor 2: Ability to Work Under Stress, Table 45) were represented in the canonical analyses (Tables 25 and 47). Of the three variables just named, only V3 and V4 cleanly loaded on only the "ability to work under stress" factor, whereas V11 also loaded on the "spatial/analytic" factor in the REDEYE sample. V3 and V4 are also the only two variables specifically designed as measures of "the ability to work under stress" that remained in the second REDEYE canonical analysis.

The "ability to work under stress" factor shown in Table 46 consisted of four other variables which loaded at $\pm.20$ and $\pm.30$. None of these eight variables were represented in the canonical analysis (Table 25), yet all are part of the "factor." Nevertheless, the investigators have described the canonical results in terms that suggest a relationship with the entire factor. This is appropriate as long as one recognizes that the relationship suggested should not be interpreted absolutely. Rather, it should be taken as it was intended; namely, as suggestive. Firmer interpretations and conclusions should be explored in future studies to see if the suggested relationships of components of the factors may hold true for the entire factors.

The "spatial-analytic factor" (Factor 1--Table 46) contributed next most to REDEYE performane after the "ability to work under stress." The components of the REDEYE "spatial-analytic" factor which were represented in the final REDEYE canonical analysis were (in order of magnitude of contribution) V16, V11, V5 and V10. A lesser component of the REDEYE Factor 1 (V25) also remained in the canonical analysis; however, V25 was more important to the "Happy-go-Lucky/Venturesome/Outgoing factor," (Factor 4) than it was to any of the other factors of Table 46. There were six other variables that loaded at $\pm.30$ or greater on the "spatial-analytic factor" which were <u>not</u> part of the final canonical analysis.

In the effort to save space, the investigators will not document every variable from the separate canonical analyses (REDEYE, CHAPARRAL, and VULCAN) in terms of the factors with which they are associated (Table 45). Nor will they list the other remaining variables from factors that were not represented in the separate canonical analyses. Instead, the reader is asked to generalize from the explanations given thus far to the remaining variables in the REDEYE analysis as well as to all variables in the CHAPARRAL/VULCAN analyses.

By careful inspection of Tables 45 and 46 (Factor Analyses), Tables 25, 37, and 44 (Canonical Correlation Analyses), and the correlation matrices found in Appendix D, the reader should be able to follow the synthesis of the information that eventually resulted in Table 47. With this in mind, no further explanations will be given in this appendix.

APPENDIX F

RATING SCALES USED DURING CHAPARRAL/VULCAN ANALYSES TO AUGMENT ARMY DEPENDENT MEASURES

COPY

INSTRUCTIONS FOR TRAINEE RATING FORM

1. This form will be used to rate each individual trainee on several attributes you have observed during training. The attributes on which you will be rating the trainees are listed and defined below:

   MOTIVATION: Demonstrates a desire to learn all relevant information and to achieve the highest possible proficiency in this MOS. Demonstrates a desire for career advancement.

   ABILITY TO WORK AS A TEAM MEMBER: Develops good working relationship with peers. Provides all possible assistance to other team members when working toward a common goal. Responds well to authority.

   DECISIVENESS: Demonstrates the ability to evaluate a situation and quickly decide upon a proper course of action. Demonstrates self-confidence during decision making.

   ABILITY TO WORK UNDER STRESS: Demonstrates the ability to work quickly and precisely while being subjected to psychological or environmental stressors.

   VERBAL ABILITY: Demonstrates the ability to understand and communicate job-related information with peers and superiors using the English language.

   OVERALL PERFORMANCE: This rating is for a measure of the trainee's overall performance during training. To make this rating you should not entirely rely upon the trainee's test scores during training but your subjective evaluation of the trainee's performance, especially if you feel that his/her performance is not well reflected by the test scores.

2. To complete the rating form, draw a line through each scale at the point you feel best represents the trainee's performance in that area. A properly completed form is included as an example. This example shows a trainee whose MOTIVATION is slightly above average (a score of about 2.2), ABILITY TO WORK AS A TEAM MEMBER is rather high (a score of about 3.4), DECISIVENESS is very low (0.5), ABILITY TO WORK UNDER STRESS is slightly below average (1.8), VERBAL ABILITY is very high (3.9), and whose OVERALL PERFORMANCE is somewhat above average (2.5). Note that the ratings can fall at any point on the 0 - 4 scale.

   Note also that a space is left on the rating sheet for your comments. This space can be used, for example, to tell us that you are not confident of your ratings if you did not know this trainee well, or for any other information you think might be important to us.

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SAMPLE

TRAINEE RATING FORM

Trainee Name: *JONES, A* MCS: *16 P*

Rated by (name): *SGT SMITH* DATE: *8 AUG 79*

MOTIVATION: 0 1 2 3 4

ABILITY TO WORK AS A TEAM MEMBER: 0 1 2 3 4

DECISIVENESS: 0 1 2 3 4

ABILITY TO WORK UNDER STRESS: 0 1 2 3 4

VERBAL ABILITY: 0 1 2 3 4

OVERALL PERFORMANCE: 0 1 2 3 4

COMMENTS: *LITTLE OPPORTUNITY TO OBSERVE THIS TRAINEE'S ABILITY TO WORK UNDER STRESS.*

RATING CRITERIA

0- As poor as the poorest trainees I have known.

1- Poorer than 75% of the trainees I have known.

2- Average. Half of trainees are better, half are poorer.

3- Better than 75% of the trainees I have known.

4- As good as the best trainees I have known.

COPY

TRAINEE RATING FORM

Trainee Name: ______________________ MOS: ________________

Rated by (name): ____________________ DATE: ________________

	0	1	2	3	4
MOTIVATION:					
ABILITY TO WORK AS A TEAM MEMBER:					
DECISIVENESS:					
ABILITY TO WORK UNDER STRESS:					
VERBAL ABILITY:					
OVERALL PERFORMANCE:					

COMMENTS: ____

____

RATING CRITERIA

0- As poor as the poorest trainees I have known.

1- Poorer than 75% of the trainees I have known.

2- Average. Half of trainees are better, half are poorer.

3- Better than 75% of the trainees I have known.

4- As good as the best trainees I have known.

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